ORAL HISTORY TRANSCRIPT

JOHN LLEWELLYN
INTERVIEWED BY DOYLE MCDONALD
HOUSTON, TEXAS – 15 SEPTEMBER 1997

MCDONALD: This is an interview with John Llewellyn on September 15, 1997, in Houston, Texas.

John, what did you do before you became a NASA [National Aeronautics and Space Administration] professional?

LLEWELLYN: I was going to college. I was at a liberal arts school at Randolph-Macon, and then I transferred to William and Mary. Before that, I'd been in the U.S. Marines. Got in the Marines in '54. Went to college in '55. Then I had some employment with NASA, starting in '55 and '56 and '57.

The reason that I'm doing this is, in '57, that fall of the year is when they launched Sputnik, and that changed my curriculum around and changed what I was doing in college, because up until that time I was a mathematician and more or less a philosophy major. I had been working at NASA in that kind of thing and worked for PARD [Pilotless Aircraft Research Division] and Structures. Each summer I did something different. It was very good experience.

But anyway, that thing turned it around. Our college, William and Mary, actually got people from industry that came and taught us. We knew about masers and pin-P [phonetic] transistors. We got all of that, that we would have never gotten, and it kind of changed the way that we were doing things.

By that time I became a physicist. I went back my last two years in school and became a physicist. In those days, a mathematician didn't get a—I forget what they called it,

a professional rating. I forget the names. You didn't start off as a GS-7 or something like that. So that's what I did, and I graduated in physics.

By this time I had a very interesting thing happen. I worked in PARD after '57, which was the Power [Pilotless] Aircraft Research Division, and I was in the business of going to Wallops Island and launching rockets. Probably NASA, and I'm sure that you can go back, of all of the people in the free world that knew more about rocket-launching, rockets, were probably at Wallops, because that's why we were doing that. We launched more out there than they did at White Sands [Test Facility, New Mexico], because we used to stack up the Sergeants and the WACs and all of that, and all. Then we'd stick the rockets on top of it. What we were doing with them, the biggest job was to find out how reentry heating was, because we couldn't reach Mach 20 and those high Mach numbers in tunnels. You did it, but you didn't have the time, because the model didn't give you the time for your recombination and stuff. Remember, by this time [Maxime A.] Faget had come up with the blunt body. That thing had changed the way the whole analysis of reentry heating was being done.

What we would basically be working on is a myriad of weapons from an Air Force perspective. The military, they were thinking about some way to bring a vehicle back without having it burn up. In those days they used a heat-sink situation that was like a big brass, let's say brass or copper, something that had a lot of good conductivity when you get it hot, specific heat. What we'd do is, once you got the heat pulse and got out of the reentry part of the blackout, they jettisoned that and that carried the heat away. But that made it so heavy.

MCDONALD: Before ablations.

LLEWELLYN: Yes. So what they did then, to get away from that, NASA was working on a way and we came up with the ablation heat shield. The first ablating heat shield you ever saw was made of ice, because ice is a good ablater. That was the kind of stuff that we calibrated. I mean, they had all kinds of—they had a pebble heater and all that.

Well, that was what I was doing, was putting the launch vehicles together. That's my job, of stacking them up and finding the CG [center of gravity] level. I'll never forget the first time I had to do that and I couldn't figure how to do it. So I had a friend, believe it or not, that was in the Marines with me in Korea, that was in apprentice school. He brought a crane over one night. I figured one way to do it, I could get some cables and stuff and I could hang this thing and I'd find exactly where it was. Once I found that, then I decided I knew how to solve it. And I became way ahead of everybody, but nobody ever knew how I did that thing. I actually hung it up and found out where the CG is, because I couldn't figure it out. I didn't know how to do it.

So that's what I did, worked in PARD. That was a really good experience, and it was so much good fun. We used to fly over there in one of those Grumman Gooses. Just was a good time. We learned a lot. That was really [Robert R.] Gilruth's division. Dr. [Joseph F.] Shea came out of that. Almost everybody that became—Caldwell [C.] Johnson, all those guys came from PARD. I was lucky, I had one summer to work with them and I was going back with them.

Then I went to some classes in NASA during the summer, engineering, calculus, and stuff like that. They decided I was pretty good at that, so I went to what they called Structures, and worked on the Dyna-Soar [Project]. That's what I was doing when I heard that the Mercury Program was in effect. I kept hearing about it.

The interesting thing I know about it was that they were launching old Redstones, and I knew the Redstones would not work, because I happened to be a Marine officer and I was in charge of some Redstones at Camp Lejeune, North Carolina. None of them would ever

work. What the Marine Corps did, what they'd do is, if we had to use them, we'd drop real close to the lines and push them over on the Chinese. Because that's how unsafe they were. [Laughter] The Redstones were not working. When I heard that we were going to use a Redstone for a manned vehicle, I couldn't believe it. See, I wasn't even a real engineer. I was still in the thing. I hadn't even got my GS-9 yet. In those days you had to go through to qualify. Did you know what you were doing? Then you had to give a talk and you had to be—

MCDONALD: Intern program.

LLEWELLYN: Intern program. You know, a lot of guys failed, and they had to keep doing it until they made it. I did mine on reentry heating from data. I ran the block tunnel in Cleveland. Anyway, [unclear] heating.

By the way, Faget was at the meeting and he got very berserk with me, because he thought that my heating rates on the back end were too high. By the way it turns out, remember we had to put heat-protection scheme on a parachute canister, because it'd burn holes in it. The first MA-2 [Mercury-Atlas 2] shot. You can look at the data and see it.

Anyway, then I worked over in Structures. Then I wanted to get back over there. I some way persuaded people at STG, Space Task Group, to take me, even though I wasn't a full-fledged engineer or NACA [National Advisory Committee for Aeronautics] guy. The reason that was is that NASA, believe it or not, but the old NACA people did not want to make a change. They did not want to go with the Mercury Program. Most of the people at Langley didn't want to do it. In fact, Mr. [Joseph N.] Kotanchik, who later became a real top guy in design of the Apollo, the Apollo spacecraft and the Shuttle, he told me one time that I could always come back to Structures. He wanted me back there. He had said something

like, to me, if the spacecraft, the Mercury, was supposed to fly, it would have wings on it, or God would put wings on it or something like that. I don't know.

But anyway, that was the way we saw it. When you think about starting at that time and what we were doing, it's so exciting, because not hardly anybody really knew what we were doing. Faget, in engineering the thing, actually was building the first capsule in the hangar there over on the west side. This is before McDonnell-Douglas, anybody ever got in it, we built one.

The good thing about it, you could actually go down—the engineers could go down in that hangar and see it being built. You could look at it, which was really neat, because you could see all the parts, like you were doing on the heat shield. You could actually see it. You could see where the clock was, or you could see where the chairs were and what they were doing and what it looked like. That was really a good experience.

But anyway, that's how I got in it. Then the next thing that came along that was really a change, I was working in heat transfer and I did a lot of stuff. I probably had more experience running tunnels than guys had that had worked at NASA for ten years. I ran Tullahoma [Tennessee]. I ran the blow-down tunnels. I ran the real big one at Langley [Research Center, Hampton, Virginia]. Everywhere. I got to go to Ames [Research Center, California]. I knew the guys that did all the stuff out there on the blunt bodies, Kemp [phonetic] and Riddel [phonetic]. I just got to know a lot.

Anyway, the next thing happened was that I was in heat transfer section. Mr. [Leonard] Rabb was a guy from Lewis [Research Center, Cleveland, Ohio]. Because they were having so much trouble, we had to get to Lewis and everybody in it. We finally got, and it was the biggest help. People don't realize it, but we probably got up to sixty Canadians from the AVRO Project. They're the ones that came and they brought a lot of tech. That was Tec [Tecwyn] Roberts, that was all those guys. John [D.] Hodge came from there, too. All of those guys came down here and really did a lot of stuff. They knew some

things about analog computers that we really didn't have that much experience in. They'd been in the AVRO.

The AVRO [Arrow] was an airplane that was in competition with our Century Series fighters, F-100 and F-101A. It was one of those, I forget which one, they were in it. When they lost it, the whole damn thing closed down and they didn't have anything to do. They did it just about in '60 or '61, when this thing was coming together. We were very lucky to get those guys. So anyway, that's the next thing that happened and that's how I got in.

Then Mercury became a project and it was funded. Remember that this was 1960. By the way, I don't think that [President John F.] Kennedy was even elected until—when was he? '62?

MCDONALD: '61.

LLEWELLYN: '61. So we were already started on it. Anyway, we had already committed themselves to manned flight. Even before he got here, we got into it. I think that was [President Dwight D.] Eisenhower that did that. He's the one that redid the thing to make NASA the big power and took it, kind of took the Air Force's—when you think about it, it kind of took this whole thing—remember back then it was a good idea. It gave the civilian a civilian approach to a program that up to this time, we were the only country that actually had a civilian spaceflight. Everybody else's was tied up with military. We actually had one. We kind of set that point. Nobody had one up to that time. Eisenhower did that. So that's how it started.

I'm kind of telling you more about this than—the next thing that happened, that really happened to me, and I didn't want it to happen, was becoming a flight controller. They pulled all the young guys. This was something because we realized that we had to build a

range and we had to do the flight operations. I didn't even know that. [Telephone rings. Tape recorder turned off.]

Remember, when they got this thing, with flight control, it was kind of, as soon as you were on the list, everybody made to think that that was a list of people who were less desirable engineering-wise and science-wise. Because, see, operations was kind of like technician stuff and it stayed that way for NASA forever. It's still there, to this day.

What we call flight operations now has some dignity because the flight crews do it. A basic aerospace engineer, which is what we developed, doesn't understand that that all came from flight operations. Because who in the hell would want to know about telemetry if you were an engineer? Nobody taught telemetry anywhere to any engineer. FMF telemetry was taught to us by guys from remote science, tech reps. And how you do two's [phonetic] complement, and what an EECOM [Electrical, Environmental, and Communications Officer] is, and how you ground an antenna. All of that came from that. But that's the kind of things that we had to know because we ended up building stuff on spacecraft that we had to build antennas on, and put com [communication] systems together and know about RF [radio frequency] and you know you can't be shooting it around, because you'll fry people, because you got people involved.

But anyway, I'm getting away from it. The point I'm making is, I was a little paranoid anyway, because I had already started a image that was not fitting. My Marine Corps and college activities and the way I was doing things did not fit into this Langley milieu. Because, remember, these guys have been engineers. Let me tell you, I'm going to tell what kind of guys they were. They would go to Winchester, Virginia, to buy shoes cheap. One of the worst things, friends of mine that sold cars—and they call them "NACA nuts." When they saw one coming, they would get out of their way. They did not want to try to sell a car to a NACA nut, because he'd ask too many questions. He'd ask them questions they couldn't

answer. And that's what these people were. I fell in the middle of that, me and all these new guys right out of school.

When you get around to asking Chuck [Charles W.] Mathews, ask him what was the best class he ever seen. It was the class that I came in with. The '59-'60 class is where he got all his people from. He said, "I never in my life have gotten so many good people in my life." He told me that one time when we were talking, one night when Tahatchet [phonetic] ate the tickets to keep him from going to a dinner in his honor, so he had to go with Tahatchet at a lunch. [Laughter]

But anyway, I got into the flight control and I really did want to do it. The first time I went to do any flight control training, we didn't have any simulations. We kind of did it real time. I went to the Cape [Canaveral, Florida] and watched, I think it was [unclear]—it was a Mercury thing that the thing shut down early and it went to its all-sequence because they'd cut off the timer. Everything fired at the [unclear] fine, and the chute came out. It was really sad. It was really a bad day. I don't see how NASA pulled through that. I guess because it didn't get on TV. I mean, you could look at the Redstone.

I had a friend named John Graham that was in recovery. I said, "John, you've got the perfect type. Go get it. It's right there. I can see it." They couldn't get it because it still had all these explosives up there. You know what they did? They got somebody down there with a deer rifle and shot the safety thing. That's how they got to it. Did you know that?

MCDONALD: No. Explain this again.

LLEWELLYN: I don't remember all the stuff, and I'll go back and get the data on this. But they had to disarm it because everything was hot. They made a mistake. They had trouble with the first one, because I think they had an overspeed and the system thought it was something else and it had a mode one aboard, and they took the monkey through about 10 Gs

and he never recovered. I'm not even going to get into that discussion, because that's going to be covered by somebody else. I'm sure of that. Or maybe nobody else wants to talk about it, because we try to hush it up, because we wasn't supposed to be using animals as test subjects, anyway. That's when one of the Presidents decided, that we couldn't do that.

So the second one that disarmed it and it was worse, because it actually did everything. It actually clocked through everything. We learned a lot from that stuff. Anyway, so to disarm it, they had to shoot the—had to hit a box somewhere. I forget exactly where. Somebody did it. I don't know who did it. Anyway, that's my first one.

That's when I first started strip chart recorders and stuff like that and starting reducing data that way. We actually did it. I sat there and measured slopes and worked through difference equations. I don't know if you've ever done that. From that, really, came the first time I wrote one of the first programs [unclear], based on those things.

MCDONALD: So you guys were the first people to use strip chart recorders?

LLEWELLYN: Well, we got them from the Germans, because that's all they used. They were past masters of the strip chart recorder. Everybody had them. I mean, because they had always looked at them. That's how we did it. All our data was strip chart, so a vertical racks [phonetic] was strip chart. A lot of them were right, the good ones that make decisions, real-time decisions, wasn't telemetry; it was strip chart recorder. It was these tables. You look right at it. And that's how the Germans did it. We learned a lot of that from them.

Then from that we went to a console. That was hard to do, because the Germans still use strip chart. They would not get of them. Even though we had consoles and gauges and stuff like that, and even strip charts on the consoles. But I'm getting away from something.

The point I'm making is that I kind of—but then I got to knowing the guys who were doing it, all the NASA engineers, the guys saying, "Oh, we're young, having a good time." I

went on—this is a kind of a funny thing that happened. On MA-3 [Mercury-Atlas 3], I went to Guaymas, Mexico. They were pulling me out there. I didn't quite get there, because MA-3 was lost. There's another story about this, that there was some guys that actually said some very ugly things to the Mexican Embassy and the President, and we almost all got locked up. But I'm not getting into that.

They told me to come back, and I was one of the first ones back.

MCDONALD: To?

LLEWELLYN: To Virginia. What happened was that the guy, and I can't think of his name, the guy that ran the flight operations personnel before [Eugene F.] Kranz. Kranz worked for him. He told me, they say, "We need a guy to go on the MR-3." That's the Mercury Redstone 3, [Alan B.] Shepard's [Jr.] flight. Most of the guys that had been top guys were gone. They had me and a bunch of other guys. This guy liked me because I'd gone hunting with him or something. I said, "I want you to get on a plane and I want you to be on this flight and you're going to be on MR-3."

Well, it turns out that that whole experience really changed my life and the way I was going to do things, because I realized right then and there that this was a tough job. I got on, picked up a systems man and a doctor—a Surgeon, we called it. I was briefed by [Henry E.] Pete Clements at the Cape. We drove to Mayport, Florida and got on a destroyer and met the Coastal Sentry *Quebec*, which was really an Indian Ocean ship, but they had it on the way, because the Atlantic Ocean ship was off the coast of Europe to support MA-3. Everybody knows what MA-3 was. MA-3 was launched and nobody ever saw it again.

That's when [Christopher C.] Kraft [Jr.] came up with the idea, we'll never launch in bad weather, ever. Ever again. Kraft came up—well, Kraft and Chuck Mathews, whoever was doing all that. Kraft worked for Mathews then.

So that's how I did it, and that was quite an experience, and probably I was there a long time. If you believe or not, I'll have to get my log out, but I was there during the invasion of Cuba. I happened to be right down there when that was going on.

MCDONALD: On the boat?

LLEWELLYN: On the boat.

MCDONALD: During the Bay of Pigs?

LLEWELLYN: I have a feeling that was part of it, but I don't want to get into it. If you remember right, right after that Shepard landed down in the middle of that. I was there. I guess I was out there for about three weeks, and I was glad to get off of it. That's a whole bunch of stories.

MCDONALD: What did you do while you were on the boat?

LLEWELLYN: I was the Capcom [Capsule Communicator], and most of the things I did was enforce NASA's position there, because this was an Air Force ship and we had a guy, another ship operation manager, that thought that I didn't have anything to do with anything. We had battles every day. In fact, Pete Clements thinks that some of the best—well, see, we didn't have anything but teletype then. Some of the best teletype messages he ever seen came from me, talking about the ship's operation manager, and everybody within range saw it, this harangue that he and I were having out there in the middle of everything else.

But let me tell you what happened, man. This is interesting. This is an interesting part of it. The day that we had the flight, we had a lot of noise. I was in the area where the

capsule touched down. I was a little bit up range, to see the main chute. That was one of the things I needed to do, and look at some other things like was the heat shield deployed, and all that stuff. I had that stuff to do. That was my main job.

I was the first one that anybody talked to on the ground after blackout. I was the first. I was position. Nobody had ever been on a remote site before. I was the first Capcom. This is the first time they ever had one. They were going to do something like MA-3, but I was the first one. That's the one first on the ship.

I knew exactly what to do, because I'd practiced it over and over again. I knew what to look at, what to report. I checked it out. We never had any sims [simulations]. They used to call us up. We'd just talk every once in a while, but not much interference with the Cape. I mean, I could hear Kraft, but most of the times I was talking to technicians, because we had some bad problems. Like on the ship we still had transmit/receive. You've been on ships, haven't you?

MCDONALD: Sure.

LLEWELLYN: You transmit and received it right back. Do you remember that? It had all those grounding problems and stuff like that. Even though it had been an Air Force ship, it didn't have—see, we had an acquisition aid on it. We had everything. Had a command system on it, because you could relay commands on it or I could do it. That was hairy, too.

But what happened was that when I was sitting there and Bert Compton [phonetic] knew what I was talking about, came on the loop. In those days we had WECO [phonetic] headsets. We didn't have the Plantonics. I'm sitting there talking and I could hear Kraft says, "CSQ Capcom, give me a status on all the events that you see on your display." I went down them. It turns out about the time that that happened, we had a cable wrap problem on antenna because the fucking—I mean, the spacecraft went overhead. When I did, we had

LOS [Loss of Signal]. I did not know that LOS [loss of signal], all the things that were up would turn on. So I had said not only had main chute employed, but the reserve chute employed, because that's what I said. This caused an awful lot of consternation. I tried to recover from it. I didn't even know how bad it was. Kraft, they tell me, looked like a ground [unclear] machine, especially when he found out it was a human error. I was glad to get it over with.

So I had gotten an inkling that I had committed some kind of thing and they sent me faxes and stuff saying, "How much time training have you had?" and all that. I knew it was not going to be a pretty sight. But I still—I mean, I was still out of it. I was still a guy that was very—I thought I was really smart because I had done very well in college. I was working on my master's and I knew all this. I'd started wearing gray suits with fanny pinchers and button-down collars. I was pretty smart. I was even thinking of buying a [Triumph] TR3. So I was already very high-class. This job was not really what I wanted to do, anyway. I wanted to be a topnotch physicist, an aerospace guy. I didn't want to do this.

This part is really hard. We had to transfer from the CS crew back to a destroyer on a high line this time. The guy that I was with was a Navy guy. I forget his name. But he had been on destroyers in World War II and he had three or four of them suck while he was on them. They're really—he had known high lines and he'd seen a lot of guys never make it. But anyway, we had to do it. We got on the destroyer and they treated us real well. I never saw a ship move that fast in my life. I just didn't even know they could go that fast.

Pretty soon we're back in Mayport. I bought a car. We came down and I had to go to see Kraft. I couldn't go back to Langley; I had to go back to Kraft. Drove over to the Cape, and I was talking to the systems guy. I said, "What do you think about it?"

He said, "I don't know, John, we've got to kind of be careful with this thing."

I walked in there, I'll never forget this, and Kraft was sitting in the hangar down there in one of those things. He had a cigar in his mouth. He actually had stayed. It was a

Saturday afternoon, about two o'clock in the afternoon by the time I got there. He said something to me about this, about [unclear] and all this. He says, "Did you do this? Did you do that? Did you do that?"

I said, "Yes, sir, I did all that." I said, "But you know something?" I think we called him Chris or something. Mr. Kraft. I didn't call him—I said, "You know something?" We didn't call them flight in those days. We hadn't gotten around to that yet. I said, "I think you're overreacting." [Laughter]

Honest to God, that's the worst thing I could have said. He actually went totally out of it and screamed and hollered. I said, "God, I'm through. I am through. I know it. What am I going to tell everybody?"

He told me, and I had to sit there. I mean, the systems guy had to write down our history and what we did and why did this and what the CSQ—and he and I sat there from about 2:00 to 5:00, writing kind of like a—

MCDONALD: An essay.

LLEWELLYN: An essay. Not only that, it was reminding me of something that this was my last will and testament. At the end, my NASA career was over. I could not believe that you could get this kind of situation. I just, I just couldn't believe. I got to thinking as I was writing it, I said, "You know something? I can see now how important this is. I really can. I don't know what I was thinking about." I'm in a position—and when I really look at it, and when you really look at the thing, I cannot believe that I was not any better prepared for this. I prepared for everything else.

And from then on, I really started trying. From then on, I really did become—if I had any time to get in the Mercury simulator—it wasn't much. It was this little analog thing. At least I'd go in and try to do that. Every time I could get a chance and I really got to working

on clocks and telemetry and really started doing that. First thing I knew, I was picked to go—I think the next thing I did of any consequence was Zanzibar [Africa].

MR-3 certainly was a turning point for me in the space business, because I realized what an important thing that our flight operations was. You had to really be really good to do it. It wasn't the kind of thing that just anybody could do. You had to have technically to do it. You had that responsibility as the Capcom of the team to coordinate NASA's space task, what are we doing on those sites, because we were their eyes and ears. Because in those days we could only talk through low-speed teletype. We didn't have the high-speed data, except in the launch base. I think even that was only about 54 kilobits, and we thought that was high-speed data. That's what we did. I'd go no-goes on it. I think it was something like that. It wasn't much. It was a little bit better. Maybe it was 64, I don't know, but whatever. It wasn't even a T-1 circuit. Not anything.

Anyway, the problem I'm saying is that that really stuck. Even though I had another job to do, I had another job in the Heat Transfer Division. I was still asked to run tests and be turning that out and doing a lot of stuff with that. But this thing had had already—I was actually doing two jobs for NASA and I did my flight op [operations] stuff kind of like when I could. We didn't really have schools, as such. We started doing it. But anyway, that's the point. I spent a lot of time.

I found out that a lot of things that I was familiar with, like orbital theory and stuff like that, I was a lot better off than some engineers because I knew celestial mechanics and I could actually talk about how orbits were and where they were and what really a ballistic mission—what it was. I mean, I could actually work the equations. I mean, [unclear], but I could do it. Then I had the background of the heat transfer.

So I had a lot of stuff going that really put me in a position to understand manned spaceflight and the seriousness and how that we have to develop a system that will support a man in space, and how important it is to know which parachute opened. You don't want two

of them and all of that. That's stuff that I knew about, but it wasn't the kind of things you could make a mistake in. That was the kind of thing that I started. I think that anybody that knew me, that understood what was going on, knew that that was what I was doing. I was very clearly a person that wanted—when we were getting ready to fly an operation or do a mission, they knew damn well that I was very serious about what I was doing, and everybody had better be ready to do it. I would talk to people and I would find out what they were doing and asking them questions, because I knew that the systems they had that I depended on my information. Remember, a man's judgment is only good as his information. If you've got bad information, you're going to have bad judgment. I learned that a long time ago.

So, that's the thing. I don't know when that was with respect to some of the other developments, but the big major issue was that the fall of the year, going to Zanzibar and just getting there was a real challenge in those days. By the way, the 707s had just been invented. Up until that time, it was prop planes, and the best one in the world in those days was a Comet. The U.S. was kind of behind times. Unfortunately, the Comet had a cracked bulkhead and that was the end of that. The 707 never had that problem. If it did, it was designed around it, I guess, because it was a KC-135 first.

But anyway, going to that, it's interesting when I got to Nairobi, it was such a beautiful place. It was cool for being in Africa. I had looked at the map, I knew a lot of stuff about it. We were real close to the equator and it was really cooler than it was in Virginia at that time of year. I just couldn't get over it.

The other thing, too, I had read a lot of books about the Moumou thing, and that was going on. It had just gotten over. In fact, Joe [unclear] got loose the same day I got in, and they were going crazy. This is after he came back and he stopped doing what he was doing. Whatever the Brits [British] did to him, we don't know. But he came back and was very peaceful and stopped that whole Moumou thing.

From there I went to down to Dar es Salaam and crossed from Dar es Salaam into Zanzibar. In those days, Dar es Salaam was part of Tanganika, and Zanzibar was a country all by itself. It was only after the Chinese got in there and then they finally went Communism, that Tanganika became Tanzania and it turned out, and it got Zanzibar and all those islands at the same time. That's when we lost our site at Zanzibar. We lost that to the Chinese.

Anyway, I got there and the interesting about it was—and I don't think anybody really realizes this since it was the first time it ever happened—that we had built a network—and this is very important, and we never see it—of plus or minus 32 degrees around the Earth that we would always have—and you can't do it too good—that we had at least for the first four revs [revolutions] almost constant communication with the capsule. We put ships in it and we could do it with—no matter. We couldn't talk to them, but we had people could do it and the people could report over low-speed teletype. That was a basic job.

MCDONALD: Let me try and understand this. We had down-link communications from the capsule?

LLEWELLYN: Yes.

MCDONALD: And you didn't have up-link necessarily?

LLEWELLYN: We could do commands.

MCDONALD: But you couldn't talk?

LLEWELLYN: We could talk.

MCDONALD: You could or could not?

LLEWELLYN: We could. That's what the Capcom did.

MCDONALD: But you could not communicate among the sites except by teletype?

LLEWELLYN: Except by a teletype. But you could hear the other guys talk. We did that. A lot of times we would make damn sure that we were hearing the other guys talk. In fact, that was one thing that kind of give Kraft the idea of doing something different. He could actually hear on the old conference loop. We'd put the air-to-ground on the conference loop and nobody better get on it when we was doing a pass. I don't care what they did. If you wanted to get to the site, you went autowire. Nobody else ever did that. No other person. Right today, if you look at what's going on the *Mir*, the *Mir* doesn't have but very small voice. We've always done it. We've always had communication with the ground. That, I think, is a really positive thing, it really is, because we always looked at it and we always were part of it. The people who were actually flying a mission were part of what the crew was doing. We knew exactly all the things and we had a system. When you think about it, we did that. It was pretty tough to do in those days with the Communists and the blocs. We also had a Landing and Recovery Division that would go in any country to go get them, too, no matter where they went. So from that standpoint, we had a really good thing to work from. I was very proud of it, trying to make it work. When I was at Zanzibar, the Ac Aid didn't work. We used to call it an Ac Aid because it never worked.

MCDONALD: What is that?

LLEWELLYN: An acquisition aid in those days, because you had to track it, and we didn't much time. We had to get that telemetry thing. What it did, it told us, it kind of gave you the pointing data, but it also had the recession stuff in it. That one, they built in there. It's so easy to do that, because you can put one chip. But it was quite a mechanical thing to make that thing know that when it's coming at you, it's getting fast; when it goes away, it gets slow. You had to have that built in it. That's incredible. The Doppler effect, is what I'm trying to say. That's the first time. That helped me later on, too, how that works.

Actually, we used to get that help and I was there a long time. In fact, one of the simulations that I was at, we had to close down early, because the Moumous attacked the village real close to where the site was. The [unclear] actually had to put a company of guys out there to bring us in. I didn't want to stop the simulation, but everybody told us we had to get out of there. They were there. So I had to close down one of our simulations—I think it was MA-4 [Mercury-Atlas 4]—for the Moumou uprising, which finally took Zanzibar over. We lost a lot of our friends there. God.

Anyway, that was that flight. Then it was Kano, Nigeria, the next one. Then I got on the ship again. The big one was [John H.] Glenn's [Jr.] flight. I was at Canaries [the Canary Islands]. That was the first time we had air-to-ground to Canaries. In other words, you could actually, because we did it out of—air-to-ground was out of the military complex, the single sideband. So we actually had air-to-ground. So now we had gone from the Cape to Bermuda, then we'd gone to Cape down range to Canary, so they could hear the whole launch phase, because they used to have LOS about T-plus five.

So I was there and that was Glenn's flight. It was very, very, very, very, very long. We stayed there for a long time in Canary Islands and we learned a lot on the sites and all that. But I made a lot of mistakes there also.

MCDONALD: Where's this?

LLEWELLYN: At Canaries. In fact, I got my ass chewed out so many times there, that even ship says—I'll never forget—and Kraft would say, "Let's go back to Canaries. We want to talk to that Capcom." In fact, the guy that was with me was named [Mortimer] Rosenbaum. Up until this time, he thought I was a shiny-head boy and the whole thing. He was trying to distance himself from me by this time, because he wanted the Philco contractor to build a control center. He did everything he could do to help me. He wrote down all the things and helped me with Will-Co and what to say and all that stuff. We worked on my Morse code every night. We worked. I'm not kidding you. The whole time out there, that's all I did was train.

Anyway, by the time they got around to the flight, and we finally got him off, remember he had twelve or thirteen false starts. Remember that? It went on through almost all of January and into February. Remember? I think I finally got back to Virginia about the time of Valentine's [Day]. But at the end of that thing, I did such a good job, because I was the one that saw the heat shield separation first. I was the first one to pick that up. I handled that and the whole thing. It went over good.

Then he actually said during the debriefing that the Canary Islands did an exemplary job. It was really nice and I really felt good for a while. I just had worked so hard. It's one of those things that, you know, when you work real hard, you keep doing things. You ever get this feeling, is this all it is? That's really where the depression starts. But anyway, I'm getting off the subject. But it really was tough.

When I came back, a couple of things struck me. By this time, we really were going to move to Houston [Texas]. At this point in time, that was the thing that was going on parallel with this. We wasn't going to Tampa [Florida]. We wasn't going to Goddard [Spaceflight Center, Greenbelt, Maryland]. We were going to Houston. I had come back to

my job as a aerodynamicist, heat transfer, or whatever I was doing. Guidance expert. I did all that stuff.

I could tell that my seat was empty. When you're not there, you get left. Right? Any job, if you travel a lot, you're losing out. I got the word that the flight director wanted to talk to me, and [Glynn S.] Lunney talked to me, too. I got the job to be a r____ officer, flight dynamics officer, at the Cape. I was thinking I'd rather be on remote sites. I actually argued against that. Tec Roberts says, "Honest to God, you've got to be the dumbest son-of-bitch I ever met. You got a chance to do this. Should I just tell them that you're not going to do it? I mean, do you know what this means? Here you're sitting here telling me—I don't even know who you are. You're telling me that you've been selected to do—" I'll never forget this. "I don't understand what you're doing. I'm really confused."

I thought to myself, "Good God."

But again, I really hadn't gotten there, you know. I liked what I was doing, because I liked remote sites, because we went everywhere. We were like jet-setters. I mean, to go to [unclear], to get home from that. Look how many places you could go on the same ticket. All you had to do is take annual leave. I mean, the first time I came back from Zanzibar, I spent like a week flying around being a big deal in Europe. I saw places I'd never—I saw Greece, I saw Egypt. I saw it all on the same plane ticket. See, in those days if you bought a plane ticket, you could fly anywhere on the same plane ticket. I mean, that experience was really something. We saw so many neat places and went places. Anyway, I had that job, and it was very tough again, because I was breaking into a new area. Very, very tough.

MCDONALD: How did they structure that, though? You were offered a specific job. How did they decide what jobs were where?

LLEWELLYN: It was Kraft's decision. He brought a lot of guys. Remember we were going through a lot. This may not be good to have it on here. Don't forget there was lots of positions in the control center that were there, and then guys didn't make it and they moved on.

MCDONALD: Who set the structure for the control center?

LLEWELLYN: Kraft did it, and I'm sure Chuck Mathews and all of that. I'm sure Kraft and [Sigurd A.] Sjoberg did and those guys. I'm sure they did. You had to be accepted by the crew, too, because they were part of it and they were very big and vocal. Kraft had a hard time with him, especially Shepard. But, again, it's the kind of things that make men. I mean, that kind of competitive thing, who was going to be in charge. That's the name of the game. And Kraft proved it. Kraft proved beyond a shadow of doubt that he was going to be in charge. There's no doubt. It was tough. I mean, he had some tough guys to go against. I mean, when you think about it, because he had guys like me on this thing, too. I had been around.

Your question was how I was selected. I don't know, but it was very—I do know there were lots of substitutions and some people, I felt, that were qualified, were not qualified, just through experience.

One thing that, just to believe, just to show you the kind of person and what it took to do that, one of the flights that we got into a discussion over was a discussion over a sequence of events in case you didn't have enough Delta-V, enough energy to put the Atlas to go into orbit. I don't know if you guys remember this, that was very marginal in putting the Mercury spacecraft in orbit. It was within a feet per second. A lot of the times—I'm sure that people will say this is not quite right—but a lot times the separation velocity put us over the [unclear]. Delta-V twenty-feet a second, something like that. I forget what it is.

One of the things that had come up with it, that I had been asked to do because [Virgil I. "Gus"] Grissom and I got to be friends is, in other words, if you got that thing fire-retroed to get in, then we'd have enough, more than enough for two more left to get in, back in. In other words, use the retro rockets, the posigrade rocket. This thing became a big issue. It wasn't an issue above anybody but with the flight ops people. I don't know who ever got into it. I don't know if even the program was in it.

But it got in it between the flight operations people, for sure, me and Kraft and the crew. I can understand where they're coming from with it. I may have some of the characters wrong, but I do know that during the countdown of a particular flight that this thing might be implemented in, it started off, Kraft came in and they had a heated argument. Kraft asked me, "What was the recovery are in a T-plus 5 border?" Maybe it was 5-plus 20. I don't know. It was the safe part of mode one aborts. In other words, you could come off there with the retro rockets and have not a bad G ride, and [unclear] ballistic and [unclear]. Recovery area was very good for it.

He said, "Retro, give me a countdown. Give me a count on loop to T-minus 5, Retro, and go through your sequence. I haven't heard this."

So I went through it, what I was going to do. Counted down to flight, T-minus plus, thirty seconds, [unclear] five, four, three, ten, whatever I did. And went through my thing.

He said, "Shepard, see that? Did you hear what he just did?" I gave the time, what's going to happen. He said, "If I even think I hear that during this flight, if I even think that this is going to happen, you know what's going to happen? Retro is going to start counting." That was the end of it. That's true.

Now, I'm not all the things into it, because I can't remember all of it. But he did that. That's what made him who he was. Whether he meant it or not, I meant it, because I was going to do exactly what he told me to do. And I think Shepard knew it. I think that's the kind of teamwork we had. If you ever talk to Kraft about that—I've never mentioned it to

him—but he does know about the Canary Islands and the MR-3 thing. But I've had a lot of discussions with him on stuff. I never forget about T-minus-3 update for Gemini. We just had it pretty one way for Gemini. Well, that's another story.

But anyway, that's how I got to be there. I totally enjoyed it. My first flight was MA—Mercury happened in six, I was on seven, just right after [M.] Scott Carpenter's flight. Gosh, that started a long story about John [unclear] and Scott Carpenter. It really even got into the Gemini thing about Sealab. This thing went on and on.

But anyway, M. Scott's behavior at retro firing was very, very unusual. In fact, we almost did not have a retro firing. It was just that interesting. Of all the missions to be my first mission, I just was almost totally out of it. My first mission as a flight dynamics officer on prime, I'd get called as a backup, which was my call and [unclear]'s first mission, too.

It was a very long, drawn-out count, because there was a fire, some wire fires or something. In those days, we had a Zuza [phonetic] system that worked on the endolometer [phonetic], that we had to have a clear day to get good data. That was the only good backup to the Atlas guidance system. But anyway, I'm getting off the subject.

So the countdown was slow and we finally got off. One of the first problems that came up, that I heard, and you always do it as a flight [unclear], is I marked off the kind of things that would call for early termination of mission or something. We had a very good launch phase separation. Over [unclear]—maybe it wasn't [unclear]. I don't know what it was in those days. They had a problem with the inverter. This thing started a long discussion on the inverted temperatures and what they were going to do with it. Kraft got on the loop and said, "You've got to get that thing squared away." There was a systems guy that was there that didn't do that and he was not there anymore.

One of the things that were bothering the flight control team, including Grissom, I think, was the Capcom. I'm not sure. But flight was there. Coming into this inverter problem and a couple other problems and not keeping up with the flight plan, M. Scott

Carpenter had come up with a Spanish version of something he was going to tell the people in Mexico at Guaymas. He repeated that, and we were trying to get the inverter squared away, and then he went into a long discussion about fireflies. That carried us right over the United States past Corpus [Christi, Texas] and got us in the Cape, and this is when the discussion said, we either get this thing right or we're going to come on the next orbit. That was a long discussion with everybody, the flight directors and Capcom and everything else.

It turns out that when we went over Australia again, it wasn't right, so we decided to fire the retros on the second round and bring him into the Atlantic [Ocean], into an area that was not a planned landing area. What we finally came up with was close. So that's how that happened.

Anyway, I knew that this thing, we passed the times up, we had all our data out. We set the clock. We had to lockout someplace and the whole thing. I had my whole script ready and I was ready. When we came in into the time, in those days we had the clock set up and that sequence went up. The clock put the Mercury capsule into retro attitude and it did a lot of this stuff. Even though it was counted down, the spacecraft could do it and a guy could do it manual, the guys on the land, like the ret files, had a command that fired the retros, too. We had one [unclear], because that's the way we felt about it. We realized that no matter what happened, that we'd always be able to bring the guys in. That was the rule.

MCDONALD: Was there an override ability from the capsule?

LLEWELLYN: Yes.

MCDONALD: So they could prevent you from doing this?

LLEWELLYN: No, once you got into the sequence, whoever threw the switch would go. You could not stop it. But the problem we got into is Shepard, because he could see the attitudes, he was not in the right attitude. In fact, I think he was in the wrong direction, but I'm not sure. We'll have to go over the tapes to hear that. But it was something. So we could find retros on time. So I started thinking about maybe going the next rev, because I knew that we were getting pass and I know how much time it was.

Shepard turned around, got in retro attitude, and fired on his count. He and I both fired, and Kraft was standing there and we did. Let's say it was twenty seconds, fifteen minutes too late, which is four times fifteen is a lot of miles. Because it was essentially a ballistic missile and it's like right off we were way down range. The bad thing about it, we didn't know what attitude it was in and we just didn't have a way to do it in those days. From then on, that was one exciting ride that he had, because he had gotten out of fuel and he really had a—especially after the main chute deployed. At one time his capsule was higher than the chutes, I understand. But anyway, he went way down range.

The thing I gather from that, it was really a significant, another point in my life that I decided I was not prepared for those kind of things, but I would be from there on. I'd never, ever, be in a position that I couldn't punch in a manual retro fire into the computer. I developed what they call an auxiliary computer. We came up with a line on the window. We started doing a lot of stuff to protect ourselves against those kind of problems where you had a manual retro fire.

So from the standpoint of MA-7 [Mercury-Atlas 7], it was such a good learning experience for me. It really did show how important and how much you had to be trained to do these kind of things, because what happens, reentry is going to happen anyway. No matter what happens, it's going to happen. That's one thing that I always remembered. I didn't care what happened, I knew that they were going to finally get around to seeing me and talk to me about coming in. That's what I impressed on all the ret files, impressed

anybody that had anything [unclear] to support me. Like the guys that did data, command systems on that. We had to really be ready to support reentry and the boats, too.

I think the couple of little examples I did, the kind of experiences I had, put me in a position of the kind of person that we had to develop, because we had to really develop ourselves. We had to invent ourselves. We invented a FIDO [Flight Dynamics Officer] and retro and a flight director, the Capcoms, system minus, and the surgeons and everybody had to kind of—because nobody had ever done this before. And I'm not saying that I didn't have a hell of a lot of help. Gosh, guys helped me all the time. Guys would call me up and do stuff and give me good ideas. So from that standpoint, it was such a neat job, because it seemed like everybody in the United States was helping you. It really was.

Of course, the next was [Walter M.] Schirra's [Jr.] flight. Schirra was able to get the platform aligned and got the [unclear]. It was very difficult, but he did it with stars. Being a Navy guy, he did it. We found out we could align a platform. That was real good. We had some types of objectives. But to me that was really good. His reentry went well.

The next guy was [L. Gordon] Cooper [Jr.]. Cooper did a real long flight and he did an excellent job. Everything went well with his flight. It was the first long-duration flight and it was where we actually slept in the control center. One guy got off and the other went on. If something happened, we'd get up and assist. But it gave us a picture of what we were going to go do for the long-duration missions.

There's a whole lot of systems problems that we learned from that flight, too, but the major thing we learned from the Mercury flights was what the space business was like and what we were doing, and the kind of people you had to have, and the guidelines, and the evaluations of what was necessary to make manned space flight safe.

MCDONALD: What would you see as the key elements that you learned?

LLEWELLYN: Redundancy. Understanding the environment to the point and over-studying and having backups and looking at the thing and all, having a real good perspective of all the things that could happen. Known the daylight darkness times, where the retros were going to—we used to send up what we called block data, even then.

With the first flight plan, we did the retros, we had a little Ac and LOS thing that we knew what sites there were. I got everybody, and those things would change due to orbits and stuff like that, as we got the new data in, it would change from the nominal. We were the first ones to see that, because our nominals were not exactly—we didn't have a good idea of the K in those days, what orbital K was.

So, all of that kind of thing prepared us and each step was another step. I can only talk from a trajectory standpoint. I learned a lot about the systems and the upgrades of the telecommunications systems, the tracking and telemetry, and being able to work as a team with the rest of my team members and cueing on them and talking to them, and writing mission rules and a kind of pulling together of all our capabilities, realizing that, as any team, everybody knows that every man, everybody has a flaw and we're all flawed. What a team does, and if you have a leader, you put a team together where the flaws are compensated by the members and the leader himself makes sure that happens. That's what I learned from it. I already knew it, but I really could see it there, because what we were doing was things that people had never done before.

I mean, nobody really had ever determined a trajectory like we were doing and trying to understand that how reentries work, and step-by-step integration through an atmosphere. We actually integrated burns and everything. That was long. In the real-time systems, we had so much trouble with that. But when you think about, in those days, it just amazed me that we could—I was looking at data from RA&E, the raw radar data, just [unclear]. Just don't think anything else. I was looking at that, that thing was pulled off, put into a data buffer, shipped to Goddard, RA&E was turned into a trajectory by a simple clearance, three

or four points, looking for it. That made a trajectory. That cut your curve. That curve was then taken and stuck into a set of equations, very simple dynamic kinematic equation, and solved for all these parameters, and thrown back on that plot board in three seconds.

That amazed me. To me, I was like, I could not believe it, because I could see it happen. I mean, I was at the place that if I did something, I could know that that's happening, because I saw it. I mean, I could actually know that Newton's laws really worked. I mean, to me, it was the best lab that I could have. That's what helped all of us. I mean, you could actually see it happen. I mean, if you did a go/no-go thing, the thing jumped all over the plot board and you had one then, damn, that was it. You knew what happened. You could depend on it and you could make decisions from it. You would do it. You'd stand up and say, "This is what we're going to do." That takes a lot. That's what I learned, to have that kind of confidence in yourself and your teammates to make those kind of decisions. This flight, we've got to go. I mean, unequivocally, no bullshit, we go. And that makes a lot.

[End of Interview]