

NASA HEADQUARTERS NACA ORAL HISTORY PROJECT

ORAL HISTORY TRANSCRIPT

JOHN W. BOYD
INTERVIEWED BY JENNIFER ROSS-NAZZAL
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ROSS-NAZZAL: Today is October 3rd, 2005. This oral history session is being conducted with John Boyd of NACA Ames [Aeronautical Laboratory, Moffett Field, California] as part of the NACA [National Advisory Committee for Aeronautics] Oral History Project sponsored by the NASA [National Aeronautics and Space Administration] Headquarters History Office. This interview is being held at Ames Research Center [Moffett Field] during the NACA Reunion Eleven. The interviewer is Jennifer Ross-Nazzal.

Thank you again for taking the time to meet with us. I'd like to begin today by asking you how you became employed by NACA.

BOYD: Okay. Well, way back in the forties I had a cousin who was a paratrooper, and he got me interested in airplanes by giving me a ride in a biplane. So I went to college at Virginia Tech [Virginia Polytechnic Institute and State University, Blacksburg, Virginia] and took aeroengineering. At the time—this was 1943, '44, and '45—there weren't too many people taking aeroengineering. Well, when I finished, before I finished, thinking, "Now, what am I going to do with this degree?" Nobody in my family had had one before.

Somebody said, "Well, there's this place called NACA, and they've got three Laboratories, one at Langley [Aeronautical Laboratory, Hampton, Virginia], one at Lewis [NACA Aircraft Engine Research Laboratory, Cleveland, Ohio], and one in Ames."

I said, "Where's Ames?" I'd never heard of it.

Said, "It's in a little place called Mountain View, California."

I said, "Great. That sounds good. I've always wanted to go to California." Mountain View sounded beautiful. I thought it was a view of the mountains. It's not too bad, actually. Anyway, when I graduated, or just before I graduated, in November of '46, the interviewer came around from NACA Langley, interviewing people. But he was interviewing for Langley.

I said, "But I don't want to stay in Virginia."

His first reaction was, "There's not much I can do about that, since I'm interviewing for Langley."

I said, "Well, then, I don't want to go to Langley." Not that I had anything against Langley, I just wanted to get out of Virginia for a while. Anyway, a few days later I got a letter saying, "I can get you in touch with Ames," and he did. "And it's a great place to work, even though it's not Langley."

So I sent an application in probably the first of December, and about the middle of December I got this telegram saying, "Okay, you're hired for \$2,644 a year as a P-1 engineer. Come to work in January." So I did, and January 15th, I got here, in 1947. That's kind of how it happened.

ROSS-NAZZAL: Can you paint a picture for me of what it was like when you first came to Ames? Obviously, you didn't interview. You just sent in an application. What was it like out here? What facilities were here?

BOYD: Well, I got to the Ad[ministration] Building, which is here, Building 200, and there were not too many others. The big forty-by-eighty-foot wind tunnel was here. The sixteen-foot wind

tunnel was here. The seven-by-tens were here, which were subsonic, and this building, which had a little supersonic wind tunnel in the back of it, was here, and this is where they sent me to work in January of '47.

ROSS-NAZZAL: And this building is 207?

BOYD: It's Building 207. So I've come full cycle in almost sixty years, and I'm back where I started, as a historian now, but I started here in this building working on the supersonic wind tunnel.

ROSS-NAZZAL: What was your official title when you started?

BOYD: I think P-1, Aeronautical Engineer, as simple as that. They had P-1s, P-2s, P-3s. That was the different grade levels, like GS [General Schedule] now. So just called P-1, Aero Engineer.

ROSS-NAZZAL: What were your first duties when you arrived here at Ames?

BOYD: Well, I had a good Branch Chief here. He's still living, as a matter of fact, at Stanford [California], but he said, "I noticed on your résumé that you took Compressible Flow, which is supersonic aerodynamics. Most of the folks, the new people who come in, haven't had Compressible Flow. So we're going to put you in this wind tunnel, and I want you to devise some airfoils to test that will be good at supersonic speeds." There wasn't much data in those

days. I think it was later that year that Chuck [Charles E.] Yeager actually flew the X-1, which broke the sound barrier.

So we had this tunnel, and we started looking at all sorts of wing plan forms, wing shapes, triangular wings, swept-back wings, unswept wings. What we'd do is actually lay them out on paper ourselves and take them over to the machine shop, which we had across the street, and they would build the little models for us out of stainless steel, because at supersonic speeds the forces were pretty high. This tunnel ran at one speed, funny speed, one speed, one-point-five-three Mach number, so we got supersonic data out of it with different wing configurations. So that was what a young project engineer did, and you kind of learned along the way.

At the same time you did, though, there was a famous aerodynamicist here by the name of R. [Robert] T. Jones, so he took most of us under his wing. R. T. Jones is the man who started at Langley, moved to Ames in 1944. He developed the swept-back-wing, actually. It was his theory and his experiments. So we had him as a mentor, so what we didn't know about aerodynamics and compressible flow, he taught us.

So that's what we did. You started drawing the models. You started drawing the shapes, you took it to the machine shop, you got it built, you brought it back to the wind tunnel, you put it in the wind tunnel, you got the data, and then you wrote the report. So you did everything.

ROSS-NAZZAL: How long would that process take?

BOYD: Oh, not long, actually. Three months, because I did a series of them for the first year I was here. So I would say about that. Didn't write the first report, I think, till the second year. It took time to get the data. You started writing reports with a senior person, usually, because most

engineers out of college with a bachelor's didn't know how to write worth a damn, so we need a lot of help.

ROSS-NAZZAL: How many people would you work on one of these projects with?

BOYD: It was usually only one. We were probably kind of teamed up in twos, and this branch, it was called, probably had about twenty people in it. Some very famous people, incidentally, who went on later—R. T. Jones was one of them, and “Harvey” [H. Julian] Allen, who developed the blunt body was in this building, and a number of others. Dean [R.] Chapman. People whose name aeronautical folks would recognize. Milt [Milton D.] Van Dyke, many people like that were resident here. For the first year or two I was here, they only hired about a couple of young engineers, and I was one of them working—I call them senior engineers, but nobody was over twenty-five or thirty at the time.

ROSS-NAZZAL: What was your workday like? What time would you arrive at the office, and when would you leave?

BOYD: Not so early as I do now. I'd get here about seven-thirty, and work till about four-thirty or five o'clock. That was kind of typical. Sometimes we'd get so wound up in what we were doing we'd come in on Saturdays just to get ready for the next week, but that didn't happen too often in the first year or two. It was pretty steady, eight-, nine-hour days.

This was after the war, and many of the people who were here, the so-called senior people, had been in the war. In fact, this Center was indoctrinated into the Navy, so that during

the early days, in the '42, '43, '44 time frame, the people who worked here actually as engineers were Navy. They'd been drafted into the Navy and just let work here.

See, this Center was established in 1939, so when the people started coming out, the first cadre of people who came here, many of the brighter people, came from Langley; I'd say the first dozen or so. The man who led the Center and his deputy came from Langley, as did R. T. Jones and people—Harvey Allen. Some of them had gone to school out here at Stanford [University, Stanford, California], but they'd gone to Langley because this didn't exist in the thirties.

ROSS-NAZZAL: Was there any sort of cooperation between Langley and Ames? Did you work with any other young engineers out there?

BOYD: Oh yes. Yes, we wrote reports, and we'd communicate with each other before we put down the final reports. This was probably in the second, third, and fourth year after I got to be a little more knowledgeable. We got to know people like Dick [Richard T.] Whitcomb and John Stack, whose name you may not remember, John Evvard from Lewis, and as young engineers, yes, we worked a lot together.

We argued a lot and debated a lot, but I think Langley as the mother Center always—Langley was first, Ames was second, and Lewis was third. So they always sort of thought of us as their kids, and sometimes there was hard feeling, but mostly it was fun, competition. But we've always competed with Langley for that reason. I think Lewis less so, because Lewis became the propulsion Laboratory. Langley didn't do too much of that; they did some. But we were the aerodynamics, as was Langley, so it was a natural competitive area.

ROSS-NAZZAL: Tell me about writing those reports. You mentioned the first time you worked on a report, you worked with a senior person. How did you learn how to write those reports?

BOYD: Well, we had some ones to go by from the recent past, of course. A man named Walt [Walter G.] Vincenti, who was a Branch Chief here, was a superb writer. Most of us weren't. So you would conduct the test, and there was a kind of a format that you had to use. You had an abstract, you had an introduction, you had the guts of the report, and then you had a conclusion. So you had kind of that format. You had to make figures that would go in the report that would demonstrate the data that you'd gotten. When I tried to write, I'd have some data that would show me a certain characteristic of a vehicle, a L over D [lift-to-drag ratio]. I'd try to start out by saying, "Compared to vehicle *x*, *y*, or *z* that had been tested before, this one is much more efficient," or "much less efficient." So I wrote pretty straightforwardly, but it wasn't very good.

So the senior guy, who had written maybe a report or two before, would usually take the draft I had written and review it. Then we had a very, very tough internal review. We had what we called Editorial Committees. So a group of four or five of your senior people would sit on it and read your report, make comments on it back to you, and you'd go back and correct it.

It would take sometimes longer to write the reports than it did to get the data, because they were very rigid in wanting to make sure there was an understandable, fairly well written report, because in those days the industry used all that data very quickly. They'd sometimes come and get the data, as a matter of fact, before we'd finished writing the report, because they were really in a hurry for it. This was early on the days when we were working in supersonic vehicles, and they needed the data right away. So the report writing was a torturous part for most

of us engineers. Getting the data was the fun part, and developing the theories that went along with it.

ROSS-NAZZAL: Are there any reports that you remember that were particularly challenging for you?

BOYD: Yes, one in particular. I'd been here about—let's see, I came in '47. In 1949 it was decided there was going to be a big aeronautical conference out here—they rotated around the Centers—on supersonic aerodynamics. Well, so we were asked to start preparing a paper for this conference, and mine happened to be the effects of pressure distributions. You take lift, drag, and pitch of your models, or you could also put little holes in the model, taps in it, tubes out of it, and read the pressure distribution over it, which gave you a lot of detail about the flow. That was the report I was giving, "Pressure Distribution over a Triangular Wing."

Well, I wrote and wrote and wrote, and it got reviewed and reviewed and reviewed. It was tough, because this was now NACA's outside world presentation. Industry would come. Universities would come. So they wanted to make a good impression. So it took me about three years to get to that point, but even then it was tough. Then the week of the conference—in fact, I'm going to talk about it next month. I've been invited to go to Caltech [California Institute of Technology, Pasadena, California] to give a lecture to some aero seminar. Anyway.

People whose name you may not have heard, Dr. Theodore von Karman was the head of the—he started the Jet Propulsion Laboratory [JPL, Pasadena, California]. Anyway, he was here, the most famous aerodynamicist in the world, and sitting in the front row. When I walked into the conference room, I said, "No way am I going to give this paper. No way."

He must have felt my discomfort, but he came over and said—he was German, so he had a heavy accent—he said, “Do not worry. Dis is something you know more about than I do, so go do it.” So I had no choice; I did it. That was tough. There was a lot of other famous folks in the room as well, but he was the one that was the most intimidating. And he was a gruff guy, but he was a good teacher, I think.

ROSS-NAZZAL: Can you tell me more about those aeronautical conferences you would have every three years?

BOYD: NACA put out an annual report. You probably know this. They would select the best papers of the year and put them in this report, and that was what was called the “Report to the President.” It was actually, in the foreword, was to the President of the United States. So it would go out annually.

In addition to that, as I said, the industry was very anxious to get the data we were turning out in the forties and fifties, so they decided to have a series of conferences at Langley, at Lewis, and Ames. I don’t believe there was one at Edwards [called the NACA Muroc Flight Test Unit, and renamed the NACA High-Speed Flight Research Station, and later called the NACA High-Speed Flight Station] at the time. Anyway, that was in an attempt to get the data back to the companies quickly, because they would be well attended—the one I’m thinking of here in 1950 probably had about four hundred people from all over the country—to get the data right away, and it was published in the *Proceedings*, the conference *Proceedings*. That was the nature of them.

Each conference would probably last two to four days, so there may be six or eight papers each day, not unlike some of the AIAA [American Institute of Aeronautics and Astronautics] meetings now. Each Center would have selected the people it wanted to give the papers. When the conference was held at Ames, it wasn't just Ames people giving their papers, it was Langley, Lewis, and Ames. Same way with Langley. Same way with Lewis. So that way they got all the Center data into the conference papers fairly quickly, and then it may take another year to get the final report out. That was the reason for them, I think.

ROSS-NAZZAL: Besides attending that conference, were you a member of other organizations where you gave papers?

BOYD: Other organizations—I gave papers away from Ames on occasion. Other Centers?

ROSS-NAZZAL: Other Centers or national organizations. Did you belong to any engineering organizations?

BOYD: Yes. It wasn't called the AIAA then, it was called the American Institute of—I think it was AIA. Yes. There were organizations that young engineers, or old engineers, belonged to if they chose to, and they would have annual meetings on occasion, and you'd give papers there, too. You would publish papers. You'd give papers at the NACA conferences, and you'd give papers at academic locations or industry locations. I gave maybe half a dozen in that first six, ten years. Most of the time we spent on-site, writing, getting data and writing. Didn't do much traveling in those early days. If we picked a conference to give a paper, it was usually not too far

away, like L.A. [Los Angeles, California] or San Francisco [California], Washington [D.C.] sometimes.

ROSS-NAZZAL: Did you have the opportunity to visit any Laboratories while you were working with NACA?

BOYD: Some. You mean other than NACA. Did you mean NACA Labs?

ROSS-NAZZAL: Other NACA Labs

BOYD: Yes, we went to Langley and Glenn [Research Center, previously called the NACA Aircraft Engine Research Laboratory, Cleveland, Ohio] and the desert; it was called Dryden [Edwards, California]. It was called the [NACA Muroc Flight Test Unit, renamed the NACA High-Speed Flight Research Station, and later called the NACA High-Speed Flight Station] in those days until it was named after Dr. [Hugh L.] Dryden. Yes, see, that's all there were; there were just the four sites. The others hadn't come about until after 1958.

ROSS-NAZZAL: When you went to these other Laboratories, what was the purpose of going?

BOYD: Mostly to review data other people had gotten that was similar to your own, or to coordinate on writing papers. But fundamentally it was exchanging information, each other's, so you could take another step forward and not do the same thing they were doing. You usually kept up with them that way and with reading their papers. You became good friends with your

competitors. Everybody always thought of them as friendly competitors, particularly in NACA days.

ROSS-NAZZAL: How much time would you spend down at one of the Laboratories when you would go?

BOYD: Two or three days. It took longer to get there, so you wouldn't just go for an overnight visit.

ROSS-NAZZAL: Would you take the train?

BOYD: No, I only took the train once. Our director here, who had been a pilot and had lost an eye during a crash, actually, promised his wife he'd never fly again, and he didn't. He took the train when he went to Washington [D.C.]. I generally would fly. The first flights I was on was like the old DC-7s, which were slow; it took you seven and a half hours to get across the country.

ROSS-NAZZAL: Were those Ames planes?

BOYD: No. No, no. We didn't have passenger planes. In fact, we've never basically had passenger planes that we owned. Most of them were research aircraft. We did have a few that could be utilized on occasion for passengers, but fundamentally we didn't have passenger planes, no. It was all commercial.

ROSS-NAZZAL: Did you have the chance to visit other non-NACA laborator[ies]?

BOYD: We'd go to the company labs, like Boeing's up north in Seattle [Washington], McDonnell in L.A. See, the West Coast had a tremendous number of aerospace labs. So I didn't go—Texas, occasionally; used to be a place called Chance Vought in Fort Worth, Texas. I went there. They were the ones who built the supersonic bomber that used our techniques, called the B-58 bomber. So we'd go there, but mostly it was the West Coast labs. But, as I said, in the early days, like the first ten years, you didn't do much traveling. Mostly people came to you to collect the data.

ROSS-NAZZAL: And when you went to these various laboratories, were you working on research, or what were you doing there?

BOYD: Working on research that was generally applicable to something they were thinking of building. For example, I moved from this wind tunnel after about a year and a half to a tunnel called the six-by-six-foot supersonic wind tunnel, which is no longer running, but is still here. That's when I got into looking at ways to improve the L over D, the lift-to-drag ratio, so one of the projects I worked on five or six years after I got here was something called conical camber. It was a technique to droop the wings and improve the lift-to-drag ratio. The industry was very interested in that, because they were in the process of building triangular wing fighters, like the 102 and the 106 and the B-58 bomber. Worked perfect on those airplanes. In fact, it was so good they had a field modification to the 106 and built the camber into it.

So we'd take that data—or they'd come and get it—to that company. From the wind tunnel tests we could prove that this is going to be a lot better for you. First you did the theory, fluid mechanics theory, then you built a model, tested it, as we did earlier, and bring it to the companies, and it was up to them whether they used it or not. Then the B-58 was the first full-fledged bomber that actually started out building its wing that way. That was probably one of the earliest and most satisfying things I did, to help in that shape, shaping, for the supersonic triangular wings.

Worked with a very bright man named Charlie [Charles F.] Hall, too, who was the Branch Chief in the six-by-six-foot wind tunnel and a good theoretician himself. As a matter of fact, you'll see his name pop up in Ames history later, because he became the Project Manager for the Pioneer Project, which was a very successful project. It was designed and built out of here, and the first manmade object to ever leave our solar system, as a matter of fact. Even though JPL doesn't like to hear that, it's true. It was launched in 1971, so that's kind of the way that went.

ROSS-NAZZAL: As you were working on this aeronautical research, what were some of the tools and equipment that you were using, besides models and wind tunnels, to do your research?

BOYD: Well, slide rules were very popular in the forties and fifties, because we didn't have big computers. We had IBM [International Business Machines] computers. As a matter of fact, in this very room there were about six ladies who sat at IBM computers reducing the data out of the wind tunnels. One thing we didn't do as young engineers, because the mechanics—we had a crew of mechanics that would run the wind tunnels and those who built the models, they

wouldn't let us build a model. Engineers weren't that smart. We could devise the theory. We could write it down on paper. We'd give them a design that we wanted to have built. So basically we used our minds and our slide rules, and the tunnels themselves were the facilities. We had small tunnels, small tunnels that went all the way from a foot in diameter to, finally, six by six feet in diameter, so the tools were really slide rules and a wind tunnel.

ROSS-NAZZAL: It's amazing what you can do with those tools. Nowadays people need computers and other types of equipment to do their jobs.

BOYD: Well, the advance in computers has permitted us to be able to solve the equations much more effectively and efficiently. We could always write the equations down, but we could not necessarily always get a final solution. We always saw the wind tunnels as an analogue computer. You could really put it in the wind tunnel and find out what the real answer was. The theory told you what we thought it should be, based on our understanding of fluid mechanics, but it wasn't always true.

There's a parameter called Reynolds number. If you don't test at the right Reynolds number in a wind tunnel, you probably aren't going to get the right answer. Reynolds number is a function of the density of the air and the temperature of the air and the size of the vehicle you're flying. So that was a wrestle. We wrestled with that. We still are wrestling with it. That's why we built the full-scale wind tunnel. These little wind tunnels over here, the one-by-three, couldn't even get close to full-scale Reynolds numbers, so you'd have to extrapolate.

We thought marrying a wind tunnel and computer, as it came along in the sixties, seventies, and eighties, was really the best of all, and now I think we use computers much more

than we use the wind tunnel to solve the equations. Every once in a while you've got to go in and get a good data point, though, and the wind tunnels do that.

ROSS-NAZZAL: You mentioned you worked with the aircraft industry. Did you also, in turn, work with the military on—

BOYD: Oh yes. You know, NACA was put together to support the military. In fact, these vehicles I'm talking about, the 102s, the 106s, the B-58s, were all military aircraft. The military came to us all the time. They were here every week, every month, getting as much data as fast as we could get it. Later on the Air Force built Wright Pat[erson Air Force Base, Ohio], but in those days it didn't have—Wright Pat came along a little bit later than that. So they needed the NACA wind tunnels.

Yes, I would say [Charles A.] Lindbergh, who went to Germany and got word about the German technology in aviation, was the one who came back in the late thirties and said, "You really need another Laboratory, not just Langley, for two reasons. One is Langley probably can't expand too much more, and two, you don't want to put all your eggs in one basket on the East Coast, which somebody might bomb or destroy. So you need another Laboratory to do these studies in aviation." So Lindbergh was responsible for selecting this site, actually, which, as I said, they established in 1939.

ROSS-NAZZAL: I understand from your biographical data sheet that you also worked on canard configuration.

BOYD: Yes, that was part of what we did in the—we looked at every possible shape, size, configuration we could think of. Canard is just the tail in front; instead of the tail being behind the wing, it's in front of the wing. It had some certain advantages on being able to trim the airplane, trim so it would fly stable. It had those advantages, we thought, so we tested those a lot. In fact, they were put into the B-70 bomber; it was a canard configuration. We only built two of them, but it was more efficient at supersonic speeds, at certain speeds, and it was somewhat more controllable. So we spent a lot of time looking at the tails at different locations. We'd move them behind the wing in different locations, and finally somebody thought, "Well, why not put them in front of the wing?" You've got a long lever arm, and that gives you more control power. If you flip it, it will give you more maneuverability.

That had certain problems of its own that were inherent in it, and that is anytime you've got a wing flying—in the canards, it's just a small wing; usually the canards are a lot smaller than the wing—behind it, you get a vortex from it. The vortex hits the wing and can cause instability or increased drag, so you had to place it very carefully. So, yes, we did that work probably for four or five years. Some airplanes were built with it. In fact, the French built a fighter with a canard, as did the Swedes, the Viggen, I think. The Viggen, Swedish airplane, is a canard configuration to this day.

Then, of course, we looked at flying wings. Mr. [John K. "Jack"] Northrop built the first flying wing, and if you look at some of the current things that are flying, they look a lot like his flying wing, like the Stealth vehicles. R. T. Jones himself got into the odd wings, flying wings. These were wings that tilted back behind the Mach cone to give more efficient flight at supersonic speeds. So we were looking at every imaginable combination of shapes. Airfoil shapes was important, too. Langley did much of the early work on shaping the airfoil. Anyway.

ROSS-NAZZAL: Did the number of people increase as you were working on this new project?

BOYD: Well, when I came in '47 here, Ames was fairly small, about maybe six, seven hundred people. It grew slowly, very slowly. The other Centers were big. Langley was always larger than we were in size, and Lewis actually became larger. But we grew very slowly, I would say, in the first ten years, maybe from six hundred to a thousand, and a little more slowly then in '58—well, earlier, mid-fifties.

Fifty-eight when NASA formed, we really took a jump, because we then not only had to manage research and development, we had to manage projects then. NACA never managed a project, per se. It was mostly just R&D [Research and Development]. But when we became NASA, we became the users of our own R&D, and we started out building things like the Merc[ury] and the Gemini and the Apollo. But most of the data for those shapes and what have you came from the early fifties in the wind tunnels at Langley and Ames and Lewis.

ROSS-NAZZAL: That's an important connection, I think.

BOYD: Yes. Yes.

ROSS-NAZZAL: I understand you were also working on planetary entry studies and hypervelocity ranges. What did that involve?

BOYD: Well, let's see. In the mid-fifties we began to think maybe someday we'll go out into the far blue yonder, and if we do, what are we going to fly? How are we going to bring it back into the atmosphere safely? Well, Harvey Allen, who I had mentioned before who developed the blunt body, said, "Well, it's going to be a blunt body, that's for sure. At least, it should be, because it dissipates the heat." So probably in the late [fifties], we thought, "Now, we're going to become NASA." We thought already in '57, "We're going to be a space agency here before we know it. We'd better start thinking of what we do other than airplanes."

So we had some ranges here that had been built to look at high-speed projectiles. They fire a model down it at free-flight. So I said, "Why don't we take one of these ranges and fill it with gases that are like Mars and Venus?" We knew they were some combination of CO₂ and nitrogen. Nobody knew quite then the exact compositions of those atmospheres. So we did the whole bit. We'd do 10 percent nitrogen, 90 percent carbon dioxide, and go all the way to the other extreme. And we started flying the models into the different atmospheres of Mars and Venus to see what the effect of the gas was. That was a worry we had. That's how I started doing some of the planetary entry probes.

So some of the early shapes, we tested every imaginable shape, blunt shapes, sharp shapes. Harvey said, "Don't worry about the sharp shapes, because they're going to burn up and they'll become blunt, anyway, so do blunt shapes."

I did that probably until about late fifties or early sixties, at which point—at which point—having been in the wind tunnels for fifteen years, they said, "Don't you want to come into the Administration Building and be an administrator of some kind?"

I said, "No, I don't really. But I'll come for a year, if you want me to."

“Okay.” Well, that was the end of my research career. Actually, the Center had a Director, then it had an Assistant Director for Aeronautics and one for Space. It would become NASA by now, so I went to work as a Tech Assistant [TA], they called them, for the Director of Aeronautics. I worked there for about four years, and then the guy from Astronautics, who I knew very well, and that was Harvey Allen, said, “Why don’t you come over and work for me?” So then I became the TA for Astronautics as well. But that was like in the early sixties, so NACA was gone.

ROSS-NAZZAL: When you were working on these planetary entry studies, were you doing any work in conjunction with PARD at Langley?

BOYD: Not much, no. We knew of their work, and Bob [Robert R.] Gilruth was running it at the time, as I recall. Some people here may have. I did not, no.

ROSS-NAZZAL: Who were some of the other people who were working on these studies with you?

BOYD: Well, people like Dave [David E.] Reese and Al [Alvin] Seiff. Harvey Allen, of course, guided us all. Vic [Victor L.] Peterson, who later became the Deputy Director here, worked on them. Another guy named [W.] Pat Peterson worked on the entry studies. Charlie Hall was my real mentor in doing some of the high-speed aerodynamics, which led to the conical camber work. And, of course, the ones I’ve mentioned before, Van Dyke and Vincenti and people like that who were here.

ROSS-NAZZAL: What do you think was the ultimate impact of your work on—

BOYD: Another guy, Murray Tobak, Murray Tobak. He came to the six-by-six about '48 or '49, and he was a dynamic stability guy, as opposed to pure static stability, which I tend to focus on. He was very helpful, and bright guy. He's still around, actually. He retired a couple of years ago, but it's another name. What was the next question?

ROSS-NAZZAL: What do you think has been the impact of your work on planetary probes?

BOYD: Well, I guess it helped shape some of the probes and determine that there really was some real gas effects—other gas effects, like carbon [dioxide] and [nitrogen]—on certain shapes, so you had to be fairly selective about the shape you used and design it properly, depending on what planetary atmosphere you were going in and what its composition was, if you knew it. We now know pretty much that Mars and Venus are made up mostly of carbon dioxide, which is a very heavy gas; with some nitrogen; very, very little oxygen, if any. So a heavy gas causes a flow field that would be different than, say, nitrogen, so you have to understand the complexity of the different gas mixtures. So I think helping to start understanding that, long before we sent probes out to the planets.

The ranges were great things to do this with, because you could get much higher speeds. See, the wind tunnels were limited to Mach numbers of about five, maybe ten. If you heated the air, you could get to ten. But these ranges could get velocities up to 15[000] or 20,000 miles per hour by firing the models, so you could get speeds approaching planetary entry speeds. Well,

you couldn't do that in the wind tunnels. You had to take the data and at the end, extrapolate as best you could. Now, each facility has its own disadvantages, but you use what you can and put them together. Al Seiff and Dave Reese were kind of precursors to working those range sort of problems, though.

ROSS-NAZZAL: While you were working at Ames, the Korean War began. What impact do you think that the Korean War had on Ames?

BOYD: What year was the Korean War?

ROSS-NAZZAL: I'm going to say '52, '53.

BOYD: It was fifty-something. Not noticeably. Not noticeably. A few people who were in the Reserves probably left. I know one I can recall. The Korean War really had not too much effect on the research we were doing, I don't think.

ROSS-NAZZAL: I've heard there was some discussion of perhaps inducting members of Ames back into the Navy. Do you recall those discussions?

BOYD: A little bit, but I never took that awfully seriously. It could have been more serious than I thought, since I was just an engineer. We didn't pay much attention to politics, actually, as we do now. Now we know. By reading *NASA Watch*, you know everything that's happening to everybody every day, every hour. But at my level, we didn't worry much about politics.

One thing about it, the Center had a Financial Management Office with two people in it, two people. The money came in, in the NACA days, and these two people managed the whole budget. Now we have, what, fifty people in the Financial Management Office, and you look at every detail. Engineers at my level never worried about money, ever. We just did what we needed to do. We built the models and tested them, and nobody ever talked to us about dollars. Now, this changed soon after NASA started, probably in the sixties. Then you had to really pay more attention to your budget, I think.

ROSS-NAZZAL: What do you think was the impact of the Cold War on NACA?

BOYD: A lot. Well, it drove us to do the whole manned missions, you know. I think without the Cold War, we probably would still be fooling around figuring out what we wanted to do. But the race was a—well, two things happened. The Russians started building these huge rockets for ICBMs [Intercontinental Ballistic Missiles]. Harvey Allen, in fact, his blunt body was first used for ICBMs, something that came back into the Earth's atmosphere, not necessarily having been away from the planet, just ICBMs did that; that's the way they flew.

So I think the Cold War drove this country and the development of NASA to go to the Moon. Without it, it would have taken us probably another twenty years, I suspect. We would have done it eventually, but—that's a big impact, and it changed our budget. It changed the focus of the research we were doing. Many of the research projects we had before '58 we kind of transformed over into focusing on spacecraft. But once you got the mission to go to the Moon that [John F.] Kennedy gave us in the early sixties, and it was to beat the Russians, pure and simple. So it transformed the whole agency, I think.

ROSS-NAZZAL: When you first started working out here at Ames, was there a dress code?

BOYD: Yes. You always wore a tie. Dr. [Smith J.] De France, he was the first director. He was the director for twenty-five years. You never knew when he was going to either drop by and see you or you'd be called up to see him, and he wanted coats and ties. So there was no—what do you call it?—Friday.

ROSS-NAZZAL: Oh, casual Fridays.

BOYD: Casual Friday or casual any day. I remember starting from bang, wearing a jacket and a tie. You were permitted to wear a sweater, as long as you wore a tie with it. So the dress code in the first ten or fifteen years, as I recall, was—there was never any debate. It didn't seem strict. It was just something you did.

The other reason for it, I think, in his view, was we had a lot of outside interface with company execs and engineers from other companies, and he just wanted the presentation to be right. I don't recall that the women—it seems to me I don't recall them wearing slacks in the early days, but I think that was typical wherever you were. It wasn't just here. Women wore dresses to work, I think, at least in the early days. The ladies that worked in here did.

It's interesting, too, though, talk about the engineers marrying their computers. There were a number of engineers who really married their computers. I mean, they met them here, they worked with them here, and they married them. I didn't happen to, but a number of my friends did, married the young ladies who were reducing the data for us.

ROSS-NAZZAL: Where did you meet your wife?

BOYD: I met her in Palo Alto [California], which is close by. I ordered some Christmas presents to send home to my family in Virginia. Came back a week later, and they arrived at my house in Palo Alto, and I went storming into this store. “These are Christmas presents that were supposed to be in Virginia. What do you mean sending them to my house here?”

And she happened to be the one I—she didn’t do it, but she happened to be the one at the counter. She worked in this clothing store. So after raising hell with her, I asked her to go sailing. And she did, and that was fifty-five years ago. Fifty-six years ago; we’ve been married fifty-five years.

ROSS-NAZZAL: Congratulations.

BOYD: That’s a long time.

ROSS-NAZZAL: It is. ... You’ve got a full house.

BOYD: Yes, and my birthday was just held last month. There were twenty of us in the picture, so almost everybody was here, but one or two of them were missing. It was fun. Yes, putting them up that week was an interesting chore. We used a neighbor’s house and a motel uptown in Saratoga [California]; our house. But it worked. It just cost about \$10,000 to feed them, I think.

Or a lot. Fortunately, they all cook. And we had the swimming pool, so the kids were all happy, so that worked well. ...

ROSS-NAZZAL: You mentioned that some of the engineers married their computers. Can you talk a little bit about social activities at the Laboratory while you worked for NACA?

BOYD: We didn't go out socially too much. I guess most of us had three or four friends that we would interface with and have dinners with, and then our kids started growing up together with each other.

One thing we did do, which I thought was fun. We'd have a Christmas party every Christmas, and this hangar down here, we'd put on a show in the hangar. For about two or three years, we had a barbershop quartet, and I was a member of it. But we put records on, and we mimed to the barbershop quartet. Nobody knew it for the first few times, and then they caught on. Santa Claus would come in in a helicopter. Can you believe us flying a helicopter into that hangar with Santa Claus now, with all the safety regulations? Every year we'd have something like that for the kids, and that went on probably for ten or fifteen years.

But offsite, there was not a lot of gathering of large gatherings. They were two or three at a time. As I say, you'd have two or three of your friends.

ROSS-NAZZAL: Did you have any yearly picnics that were sponsored by the Lab?

BOYD: There were picnics. I don't recall ever participating in them much. That was kind of spotty. Each branch or division would have a picnic, generally, not the whole Center. The only

thing I recall the whole Center doing together was the Christmas parties, and, of course, the conferences that we had were sort of a bringing together of the technical family.

ROSS-NAZZAL: Were you involved in any intramural sports?

BOYD: I wasn't. I never was good at sports. I liked to read and listen to music, and travel a little bit in those days. Now I'm tired of traveling. It's been so many, so long. But my wife hasn't gotten over traveling. She loves to do it. So I wasn't, no. I wasn't in sports. Even in high school, I wasn't in sports.

ROSS-NAZZAL: When you first arrived at Ames, how did you get around the Laboratory? It seems fairly large now. How were you able to get around?

BOYD: Walk. Just walk. It's not all that big. I still walk. It's grown a fair amount, some of the outer forty, but you could walk from one place to the other in ten minutes, no problem. Cafeteria used to be over under the auditorium, not here, so that's where people would gather from the outlying branches and buildings for lunch every day, and breakfast. The walking was no problem. A number of branches would keep two or three bicycles around, so some people used bicycles.

ROSS-NAZZAL: Let's talk about the transition from NACA to NASA.

BOYD: Actually, it was pretty painless, I think, from the standpoint of the engineers working. I was still in the engineering community in '58. I didn't get up to the Ad Building till '61 or '[6]2. So we didn't notice much. We were doing our wind tunnel studies. We started looking at different configurations than just supersonic airplanes. We started looking at spacecraft types of configurations. There still wasn't any noticeable money problems, that we noticed, at least. If you had an idea about something you wanted to try, you would propose it to the front office, and almost invariably it was approved. Not until after a number of discussions were held. Most of the management here were very bright technical people who had come up through the ranks, anyway, like Allen and [Russell G.] Robinson and those folks, so you couldn't fool them, and you didn't even try.

But it was probably the mid-sixties when we first started seeing the real effects of the financial management, the activities that you had to go through. Lots of money still available. Mr. [James E.] Webb got, I think, money thrown at him after Kennedy said, "Let's go to the Moon by the end of the decade." All sorts of money going on until the mid-seventies. Mid-seventies, after we'd done the Apollo, then people would say, "Well, you've done that. What else are you going to do?" I think they were less interested in throwing money at us, and the budget started to shrink somewhat. Then we got the idea of the Space Station and the Space Shuttle. And the budget grew recently, but nothing like it did in the sixties with Apollo—well, Mercury, Gemini, and Apollo.

ROSS-NAZZAL: What impact do you think that the Ames Aeronautical Laboratory had on the surrounding area?

BOYD: At a lot of the universities, the surrounding technical community knew we were here, and they would come to us for advice on their things, but remember, the universities trained people that came to us, and we would send people back to them as professors. In fact, a number of people in this very branch went to Stanford to be professors. The companies that were more interested around here, they grew up in a different—there weren't any aircraft companies around here, remember.

What started was the computer revolution, if you will, and of course, we needed and used computers, so they were less interested in what we did than what we used of theirs to do what we did. So the Hewlett-Packards and people like that, we knew and transmitted information, but not nearly, not nearly so much as we did with the aircraft companies. We were users of their equipments, the big computers and what have you, and we started building big computers with their help.

The ILLIAC computer was the first processing computer, and we got that in the early seventies. That started a computer revolution for us, because we'd always needed big computers to do calculations, flow field calculations, and this just stirred that on. When Hans Mark came here in '69, who was a professor of nuclear physics from [the University of California] Berkeley [Berkeley, California], as the third Director of Ames, he brought the whole concept of we can use these big computers to really do much more detailed computational fluid analysis, and we did, and started building them. So that's what happened industry-wise here, I think. It was more in that field.

Now it's in nanotechnology and intelligent systems and things that we still interface with, and we just signed this big deal with Google, which should be huge, I think, in the next two or three years. But that's the kind of thing we do. We need their wherewithal and their computer

expert to apply to what we want to do, whether it be a nanotech or modeling the foam that fell off the Space Shuttle. We did that on the big Columbia computer here, which is the third fastest computer in the world, actually. It was the first for a few months, then somebody went ahead of us.

ROSS-NAZZAL: While you were conducting your aviation research, did you do any work with the universities themselves?

BOYD: Mostly I took courses at the universities. We did some research grants. You're given a university grant, and it's kind of open-ended. You do what you want to, but in this field. So we had a few grants from Stanford and Caltech and places like that, but most of my interface with the universities was actually going back to learn. I went to the Stanford Sloan Program in '65, which was an attempt to train engineers with some business sense, because none of us had any. Since that time, I think we've sent about eighteen people to the Stanford Sloan, and MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts] has a similar program of business. We focused on Stanford, I think.

ROSS-NAZZAL: And how long was that program?

BOYD: It's a year. It's a year long. You come out with an M.B.A. [Masters in Business Administration] of some kind in business.

ROSS-NAZZAL: If you had to look back over your career with NACA and pick one program or project that you thought was your most significant accomplishment, what do you think that would be?

BOYD: It would probably be a toss-up between the conical camber research that I did and the early planetary entry studies. It's probably a toss-up between those two. One was aero oriented and one was space oriented, and they were both equally exciting in their time.

ROSS-NAZZAL: What do you think was your biggest challenge while you were working for NACA?

BOYD: NACA? Working around people who were much, much more brilliant than I was. It was fortunate, in a sense, because I learned a lot. But just to come in to work in the same office, the same building, with people like R. T. Jones and Harvey Allen and those folks, Dean Chapman, it was a real challenge. You always felt a little intimidated, and then when the outside ones came in, as I said, like von Karman, Lippman [phonetic], and Puckett [phonetic], who are famous names in the aviation world still, written books about the subject, that's intimidating. I think that was my biggest challenge. It still is sometimes, but now I've gotten smart enough to know that I can tell them things they don't know, too. Like von Karman said, "You know more about this subject than I do, even though I'm more brilliant than you are." He didn't quite say that.

ROSS-NAZZAL: When you first arrived, what sort of advice did R. T. Jones give to you as a young fledgling engineer?

BOYD: He said, “Read. Read everything you can read about aerodynamics, about everybody.” He knew people; he even knew [Ludwig] Prandtl, who was another famous German aerodynamicist, and Max [M.] Munk, who trained him, another famous aerodynamicist at Langley. He said, “Just attach yourself to these people and learn from them.” So we did.

ROSS-NAZZAL: Can you give us a sense of how Ames has changed since '47 until today?

BOYD: Yes, it's quite a remarkable change. We started out as a low-speed—low-speed/high-speed, I'll say; forty-by-eighty is a subsonic wind tunnel. We built one-by-three, six-by-six, supersonic wind tunnels. We started out looking at the characteristics of vehicles flying at hundreds of miles an hour, evolved to vehicles flying thousands of miles an hour, evolved to vehicles like the Shuttle and Mercury, Gemini, to twenty-five thousand miles an hour as it comes back into the Earth's atmosphere. So imagine, from a hundred miles an hour to twenty-five thousand miles an hour, the amount of data you need to collect, the amount of theory you need to work on, and the amount of physics, understanding of the physics of flow fields. It's a huge, huge—now, that's one regime, but Ames has been remarkable in another way.

It's gotten into probably I think about five or six different theme lines. One is aerothermodynamics, I just mentioned. One is flight research. We did flight research on every plane the Air Force ever built. We did research on air traffic control, air traffic management to make flying more safely, that's another theme. We did work on astrobiology, the detection of

life on other planets. We've done work, or expanding the work, on nanotechnology and on intelligent systems, which is computer-based research.

The other one we haven't talked about at all. We started the early simulators here that you can simulate different flying qualities, and we still have some of those running. So we've got about six or eight different theme lines that have been a part of this Center, and now some of them still are, and they're standing us in good stead. Most of these things I just mentioned we started back in the forties, fifties, and sixties, and half a dozen of them are still going. The nanotech, the astrobiology, the flight management systems are still going.

So it's changed an enormous amount, and from a group of six hundred people to at one time we had twenty-two hundred civil servants and three thousand contractors, so it went from like six hundred to five thousand. Now we're back down to around three thousand people. Moneywise, we started out with probably a budget, when I was here, of 60 [million] or \$70 million a year, and now we're \$700 million a year. So all these things are just indicative of not only the times, but the changing philosophy and the kind of research you do. And if you don't change, you're going to die.

That's one of the struggles we're having right now, which I think we'll succeed in. I had a comment made by a couple of people at the NACA Reunion dinner the other night that, "You guys at least look like you're really changing a lot in the last ten years, transforming yourselves. We,"—and I won't mention the Center—he said, "We, on the other hand, have just been trying to get our politicians to bail us out." That's not going to work for very long.

ROSS-NAZZAL: You've given me a sense of your post-NACA career up through about the late sixties. What else did you do for NASA?

BOYD: Well, let's see. Sixties, where were we? Well, in the late seventies they asked me to go to Dryden [Flight Research Center, Edwards, California] to be the Deputy Director at Dryden Flight Research Center. They had a Director there who was very good, but he didn't have an awful lot of aeronautic experience, and so I went down and spent some time at Dryden as the Deputy Director, which was fun, because it was the era when the Shuttle was landing there, so you get to entertain all sorts of people, like Christopher Reeve.

I will never forget Christopher Reeve. He had just made *Superman*, and he came to the Center off and on just to see people. One of the flights, I think it was the one that President [Ronald W.] Reagan was coming to. There was a lot of security, so you could only get in if you had proper credentials. Well, Christopher came down to see the landing, and the guard called me at the gate and said, "There's a man here who claims to be Christopher Reeve, and he can't get in. He wants you to verify that this indeed is he," because they will put him on the line.

It was Christopher Reeve, and I said, "Christopher, why are you worrying about fooling around the gate? Why don't you just jump over the fence?" And he didn't like that. He didn't find that funny at all.

But I did that, and then I came back to Ames briefly, and about that time Hans Mark went to [NASA] Headquarters [Washington, D.C.] as the Deputy Administrator, and they needed somebody there as Associate Administrator [AA] from—and management. Since I'd been in the management world here for a while, I went back to Headquarters to be the AA for management with Hans and [James M.] Beggs for a couple of years. Then I came back. Then worked here for a while, and then about in the mid-eighties said, "It's time to retire. It's been forty years."

About that time, Hans said, “Why don’t you come to Texas? I’m going to be the new Chancellor of this whole system down here, and I need some help.” So I went down there for about eight years. Had a great time. It was during the period when Ann Richards was Governor, and she was a kick to know, anyway. ...

[We also met a pilot and his son along the way—John Deutshendorf.] He changed his name to John Denver. So after that we became really good friends with John, who loved to fly, and he wanted to fly on the Space Station, as you probably know, but he got killed.

Now I got off track. What was I talking about?

ROSS-NAZZAL: You were talking about being in Texas.

BOYD: Oh, being in Texas as the Chancellor for Research. We spent eight years there. There are fifteen campuses in that university, so in the process of doing the job that Hans wanted me to do, to get research money into the system—which we succeeded in increasing the budget from about 350 million to 700 [million] in that eight-year period, for research for all the campuses. But, you know, that stuff got a little tiring, so I decided to teach at three of the campuses.

So I taught at UT [University of Texas] Austin [Austin, Texas] and UT El Paso [El Paso, Texas] and UT Pan American [Edinburg, Texas], which is a little campus right down at the tip of Texas on the Mexican border. I taught aeronautics and the history of aerospace. Hans and I both taught the history of aerospace. But anyway, so I was an Adjunct Professor at those three places, and that was fun. The kids were great. Austin kids were the most sophisticated, but the other two campuses were the most fun to teach. Usually it was the first generation in college, and during that time I would invite my Mexican son to come down and lecture for me. Everybody

thought that was great, because I would say half the population of El Paso was Hispanic. So that was fun, and that worked great.

Then I came back here in '92 to be the—I came back to help with the Education Program. We started this little Aerospace Encounter. We got a six-by-six-foot wind tunnel, which I used to work in, as an education site for students, for kids, fourth-, fifth-, and sixth-grade kids, and then we got a Director here who said, “Why don’t you come and help me? You know a lot about the Center.” So this is a guy named [Henry] McDonald, and I went up to be his exec for a while. Okay, then he left, and [G.] Scott Hubbard, who’s now the Director, said, “Why don’t you stay?”

I said, “I’d really like to do something different. I’ve been the exec.”

He said, “Well, we’re going to need a historian.” This was a year and a half ago. “Why don’t you become the NASA Historian, and you can make up what you don’t know?” Then shortly after that he asked me to be the Ombudsperson as well, and now I’m back on his Executive Council, so I’m doing sort of three pieces. And I’m eighty years old, and I ain’t going to last much longer, not working three jobs, anyway.

ROSS-NAZZAL: Sounds like you’ve had a long and varied career.

BOYD: And it’s been fun.

ROSS-NAZZAL: What do you think has been your most significant accomplishment while working for NASA?

BOYD: While working for NASA, that would have been in the sixties, starting in the sixties. I'm not sure I did much. I did mostly management. It's hard to define a management—I guess the most enjoyable thing, and probably the most useful thing, is I get along with people well, so I enjoyed working with people, and I could generally persuade them to do things they sometimes didn't want to do. Most of them have turned out, they've come back and said, "Gee, I'm really glad I did that." So I think mostly in the personnel relationship with NASA, because I'd done all the technical stuff, actually, before that.

Getting people hooked up together. I enjoy getting the right people hooked up, at whatever Center they may be, to pursue a project or a program. I did the same thing in Texas, to a large degree, but I was called the Chancellor for Research, but that's not the only thing we focused on, because that was a good opportunity to teach and interface with students.

ROSS-NAZZAL: What do you think was your biggest challenge while working in management?

BOYD: I think doing just what I said, trying to get people to go along a path you'd like to see them go for the benefit of both them and the agency. It's always tough. They have their own idea of what they want to do, and sometimes they may be right. But you've got an objective, they've got an objective, and to make them meet somehow is the best of all possible worlds, so I think that's it.

ROSS-NAZZAL: I just had one additional question. You had mentioned John Denver. Was there anyone, other famous people, who came while you were working at NACA?

BOYD: Yes, in fact, I was looking for pictures, and my college reunion, which was the fiftieth—sixtieth, asked me the same question, and the photo, I made a collage of eight pictures. I'll see if I can find it. You might be interested. But it has, yes, John Denver, William Shatner—

ROSS-NAZZAL: Captain Kirk.

BOYD: Captain Kirk. President Bush, who I knew in Texas, some, because he liked football. We had free tickets. But he's come by a few times and we've gotten together. Chuck Yeager was an ornery fellow, but it was kind of interesting to get to know him.

Two of the most delightful people I met was Prince Andrew came by, because some years ago, not too long, four or five years ago, he was a helicopter pilot, and he had heard we had simulators out here. So he came to fly the simulators and spent a whole day with us. People were saying, you know, "This is a royal blood, so you're not supposed to touch or speak to him unless he speaks to you first."

He got out of the car and came up and gave me a hug. I said, "I guess he's a pretty normal person."

Then he sent over a buddy of his, Willem-Alexander [Claus George Ferdinand], who is the [crown] prince in Holland. He's going to be the next king, as a matter of fact. A year later, this fellow came over and flew the simulators. It's interesting. With him, though, I've only had one other piece of correspondence with Andrew, but this kid—kid! He's forty years old—he writes back and forth. He got married, and he sent me a picture of his wedding. He invited us to the wedding. And he sent me a picture of his baby girl. I sent him a NASA sleeper. Now he's sending me another thing saying, "Well, I'm having another baby. What are you going to get?"

So those kind of people have been fun. But they just come along with—Shirley Temple was another interesting lady. She came out to visit on an educational program, too, and I told her that—I had my wife come out, too. I told her that I married my wife because her smile reminded me of her, and when she was seventeen and I was a cadet back in Virginia, I invited her to a dance. I told her all this, and she said, “Well, I’m sorry it took so long to accept the invitation, but here I am.” This was like three or four years ago. Delightful lady, very bright. I was amazed. I didn’t expect her to be bright, I guess. But she is an ambassador to two different countries, apparently. Ghana—

ROSS-NAZZAL: She was an ambassador to the U.N. [United Nations], as well.

BOYD: Ghana, and she was a protocol person, I think, at the U.N., wasn’t she? And Czechoslovakia and Ghana, and she learned both those languages before she went over there, which I thought was kind of remarkable. Anyway, so we went to lunch. She’s got a good sense of humor. We went out to lunch, had crab cakes at a local place. She said, “These are very good crab cakes, but mine are better.”

I said, “Well, how about sending us the recipe?”

She said, “I don’t share my recipes with people.” About a week later, I got her recipe for crab cakes, which is very good, as a matter of fact.

So it’s a diverse group of people that you meet, in addition, of course, to the normal astronauts, who, in themselves, are famous, Neil [A.] Armstrong. But we knew Neil before he became an astronaut. He was a pilot at Dryden. Always very quiet and to himself; still is, I guess. John [H.] Glenn [Jr.]. He’s come by several times recently, as a matter of fact. Anyway,

I put this collage together and sent it to my sixtieth reunion, and they're going to put it in a tomb or something, and I got a note back from the lady. She said, "We expected you to have one. We didn't expect you to have ten, but we're going to keep this copy and put it up in the school." Okay?

ROSS-NAZZAL: That's great.

BOYD: My kids had the advantage of meeting a lot of these people, too, which they loved, particularly the astronauts who would come by.

ROSS-NAZZAL: How exciting.

BOYD: We knew one of the astronauts you might know. Did you know Al [Alfred M.] Worden? He was Apollo 15.

ROSS-NAZZAL: No.

BOYD: He worked here for three or four years after the mission, and he married a young lady from Spain who was a bullfighter, and the headline around here was "Astronaut and Bullfighter Wed." They had a big party for them. But she really was apparently the second-ranked bullfighter in Spain at the time. ...

ROSS-NAZZAL: Now, I know you made some notes. Is there anything that we might have overlooked or something that you'd like to talk about?

BOYD: Yes. My wife of fifty-five years, who stuck with this the whole time, having kids while I traveled, sending five kids to college with not much money. How she did it, I don't know. And now that the kids are all finished and they come back home, she's having her fun traveling. She loves to travel, and I'm tired of it. I do go to Hawaii with her. I like to go to Hawaii.

I don't think we've missed much.

ROSS-NAZZAL: All right. Well, I thank you very much for your time today. I very much enjoyed it.

BOYD: Okay.

[End of interview]