

**Oral History Interview of
Albert Sacco**

**Interviewed by: David Marshall
October 24, 2017
Lubbock, Texas**

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Transcript Overview:

This interview features Albert Sacco, an astronaut who flew on the Columbia mission STS-73. In this interview, Sacco discusses the influences in his life that led him to pursue a degree in engineering, and later how he was accepted into NASA. Sacco also describes his experience in orbit and the experiments that he conducted while on his space mission.

Length of Interview: 01:07:34

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David Marshall (DM):

The date is October 24, of 2017 and this David Marshall interviewing Al Sacco at his office at Texas Tech University Lubbock, Texas. So let's just begin with your date and place of birth first of all.

Albert Sacco (AS):

Okay. I was born in Boston, Massachusetts to a dad that was from a small village outside Naples, with a ninth grade education, he came to Boston and he met a young lady from County Cork Island. She was also an immigrant with a tenth grade education, and they met in Boston and that's where I was born along with three of my other siblings. I have a brother—I'm the youngest, a brother and two older sisters.

DM:

Okay, well considering that they didn't have a higher education, were they very interested in you perusing that?

AS:

Yeah, that was—I mean I came from an immigrant family and that the whole idea was to come to America and get your kids educated. So, education was a big part of everything that we did. All my brothers and sisters are educated; my brother is an engineer as well. Electrical engineer, was the Vice President of Raytheon Corporation. My sister, one was a teacher and one was a nurse.

DM:

Okay, okay. It seems like apparently that's still pretty important to you, this children perusing an education because you made a lot of public school presentations.

AS:

Yeah, I do. I've made— well, I stopped counting after about forty-seven thousand but I used to count, not forty-seven thousand presentations but forty-seven thousand kids that want to know the outreach. But I stop counting after a while because it got kind of ridiculous but I give probably anywhere between half dozen and a dozen and a half presentations, around the world actually, every year. This year, for example, I'll be giving them in Chicago. I always go to the inner city in Chicago and talk to inner city kids because that's where I grew up, in an inner city, so I know what they're facing. It hasn't changed that much from when I was younger. You need someone to inspire you and in my case it was my parents, but my older brother was my inspiration. So, you need someone to inspire you. So when I go in and I talk about space flight but from the human perspective. What does it feel like? What do you do? What are the thoughts that go through your head? Why would you take a risk like that? You know, all that kind of stuff. Hopefully inspire some of them and then after that I was invited to Tulane to talk to inner city

kids down there in New Orleans, and then after that I'm supposed to go to Brazil to talk to a bunch of kids in Brazil, and then after that I think Thailand and a couple other places. So, I get invited and I go and I change it a little bit. Most space flights because we're always looking at the change in the environment, really and the change in the continents and show things shift so we always take a lot of photographs from space. So, every space flight that I was associated with took about ten thousand earth ops photographs. So we have— my point is we have photographs of every place in the world, so where ever I go, I pull the photographs from my flight so they can see what their cities look like during the day and during the night. What their country looks like.

DM:

That in itself must really be inspiring.

AS:

It is and they get to see it.

DM:

Wow, here we are.

AS:

Yeah. Often times, more often than not we take so many photographs that I can get the exact city that I'm in because I'm usually in a big city like San Palo or Rio de Janeiro. We always have plenty of pictures of those so I can always pull the city that they're in. Often times even if it's a small city I can pull it because if I don't get it from my flight, I get it from someone else's. So, we mix and match them. It's interesting and the other thing I often do is show them how the oceans have changed. You can see the coral development and how it's being poisoned off over time and talk about— when you see it with your eyes it means a lot more than people talking about it. You know, we've tracked it since the sixties really, so this is what they saw then, this is what we see now and people just go, Wow. You know, and we used to be able track whale pods going through, that's very difficult now because there's not as many as there used to be, all sorts of things.

DM:

What about polar ice?

AS:

Yeah, you can see it's just shrinking and all of that stuff. [Throat clearing] You know, the world's changing whether people want to own up to it or not, it's changing in a big way. You can argue about whether we did it, which I happen to think we did, or you can argue about that that's the natural evolution of things but either way we got to deal with it, and it's becoming serious. I mean you start this year with the hurricanes that hit. There's just a lot of that stuff going on and

you see it from space very, very clearly. You see the shift and what's going on, and as the planet changes over time.

DM:

I'm going to jump back a little bit early here and ask you about some childhood influences that might have directed you, especially toward engineering and your specific fields of engineering.

AS:

Sure.

DM:

Also, maybe toward an interest in space flight or if that was all wrapped up with your engineering interest.

AS:

Yeah, actually I was like many kids I guess, I used to love watching TV serials and at the time they were a lot about space, and exploring space, and the excitement of space. That's really what got me into thinking about space, and I was a big Star Trek fan even in high school. I guess I was in high school, junior in high school I guess then when Star Trek came on. Maybe my early years, junior high school maybe eighth and ninth grade, but it excited me because just the thrill of going and meeting other people and planets and all that kind of stuff. I was always interested in science but primarily through my brother's influence, because my math was—he was really good in math, my math was not as good. I really worked at it, I worked at it really hard, and my parents, like I said, even though my dad only had a ninth grade education he was brilliant with numbers. It was just a gift he had with numbers, so he could always help with the math at least through high school. My mother was an avid reader so she was a very good speller and very good at punctuation even though she only had a tenth grade education. She would make us read all the time and I got to the point that I read book after book after book, all sorts of books and that's how I learned. Basically, they—my brother was the one that got me most interested in engineering because I looked up to him. We hung out, even though he's ten years older than me we hung out together all the time. He would show me how to do things, he was very good with his hands, I quite honestly wasn't when I was younger and I wasn't that interested. So of all the things you say, this guy is going to be an engineer. I didn't have any of those things but I caught the bug as they say and I started building my own cars because everybody wanted a car and today you go buy one, right? In my day you went to a junk yard, and we pulled the chassis out of one old car that had been beaten up, an engine out of another, a carburetor out of another, and we'd work with the older kids and they'd help us figure out how to put it together. We'd learn a lot of things that kids don't learn today and one of the things I'm trying to do with the college is change, what I call going back to the future because I learned a lot about the practicality of engineering. That is—what I mean by that is what you can do versus what you can calculate.

You can calculate everything, but what you can actually do physically is much different and there's no better way to learn that than actually do it because all of a sudden you make calculations, and say, "Well this should— this part should fit," but then you don't realize certain temperatures, things expand differently and it doesn't quite fit the same way. Anyway, so I built my own car, built my own airplane that I flew and almost killed myself with.

DM:

How old were you when you did that?

AS:

When I built the car, I was— at the time in Massachusetts, you could get a learners permit at thirteen and a half. So, I built my first car when I was fourteen. The first airplane when I was sixteen and that was a one-time shot at the airplane thing, I almost killed myself but I got up off the ground, we flew around for a little bit, and thank God I did it near the beach. My parents had a small beach place down in Hull, Massachusetts. I built it down there out of an old lawn mower motor and it would now be called lighter than air aircraft kind of thing. I built it and ended up crashing, but I crashed into the water and I was a real good swimmer so I could get out of it and all that kind of stuff. I was really good at swimming so it wasn't a big deal, but that was the end of my flying days until later on. The bottom line is, yeah so I did that, but all those things taught me and got me excited about what you could do with engineering, and in the end made me a pretty good engineer. I decided I was going to be a nuclear physicist because I thought that was really cool, atoms and I won a science prize for that kind of stuff, but when I went to school I realize that the math with nuclear physics, and math was always my struggle, was much harder than I expected. So I switched into what I thought would be similar to nuclear physics. Which of course, it wasn't, which is chemical engineering. I figured okay I won't deal with atoms, but I'll deal with molecules, so it's one step up. At first I hated it, I'll be honest I went through and I said, "Oh this is terrible, this is just boring," then I get some inspiration from my teacher. Now the whole time my brother was inspiring me, "Listen you're good at this stuff, you're really good at fixing things, you're really— you have imagination, you have vision, you'll be a great engineer someday." He was always pushing me because I hated electrical engineering, which is what he was. He used to have me wire— we used to have to wire things in the house and all that kind of stuff and that's when you could do it, you didn't have to worry about all the legal stuff. So, we wired everything, and I hated it because I was always the one crawling through the walls in these old tenement houses in the inner city. And of course, he'd make sure—it was a big joke of his to get a high voltage line so you cut into it so you get a big zap but it can't hurt you. And I'd vibrate between the walls. Also, there were a lot of rats because we lived in the north end, which was right on the harbor side. So, when I went through the walls sometimes I met creatures that you didn't want to meet, so I hated electrical engineering. I thought that was electrical engineering, which is more like an electrician now but at the time I said I'll never do this again. I ended up going into chemistry, I ended up loving it. Then I get into material science, and so the

rest is history as they say. It wasn't an easy journey for me, I worked hard but the one thing that my parents insisted on me, with me and they used to say it all the time is, "Never let your fears get in the way of your dreams." And what they meant is you need to be self-confident because a lot of people are going to try to put doubts in your mind. You're going to have your own personal doubts and you just can't let your fears overcome what your ambition is. That's suited me well through my entire career and my brothers and sisters, I may add.

DM:

Well, this mishap in the airplane, it's kind of interesting that later on you were willing to fly in space. I think that would scar some people.

AS:

It would but the truth of the matter is I'm very comfortable with risk, and I don't know why that is but I am very comfortable with risk. I don't take—I take informed risks; I don't take stupid risks, but like a kid I used to do all sorts of crazy things like build your own airplane. I was the kid that used to climb the tallest tree when they wanted it trimmed to get up there with a saw, I'd go up seventy feet up in a tree and cut the branches off. Half the time not knowing what I'm doing, I'm lucky I didn't get killed a couple times. I did fall but I was always a pretty—I was lucky, I would land the right way and it never really bothered me very much. So, I'm very comfortable with risk. Which by the way sometimes freaks out the people here because I took a lot of risks with the college because if you're going to be really—I believe without great risk, there's not great reward. So we have to take risks because we are in a position we're trying to become globally elite, and the way you do that is you take risks, informed risks and then you have to be nimble. What I mean by that is if you make a mistake, you own up to it and you just change direction. A lot of academics in my experience, and I've been in academics a lot of years, is that the ones that take a risk will then die on their sword, they're going to prove they were right as opposed to saying, "Hmm, this doesn't look like it's not going to work we better shift into something else." I'm not afraid of doing that, I just jump one thing to the other. I mean, not helter skelter but I give it some time and if it's not working, even if I think it should I just say, "Well it's not working we're going to have to try something else," and I shift.

DM:

Okay. How was your public school preparation?

AS:

It was great. I mean, I had some great teachers in public schools and they were all really good, they were dedicated to kids. You know, I played sports all through high school and elementary school and all that stuff. I was always encouraged; I was in the Boy Scouts. All the sort of standard things that I think that kids do. I wonder sometimes, I mean I don't know about all the things you hear today about girls fighting, we never had that so I don't know how that

developed. We had a lot of dedicated teachers, class sizes were pretty small where I was, it was about twenty kids in a class, twenty-two kids in a class. They were all immigrants. That was part of it because my census, I didn't realize at the time because I was one too, a first genner as they call us now, but we were all instilled with the work ethic and the other thing is our parents backed up the teacher. So if a teacher came and whacked me in the head and I went home crying, my mother'd say, "You probably deserve another one," and hit me again. Same with the police, if the police told us something and I remember one time leaning on one of the meters, just leaning with my back on it not thinking anything of it and this police officer apparently took offence at that because an older woman was trying to pull in and put money in and I didn't know. I was just laying on it and he kicked me and knocked me right on my face, it really hurt and I went home and I said, "Geez I got kicked, I got a bruise," and my dad said, "He should've kicked you again. What are you doing that for?" So it was a different time and somehow we all worked out pretty good, I didn't feel like I did some of the things that kids do today. Sometimes I think we treat them too easily today but the bottom line is I had a great bringing up, I had great elementary school teachers, I had great junior high school teachers, I had great high school teachers. I remember all of them, and I had great college teachers. I've been very blessed. I mean with very few exceptions; they were there when I needed them. I was a shy kid, I didn't like to ask questions because I always felt like they think I'm stupid if I do that, but I got to the point when I did get to know people, they were more than willing to give up their time, and they always did and they were always there. You know, and my parents were great, my dad worked all the time and it seems like he was always away, but he was always—he'd wake us up when he came in sometime two o'clock in the morning just to say hello and talk to us for a minute. My mother used to go crazy, "What're you waking them up for?" But he did it all the time and she was a stay at home mom, like I said neither one of them had an education but they worked really hard. and they taught me a lot of values.

DM:

So, good parental support, good public school education.

AS:

Yeah, my public school education was great. I mean I can't—it was awesome, I learned a lot. It was great.

DM:

Can you single out a teacher or two that had a particular influence or is it too general?

AS:

Well, no I had a lot of them. I mean, the thing is Mrs. Weeks was great, she was my sixth grade teacher. I remember she had silver hair, I'd never seen such silver hair before, but she was just a great lady, she was always there. Mrs. Igo is my fourth grade teacher, I remember her. To me she

was the most beautiful thing in the world, she must have been about twenty-eight at the time, to me she was an older woman but she was just beautiful. She was always there for me, I had trouble reading at first so she would always come and spend extra time with me, she was great. Then Mr. Stevens, he was a gym teacher but also taught math when I was in junior high school. Mr. Russel was my physics teacher, I struggled with physics because of the math thing again. I ended up, by the way, being very good at math, but it took me until probably graduate school at which point it all came together and made sense. Suddenly I was really, really good at math and very abstract math as well, but it took all those years to develop it. I just didn't quit, but I used to get so mad that I couldn't get it and other people could. I just had, I mean I can name chapter and verse all the teachers that I've had and what subjects they taught me. But the other thing is I just felt—the teachers made me feel like I was a person and that they cared about me, so I never felt that education where you just go in and you listen and you're bored. They were always there to help and always around. You know, we're all from the inner city, we're all the same. The teachers most of the time weren't, they were from what we call upper class neighborhoods. Neighborhoods that we usually didn't go in, but none of them lived with us. They didn't live in the inner city like we did but they came in everyday, they were there all the time, and they were very well respected. That's the other thing, I remember even though they weren't paid well, I realized that afterwards, I didn't realize that at the time, that everybody in the neighborhood would give them things and all sorts of stuff because they were taking care of the kids. So it was a profession that even though you didn't get monetary reward, you got an enormous amount of respect and dignity from the neighborhood that they were in. Again, and Boston at the time, it was all neighborhoods, there was the Italian neighborhood, the Irish neighborhood, Vietnamese neighborhood, the Lithuanians, they had their own neighborhood. There was all sorts of people and there was, you know, we all sort of knew each other, we always competed in sports and all that stuff. The Italians against the Irish and then, of course, since I came from a mix, what they thought was mixed family at the time, it was always kind of interesting which side would line up with which side, but it was fun. I have no complaints, I had a great bringing up. We didn't have a lot but we had clean clothes and enough food to eat so it was good.

DM:

When you were about ten years old, Sputnik went up. Not long after, a couple of years later Kennedy made his speech and launched the program. Do you remember those things?

AS:

I remember exactly, the beep beep of Sputnik going around and the fear factor. Although I didn't realize what it was at the time, but everybody was anxious, the Russians were way ahead of us. They were going to put arms in space, they were going to put rockets on the moon, do all sorts of stuff. Then I was reading a lot of books that were coming out at the time about UFOs and about building a space station in space. And of course they had the old Flash Gordon movies and that was way before my time but I watched those and then they had all sorts of the Mysterion movies

and all sorts of things about aliens and space and I just got the bug. Of course, who wouldn't? It stimulates the imagination. Even today, every time a Star Wars movie comes out, it jams in because it's just— you know, people still have an imagination, we kind of beat it out of them sometimes. But that's one of the problems we have in college today in my estimation, is when I was going through elementary and high school, they encouraged innovation because they let you sort of think about things. I can remember for hours playing, we never had video games, obviously, but never had real toys either. I mean, we had to make our own swords or make our own cars to do with. We had to make it so we became very innovative. Now we didn't do it trying to be innovative, we did it because that's all we had available. Everybody was like that so I didn't feel, I never felt that, Oh geez, look he's got all of this, I've got none of that. We were all the same and even the people that were more wealthy didn't have toys, you had, you know, it was all about imagination. I remember get an old, you know, thinking about flying a plane, getting an old pillow and putting strings around it like it was a parachute. Put it on you back and all sorts of stuff and playing that kind of stuff. So we had a lot of imagination, and we were innocent in a sense that you look at some of those movies now and you say, "Oh how could I have believed that," but the bottom line is it wasn't the imagery, it was the story in your imagination that took you where you wanted to go. It wasn't so much what it looked like, now it's all about special effects so people judge the special effects, the stories are pretty marginal in my estimation. So your imagination is taken away from you, but when I was a kid it wasn't like that at all. Ten years old, yeah Sputnik and then Kennedy who I thought was just the world's greatest guy, and I loved to listen to him talk. I mean he was just such a speaker. Of course, it was not like it's been the last twenty years where you cut up every politician in the world. I mean I remember people thinking he was catholic, which I was, and people saying oh the Pope is going to tell him what to do. I said, that sounds kind of weird, so the mis— they were misconceptions back there too. I knew the Kennedy family because my dad at the time owned a small restaurant and they used to come in. So, I met Ted Kennedy and I met John Kennedy. I don't remember John very much but I remember Ted. I met him and he used to come in all the time. In fact, I knew him when he was a senator very well. Never voted for him, when I became old enough to vote because I thought he was a jerk, but I met him and he was a heavy drinker and that's a whole other story, but the bottom line is he's a good guy. I remember after my flight he came in—my space flight, he came met our crew and all that stuff. They said "How do you know Ted Kennedy?" Because he was a big shot by that time, but I knew him because I knew him since I was ten, twelve, thirteen years old. I knew him all through my formative years and all the stuff, I knew his family. I knew his first wife, Joan. Ted Kennedy's first wife, I knew her pretty well. Because they came into my dad's restaurant, that's how I knew them. We saw them all the time, and the kids at that time, I don't know if they do it now, I think the ranching kids do, but I used to have to get up at three thirty, four in the morning, we'd go to the Quincy Market, we'd have to pick up the stuff for the restaurant, and then I'd go to school afterwards. And then when I get old enough to drive which is fourteen and a half at the time, or fifteen I think it was, then I'd go in— my dad would let me take the car and I'd go to school, and then I'd come back,

I'd pick him up, and then I'd have to work. He would give me a couple of hours to do my homework and then I had to work until eleven or twelve o'clock when we closed. So, that was my life and I didn't think anything of it because when I tell kids today they go "Oh my god, how did you do this?" Well I did do it but I didn't feel any different because everybody else of my friends were doing the same thing in one form or another, so we all worked to help the family out because it wasn't like people made the kind of salaries they do today. And I laugh about—I don't laugh, but when the faculty complains because they didn't get a raise this year or something, I just smile because I can remember working and giving the money to my parents and them giving me 25 percent of it back because there wasn't enough money. No one was making enough money to do what we needed to do, but it was different and there were no raises—guaranteed raises, it was you made it on your own.

DM:

You continued to work for the restaurant for a while, didn't you? Even in college?

AS:

I did. Yeah, I worked all through college. I worked—actually one of the funniest stories is I used to work, when I get old enough, as a bartender and that was when I was in graduate school in MIT [**Massachusetts Institute of Technology**] because my parents were very proud I was in MIT. But I still had work, in that case, I worked Wednesdays nights and I worked Friday and Saturday nights. My brother worked, even though he was at the time and engineer for Raytheon, he used to have to work the other nights. So we worked—my sisters—in an Italian family, they're never allowed to work in the restaurant. So they had to stay home with their husbands or be a nurse or be a teacher. But they weren't allowed in the restaurant because that's my dad's rule, it was only the guys. I'd work all the time and I remember my senior year, my last year, my fourth year, getting my PhD in MIT and I worked all the time. One of the things that—I went to school with a guy named, Norm—his son was named Terry Coldwin, but his name was Norm Coldwin. He was the Vice President of research of DuPont at the time. I remember him coming in on Christmas morning and I'm in there, Terry's coming in there showing them where his working, right, at MIT. And I'm there working because I figured I had two or three hours before I had to go home for Christmas things. And he came into me and he said, "You're working? Now this kid's about to get an admin slip [?] [00:24:47]" and this guy was a vice president at DuPont, it was a great—that was when DuPont was really a going company. But my dad, to tell you the funny story, when I graduated from MIT, I used to work as a bartender and I was—by that time, I was no longer shy, and I was pretty good with being a bartender, I knew how to make things but I was also a good conversationalist. My dad would let me tend the bar and on weekends I'd make a lot of tips, so I would typically at the time make about, just from tips and stuff, make about fifteen thousand, maybe sixteen thousand dollars a year. When I graduated from MIT, I got my first teaching job. And my dad asked me, "How much are they paying you?" I said, "fourteen thousand five hundred." He said, "Well let me get this straight, you're a bartender and you make

more money in tips than you'd get a PhD from MIT? I don't understand that; why did you go MIT then? You should've stayed as a bartender." He just said, "I don't get this, I thought you—" but it was what is was. I had fun—you know, all those things formed me. I became a pretty good speaker over time in part because I had adjusted my—if I wanted to make tips as a bartender, I had adjusted what the stories I told, how I told them, how to be sensitive to people, people what they wanted to hear, what they don't want to hear. When you're a bartender that's a big part of it, you need to entertain people, some people you need to listen to, some people you need to entertain, some people you need to sort off argue with, that's what they want. Other people they want you just to agree and so I became very good at reading people and understanding, primarily because I was trying to build a family business, and a part of that was the tips that I'd get. Believe me, when they know you're the owner's son, you got to be really good or they're not going to tip you because they figure, Yeah—he owns this place, what am I tipping him for. But it was good, it taught me a lot about public speaking, to be away pretty much from being embarrassed in speaking in public.

DM:

You were shy when you were younger, but did that—so that helped draw you out?

AS:

Yeah, it did. It did. My dad believed you had to know everything about business, so when I was seven or eight I was cleaning toilets in the place. And then when I got to ten or eleven, I was cleaning the toilets And packing the refrigerators. When I old enough to carry everything, I was going to the Quincy Market, cleaning the toilets, and doing this. And my brother was doing the same thing. Then eventually, he became more or less a manager when he was—because he was ten years older than me. And I was working behind the bar, we had a lot of other people working in the restaurant. But he made us do every single thing because he said, "You don't understand, what it's like to run a business unless you've done every part of it." And I still believe that, I mean, that's why, before I took any administration positions in academics, I was a pretty good researcher, I had twenty-six million dollars in funding. Published a lot of papers, won a couple of teaching awards because I wanted to do all aspects of academics before I became a department head. Because you make rulings, you better have known what it's like because you can make a ruling that sounds good, but unless you're on the ground and you know what's going on, it can have really bad effects. The flip side of it is also, you know when faculty are trying to fool you because you've been there and you've done it all. So, I mean, when they say something you go, Come on. But all those things through life taught me and my dad always taught me, remember where you came from. I'd like to think that I've done that my whole life, then I had—I was very good at researcher. I ended up getting selected for the Astronaut Corps and I was on two flight crews and it was fun.

DM:

Something else about the sixties you were talking about the creativity of children at that time but now space flight was a reality as well. and you were still young. Did you have an inkling of an idea that you could be one of these people?

AS:

Yeah, I did actually. In fact, the big joke, when I hit my sixtieth birthday was my sisters, couple years back, my sisters had pictures from when I was growing up and there I am at different stages from about six years old with a space suit on, space helmet, a space thing. The joke was, actually, you got to where you wanted to go but you started when you were seven years old, eight years old. I did. I was always interested in that and in the sixties, I just get more and more excited. I mean, who couldn't be excited? We were doing things for the first time, again, by that time, I had already formed my tolerance for risk, I was a risk taker. And to me it looked like a big adventure. I followed it, I still have a collection of the old newspapers from almost every flight. I went down—as soon as I was old enough, I asked my parents to take us down to the Kennedy Space Flight Center, I had pictures of me when I was like—I don't know at the time, probably about fifteen, fourteen years old walking around the old Redstone Rockets. When I went to my first space flight, we used to run around the old launch pads. So I got to see the launch pads that were really there but they never showed the public. Thirty-nine A and thirty-nine B and all—so I used to run around there every morning at four thirty-five o'clock in the morning when I was in the Astronaut Corps. I loved it. But yeah, I got the bug, I never quit. The other thing is, I could remember being the most hurtful thing that my mother ever said to me is, I told her I wanted to be an astronaut one day and she looked at me and she always told me, like I said, never let your fear get in the way of your dreams. She said to me, "You can't be an astronaut." I said, "Why not?" She said, "You're too big." I said, "What do you mean I'm too big?" She says, "They're all small, you're big. You're not even going to get on that capsule. Forget about it." And I was crushed, I was like, "Aww." So I started looking at the sizes and she was right, they're all five foot seven. And I was five-eleven. They all weighed all about hundred sixty pounds and I weighed hundred ninety pounds. I'm like, "Ugh. This isn't good." Thank goodness shuttle era came around, you had to be six foot four or less than and they didn't really have a weight requirement but—

DM:

That's wonderful how that came to culmination.

AS:

It did, at that time I was like, "Oh man." But I wrote to the space center a lot of times, I wrote letters to them, how do I apply? What do I do? All sorts of stuff. They were very good, whoever answered, I don't remember, I don't have those letters but, I remember them saying things, you know you need to either go in the military and learn how to fly, or you need to get a PhD, and

then you need to work a few years, and you need to make sure that you're good at what you do. It's not about just about grades, it's about really understanding what you did. And they would write me these letters, just writing to the space center and someone would write back. I don't remember who it was, it was never an astronaut or anything but I just follow what they did to a letter. I kept myself healthy, my parents were always—I never drank in high school or ever did any of that kind of stuff. Never smoked, was very physically fit. Kept myself very fit. And studied a lot and I had to study a lot because I wasn't gifted, I don't think. And I worked all the time, because my parents was just, that's what we did. We worked. We were a working class family. I never thought about it, when I talked to kids today, they go, "How could you do that?" and I'm like—I was the captain of the football team, I just have to go to practice and do all those things and then go into work afterwards. It wasn't like—and that was just—they didn't say you had to, that was just, that was the times. And part of it was that was my family that was all the families I knew. Everybody did the same thing so it wasn't like, I could point and say, "Well, they're not doing it." I mean, they have may been doing other things but it was all—everybody was working, everybody sort of had the same, in my case, it was dedication. My daddy used to say, you know, first and foremost, it's your family, God, and country and so that's the way we were brought up and everybody helped, it wasn't a big deal. I get a kick out of it because sometimes when I hear things on TV, I go, "Oh they made their kid work after school every night," and I'm like, "Uh yeah." But I was also blessed, I didn't need much sleep, so I only slept about four hours a night.

DM:

Is that right?

AS:

Yeah, I never needed much sleep. Even today. I like to sleep six hours now, but I'm still not a good sleeper. Even on orbit, they used to get, we're required to be supposedly sleeping for eight hours but I could never sleep for eight hours, I'd sleep for two hours, three hours. But they'd make me stay in my, where I was supposed to be sleeping. I was going to say my bunk, but we didn't really have bunks. In my flights, we had these like little kitchen cabinets we'd slide inside them and so I'd be reading, reading what I was going to do the next day or what, because I always had the reading bug or I'd be listening to music. It used to drive me nuts because I'd only sleep three hours because you need less sleep in space because you don't use the major muscle groups. So everybody else—commander both times—the commander Dick Richards was one of them, and Ken Bowersox. Ken Bowersox, he'd sleep eight or nine hours on orbit, I don't know how because you're not that tired, you know you're not stressing your muscles or anything. So typically, you sleep two thirds, if you're an eight-hour sleeper, you'll feel the same in six hours, if you're a six-hour sleeper, you feel the same in four hours, you know, that kind of thing. For me, three or four hours was plenty, I was ready to go but by flight rule, I couldn't leave the area, I had to stay where I was. And they were very, very religious about that. I was like, "Oh, you got

to be kidding me.” So I’d bring stuff—the night before, I bring everything into my cubicle that I was in, I’d have pieces of equipment floating around so I could fix them when I get up and all that stuff. But we couldn’t leave the area. It was fun.

DM:

Out of high school, did you go directly to Northeastern?

AS:

I did, I went directly to Northeastern.

DM:

Got a bachelor’s in ’73.

AS:

I got a bachelor’s in Chemical Engineering in ’73, and then went to MIT after that, and then I graduated from MIT and I think it was ’77, late ’77 or at least ’78. My diploma says ’78 but I graduate—because that’s when I picked it up. But I finished school in July of ’77.

DM:

In your biographies it says ’77. What was your dissertation topic?

AS:

It was on the growth of carbon nanotubes, we didn’t call them carbon nanotubes at that time, we called them carbon filaments, but that’s what they were.

DM:

This was something that was a life-long—

AS:

Yes.

DM:

Do you still work with that or do you—

AS:

I still—well I haven’t since I’ve been a dean here but I did up until that point in time. Yeah, I loved it. That’s when I got very good with electron microscopy, which is why when I came here I brought my own electron microscope that I had bought, that’s expensive piece of equipment but I bought it, then we were down here, I raised money to buy some TEMs. That’s because that’s how you image that stuff. So I used to love to do electronic imaging. To me, it was fun. It was

like taking pictures with camera but these were nano-sized materials, and I started working on hydrogen storage and nano fibers and all sorts of stuff. I loved it, yeah. Then I get into crystal world primarily because I was always interested in science and I had a guy named Leonard Sand who was, he discovered a material called H-Bornite, he was not a chemical engineer but I met him at WPI, but he was famous. And he came to me one day, he said, "Do you want to be famous someday?" I said, "Of course I want to be famous." He said, "You can do your carbon nanotubes but everybody's working on those, you ought to work on zeolites." I didn't even know what zeolites was. I had heard the name because they catalyst for the petroleum industry but I didn't know what they were. So he starts telling me, next thing I know I get into it pretty heavily. And that's why I ended up going to space. I get to be an expert on zeolite crystal growth. I always wondered who catalysis were because that was one of my areas that how I grew carbon nanotubes using catalytic materials. But I get into crystal growing, in a big way, I found that fascinating, and then he said to me, "Do you ever think about growing them in space?" That was really his idea. I said, "No, I never thought about that." And he said, "Well, we—" he loved look like some of the old guys. He used to look for natural zeolites that formed in basalts. So he said, "I found some big, they're impure, but zeolite crystals, that were very big, as big as the baseball." These are usually about one-tenth of the thickness of a human hair. So they're usually very small. He said, "But they formed over geological time in a lake bed where the nutrients were constantly done at over thousands of years and they slowly grew the size of a baseball. But there were all impurities that were usable." But he said, "What if we could hang them in space and grow them there. Why don't you think about that?" Of course, that lined up with my interest in space. I was still interested, so I said, "Yeah, I'll do that." I wrote a proposal to NASA, it got funded it for about a million dollars, which at that time, was a lot of money. That was in the—let me see, the early eighties, maybe '82, '83. And a million-dollar grant was equivalent to maybe a ten million dollar grant today, maybe fifteen million. So that was a huge thing, and so it became a big deal, and Edith Flannigan from UOP got involved and she's one of the zeolite experts but not in space. And then all sorts of people come in from everywhere to try to figure out if we could grow a material never been grown before there. The hope at the time, was that zeolites were producing all the world's gasoline, they were being used for separations. It was like a magical material, it's like a, sort of like, you can think of it like a spaghetti strain, which allows the water go through but keeps the other stuff behind. So it was a molecular sieve basically. The bottom line is, they thought the theory was we could grow new materials in space that would help revolutionize the chemical process industry. So I got involved and I started doing ground base research, and all the initial research looked to be that's what was going to happen. And so, NASA decided that they wanted to grow materials science. And at the time, I was doing carbon nanotubes, I was doing a whole bunch of other materials, and they were looking for a materials scientist. I got nominated by the national academy of engineering, and then the rest is history as they say. I ended up getting involved and we did it, we grew some awesome stuff and then the problem is when we lost on the Columbia, we had a lot of experiments on the Columbia that were groundbreaking kind of things. We were looking to develop at that point quantum wire rays

to harvest photons from the Sun, and concentrate so we would split water and take the hydrogen oxygen and feed it for a fuel cell that produces water. It's a perfect energy cycle so there's no pollution and there's no any—you're not getting energy free but you're basically harvest photons from the Sun, but they need to have these quantum wire rays and everybody's been looking at it but no one was able to do it. And we were trying to do it in orbit, but we don't know what happened because the whole thing exploded obviously we lost it all. And then after that, NASA wanted to sort of the fetal position, I call it, they hung up—but I'll tell you, the last year or so, I've gotten inquiries from NASA and from Europe, and now from Turkey, that would I be willing to be involved with continuing that kind of research in the future. So maybe I'll get back into it, who knows. But the bottom line is—

DM:

Put your space suit back on.

AS:

Yeah. Well, I'm still know that there's Mr. zeolite at NASA. They always talk about it because we had some exciting times, we had a lot of backing from major oil companies because they were hoping they have a new catalytic material that would increase the yield of the barrel of oil. Even by three or four percent, it's such a commodity, that would be billions of dollars of additional revenue. So they were very interested in that kind of stuff. In fact, I'm talking to _____ [00:40:26] just putting together a presentation to what's called IChemE, which is the European version of the American Institute of Chemical Engineers. There's going to be a webinar too and they want me to talk about my—space primarily— but weave in what we were doing at the time, so I'm going to weave in some of the things we did, it's a chemical engineering audience, but it's all over Europe. And I'm going to, it's actually going to be in Houston for expats, but they're going to televise it all over Europe. So, I'll be doing that on Wednesday, I guess Wednesday night but—I still get called to do technical talks and it's interesting, I thought you're talking about stuff I did almost twenty years ago, right? And yet it's still topical today. Because they haven't had the ability or the resources or the interest whatever it is to have continued that work. So a lot of the things I did—and another things is scientists today, unfortunately, many of them don't read the literature, they'll ask me questions that we did twenty years ago and they're writing about them now because they think its new, but it really isn't. No one reads anymore, that's part of the problem.

DM:

Is it over-abundance of information? Are they overwhelmed is it—

AS:

I think it's information overload now, I also think it's everybody's going so quick now, and in my day, what they used to teach you to do when I was in MIT Bard Reid, God rest his soul, was

my advisor, he was awesome. He used to say, take a day and week and go library and just go through stacks and look at things that are related to what you're doing, it doesn't have to be exactly what you're doing. So I went through the stacks and if it had, in my case, I was using CO₂ and Hydrogen to produce these things. So anything that had CO₂ and Hydrogen, I'd read about it, even though it had nothing to do with carbon nanotubes, which is what I was studying at the time. So I learned a lot about a lot of stuff, and much of it helped me solve some of the problems that we would have with this at the time. It was unrelated but normally, if you just zeroed in, and growing carbon nanotubes, I wouldn't miss this because it was peripheral stuff, but turned out having a big impact to what we were doing. I think today, everybody's in such a rush that they just want you to read specifically and pinpoint sort of a surgical approach, and so they don't really get it.

DM:

You see that in your faculty.

AS:

I do. Too narrow. And they're losing the image. One of things I'm going to do is, I'm announcing it here, is I'm going to re-do the entire curriculum in engineering to try and make it to much more group learning but also hands-on like building airplanes and all that kind of stuff I did because I know that's what the kids are missing. But the secondary thing is that I'm bringing the humanities back in. I have a degree in colonial history, I don't talk about it all the time, and I got it for all the wrong reasons. I got it because all of the women were in colonial history. I looked around at either English or colonial history, I went to colonial history but I learned a lot from that, what I learned is, engineers think in black and white but the humanities teach you to think in the abstract, and also to look at things from a lot of different issues. As I've heard from humanities people that there was a debate between ethics and environmentalism and one of the comments they come out by a guy named Pit, I'll never forget it, New York Times, 2015, he said, "Science is like a compass, it tells you to go true North." He was talking about, environmentalism versus ethics. He said, "but the humanities arguably teach you whether we should go north now or should we go later or should we do afterwards." I want to bring that back into engineering discipline because the problems today cannot be solved by science and engineering alone. There has to be a social element, there has to be a discussion, and you see it all the time. Climate change is, typical, right? That's just the big one, but almost everything to do with energy and how we're going to do it. In this area of the world for example, the controversy about farmers selling their water rather than farming. That's a big— because the water—the oil companies would pay a lot more for the water and they're in a, "Geez, you know, I may get— blight this year, I may not be able to—I guarantee I can make money doing this." All those kind of things. I'm trying to bring that back in, and humanities are really important to engineers, they don't realize it. I didn't realize it but when I look back at my education, what made me effective at what I did in science, a lot of it was because I think beyond the obvious. I think our kids today

are not learning that. Even our young faculty who are brilliant, much more brilliant than I was. What I had over them, was I just never quit. A lot of our kids today, even our young faculty, if they—when I interview people, I interviewed one yesterday, I said, “Realize when you get in academics, you’re in the reject business. You’re going to be rejected a lot more than you accepted. If you can’t handle that then this is not the career for you because you’re going to write—the average is, you get one in twelve proposals, one in ten proposals. You get one in six papers accepted, right? So you’re going to get a lot of rejections. And if you get discouraged and say I’m not going to do that, then you’re in trouble.” And I think a lot of the kids today—and I don’t want to paint everybody with the same brush, but I see a lot of it, they get discouraged really easy. Part of my job, even as a dean, with the department heads, these are mature people, right? And everything else is to constantly encourage them not discouraged. When I grew up, when you grew up, maybe it was different, failing was a part of life. And you didn’t take it as a, “I failed.” You taught it as, “Well, didn’t do that very well, I better try something else or try it differently.” Now it’s like the world ends, “Ugh I can’t do it, I flunked a math test.” I flunked more of my share of math test, takes physics test, chemistry test, and I ended up arguably going and teaching at one of the best schools in the world, MIT. And I didn’t do it because I was the brightest guy in the class, I did it because I never quit. It’s the same with the Astronaut Corps, I mean. One of the things that they tested, in my day, I don’t know what they do today but I suspect it’s the same. Is they would go back and they look at your elementary school teachers and they’d talk to them, they’d interview them. And what they ask, I found this out later on, and they had our permission if they could go back and talk to everybody. They wouldn’t ask how you did in school, they wouldn’t directly say, “How was Al in reading?”, “Oh, he was really bad.”, “So how did he respond to that?”, “Well, he came in afterwards, he was kind of shy but he worked at it.” And they’d ask things like, “Did you—did he make the baseball team?”, “No.”, “Did he quit when he wasn’t starting?”, “No, he just kept working on it.” They’re looking for people—because in Orbit things go wrong, you better have it in your genes that you’re not going to quit when things can get really discouraged, you can’t quit.

DM:

That really makes sense.

AS:

And so they go back and they’d ask what your persistence was, how you dealt with that adversity. They weren’t so much interested in what your grades were, they were interested in how well you responded to failure, to disappointment, to stress. What did you do? Because being in a hostile environment, like space, it’s all stress and if you’re not comfortable with that, you’re not going to be able to think. So you have to be comfortable. I think one of the things that this country’s missing today—and now I’m on my soap box, I really do. As people assume that everything’s supposed to be easy or somehow, and it’s just—it’s just not life, it’s not realistic. And so you got all these controversies about people fighting each other, you got the do-ers, and

thinkers, and the other folks that feel entitled, and from my way of thinking, that's not good for this country as a whole.

DM:

I'm kind of intrigued about what you were saying about NASA— or NASA looking at your background. How long a process was that?

AS:

It took about eight months, eight or nine months of looking. Meanwhile we were going through all sorts of tests and stuff. But they would back—I remember my dad, the FBI, came down to talk to my dad and he tells the story, we still going this little beach house and he's sitting there, by this time, he was in his, I don't know, probably in his early seventies, and he's sitting there, he said the FBI came up. He told me this story afterwards. And they said, "They wanted to know about you and what you did in the restaurant. I said, 'he did what I told him to do.' And they said, 'well, can you give me an example?', 'Yeah, he used to clean the toilets, and all that stuff.'" He said, "Wait a minute—" the FBI guy said, "Wait a minute," and he's telling this story with my mother sitting there just smiling because my mother was there too. I said, "Did he really say that?" She says, "Yeah." Says, "Well, let me understand this, you had a guy from MIT that's arguably one of the best crystal growers in the world and he's cleaning the toilets in the restaurant?" And my father looks at him, and said, "Yeah, what do you make your son do?" And the guy from the FBI couldn't believe it, he just started laughing. He said, "I can't believe this." And he said, "Yeah, my son will do what I tell him to do, if I tell him to go run around the block three times, he better do it." But that's the way we were brought up, my dad thought it was so odd, that the FBI says, "I don't know what kind of son he has but—"

DM:

Once you were accepted and started training, you were—at this time you were at Worchester, weren't you? And you were, not only a professor, but a chairman?

AS:

Yeah, typical me, right? I decided, they came to me and said, "You've been selected, why don't you come out." And they said, "We're going to pay the school for four or five years leaving of absence." So, at the time, there was a guy named Daryl Palean, he was the provost, he said to me, "What do you want to do?" I said, "What do you want to do?" He says, "Well, I don't see anybody that can handle the department like you do. You think you can do it nights and weekends?" I said, "Sure." So that's what I did, I was the department head, I had a guy that I'd call in nights and weekends. Well I didn't know at the time that NASA trainings went from six in the morning to midnight. So, I was calling the guy at one in the morning and all sorts of stuff, and he was like, "What the hell?" But every Saturday, at least until we got into a flight mode, we would have Saturdays and Sundays off. And I would call him and spend the whole day, and I

was—I did the whole job as a department head while I was still really training to be an astronaut. And again, because of the way I was brought up, I didn't think that was odd, I just kept doing them and he'd do the day to day stuff. But I'd make all the critical decisions. He was a confidant of mine. They didn't pay me; I was being paid by NASA, but that was my responsibility to the school. So that's what I did. And during the training—the training was the same way, people say, how do they train you for flight, well, you know after you go through the standard survival training and all that stuff, which is interesting. But training for flight is all about putting you in a stressful environment, and that have everything fail see how you respond to it. The beauty I tell everybody, is that you never fail until you test right. You just say that you should've done it a different way. Why did you do that? Why did you think about that? How come you thought this way, and not that way? And the training was very good, so you became comfortable with the unexpected. And so, and of course that fit my profile. Which is the profile they look for. But I felt very comfortable, so whenever we went into these simulations, to us, it was like a big contest, it's whether the sim engineers, we used to call it, could trick us. And they would have problems that were ten deep. In other words the real problem was down here, but what you saw was over here, so you had to figure it out, it's like peeling an onion, what was really wrong. And they were all timed. Because it's—you get fifteen minutes before the system goes critical. And all this kind of stuff. And sometimes you were by yourself, sometimes you're in groups of two, sometimes you're in groups of three. Sometimes there were faults and hit five different space craft simultaneously so everybody had a different aspect to do it, but it became a who's best. And we had some sim engineers we could never beat, and a lot of them we got pretty good at. But what it did, it not only trained you as a—that you were very confident in what your crew could do, and what they couldn't do. But in addition to that, like I said, you felt very comfortable with the unexpected. So when something unexpected occurred you didn't suddenly, your heart stopped, you went into a sweat. It was just like, "Oh, this is business as usual." And some of the simulations were so authentic. They had the space moving around and they had visuals in the windows so it looks like you were rotating head over teacups, and then have all sorts of three-dimensional imaging. So the training was very good, the only thing that I yelled at, in a kidding way when I got back to the trainers was, I sat—in both flights, I sat downstairs and when the first time I flew, when the explosive bolts came off to blow the external tank off in orbit, what they didn't tell me is that the floor was going to rise about six inches. So you can imagine sitting in your seat, you hear this muffled thump and all of a sudden your legs go [thud noise] the whole vehicle flexes. And I just thought, that's when my heart did go in my throat. I thought we were coming apart, right. Because I mean not a little bit, it came up six or seven inches, and I had a, almost had a heart attack, I couldn't believe it and I remember Cathy Thorton sitting next to me and just laughing and she says, "Oh, they didn't tell you that either, right?" So apparently, they don't usually tell—at least in the shuttle area they didn't tell you that. Depending on where you sat, you either got more of it or less, the seat I happened to sit got the most flexure. And so I was sliding, you can hear the whole seat crunch, and the whole thing comes up, and it's like, "Holy,

gee.” And it happens in a fraction of a second, so your mind doesn’t have a chance to—all you know is somethings wrong. This is not what we trained for. I’ve never seen this before.

DM:

I wonder if they’ve fixed that by at least warning people it’s going to happen.

AS:

They did a lot of funny things that they used to think were humorous and all, but nothing that they didn’t tell me, which wasn’t as bad. But and some of them are just details, there’s so much to train for. But when I was sleeping, in orbit one day, I must sleep for my three or four hours. And all of a sudden I see this huge explosion, I don’t hear anything and I jerk quick, and I remember I’m floating but I’m constrained with these rubber bands. I jerk quick and I whack my head to the top because I’m floating it whacks back down, like its back and forth right inside this cabinet. And so the person above me and below me said, “What’s going on, what’s going on?” And I come out, and I’m looking around and they said-- and Ken Bowersox says to me, “Oh I know what happened. He thought the vehicle exploded right?” And I said, “Yeah, how’d you know?” He said, “Because that happened to me. What happens is the cosmic rays hit your optical nerve in your eye and you get a sensation of this big brilliant flashes.” And so it just it takes—you don’t hear anything but you see this big explosion in your head, and the beauty of it afterwards you know what it is, when it happens periodically, then it’s like looking at a fireworks display because you’re comfortable and it’s okay. But the first time it happens, and they didn’t tell me about that either, I thought the space craft had exploded.

DM:

Is that an initiation then? You’ll find out.

AS:

I often thought a lot of this stuff was initiation, but of course officially they could never say that because they were supposed to train you, so they’d say, “No, no, we just forgot to tell you,” they’d just sort of wink and smile, you know. But everybody got the same kind of treatment. They obviously didn’t tell anybody, so it would happen time again. And then, of course, the other—your crewmates wouldn’t tell you either. If they had happened before, because they wanted you to go through the same experience, so it was just a part of building a comradeship kind of thing, things like that on occasionally. Those were the major two things that I really was surprised at.

DM:

How did you do with the six-scrubbed missions? Didn’t you fly on the seven?

AS:

Yeah, I did, and that was amazing. I had more, what they call in-seat time, the people that have been—that have flown four or five times. I was strapped in and ready to go more times than most people were. And it's a big deal, there's a ceremony you go through, the night before, you write letters to your family, in case you're not coming back, you seal them, you have your final dinner. You're not allowed to drink, well sometimes we'd have a sip of wine, but you're not supposed to drink anything. You go to bed, you wake up in the morning, the suit techs take you down, you shower then they put you in your suit, they pressure test everything, that takes two or three hours. Afterwards they strap you in, they get everything strapped up and you sit there, it's very uncomfortable, and you're laying on your back, and you go through all sorts of things like they inflate the suit to make sure it's inflatable. They do all sorts of things, com checks, and this takes about an hour and a half. Meanwhile, they're checking all these other stuff and you don't know what's going on and all of a sudden you get told—no so you get up, really high right, "We're going to go, we're going to go, we're going to go," and then you don't go so it's a big letdown. And then you go back to crew quarters and it's usually forty-eight or fifty-hour turnaround. Usually it's not the next day, it's two or three days later. So what happens is, you're still in quarantine, the whole time—by the way you're going to my time, two weeks before flight to be in quarantine so you can't get sick. And so your family comes to visit you, they have to either be on the other side of a glass area or if they're in the same room, they have to be greater than six feet away from you. So you can't touch anybody. So it'd be like you and I, you'd come in and talk to me but you couldn't get any closer than this. And they have to be checked by a physician before coming in the door that they don't have a cold or anything because your immune system is suppressed in orbit. So you have to be careful of that. But you get up, you get going and then we used to come back to crew quarters and everybody would be really down, right? So what we ended up doing is that we drink margaritas, probably much too much of it. Watch movies, because we're still in quarantine, and now we had to wait another three or four days. So, you know you get up and go to the gym and usually they would let us most of the time would take out the planes, T-38s and we'd fly around to get off some energy every day for two, or three hours. But the rest of the day, all we're doing is same procedures, over and over again, and you know with six delays, you're talking about being in quarantine, about a month and a half. And the worse part about is—you know the first launch. All your friends come to the second launch, 90 percent of them come to the third launch attempt, eighty percent, by the time we get to end, the only ones that was there was my brother, my sisters, and my mother, and dad. All my cousins all my friends. I mean they can't stay down there for a month and a half, right? It's so expensive, and they can't keep flying back and forth. So you end up with half the people that you got invited to go down there, and so it was quite a thing. And then they have these crew parties and all this stuff. That your parent—you can only have them once or twice. After the second time, because they were expensive, you rent a hotel, each crew per person and their families go around. You know it's a big deal, but the bottom line is, we were just dying to get off. And then they were talking about cancelling our flight. About the sixth time and they said, "Well, we may cancel it

for a year or two.” And none of us wanted to be training again for a year or two, we had already three and a half years into this. And we knew these stuff inside out. All you can think of is, Wow. And then we finally get off, they punch us through the clouds and there was a little hole in the clouds and we go through otherwise we would’ve been—if they went a seventh day, they said they were going to stop it at least six months, if not longer, then we got to rotate the next flight in. So, we were lucky we got off on 73. That was tight.

DM:

Can you tell me anything about 73 that, especially your specific part in it? Can you elaborate a little bit on your parts in the experiments?

AS:

Yeah, I did a lot of experiments. I did the protein crystal growth experiments. I grew the first HIV crystals in orbit that they used in part to develop some of the retro drugs. But science is an iteration [?] [01:00:56] thing so I wouldn’t say they were critical, but they were part of the steps going to the retro drugs. I grew zeolite crystals, we were trying to do the things that I was doing. I did a lot of work on combustion and a lot of drop physics module, they call it, which we were looking at fluid dynamics in orbit, the effect of surface tension driven flows and chaotic flows. So a lot of it was basic science.

DM:

These combustion—you did combustion and flame studies.

AS:

Yeah, flame propagations.

DM:

Sounds kind of dangerous to do.

AS:

Yeah, well it is, but we did it in a glove box and honestly we’re supposed to have the glove box sealed but a lot of times, we just took the sealing off of it. [Knock on door 01:01:35]

DM:

Are we out of time?

AS:

Excuse me. I don’t know.

Unknown Speaker (US):

Sorry, It's ten o'clock.

AS:

Okay. So, yeah, we did a lot of things but we had to suppress the alarm system, we did a lot of things to get the science done because they're really over conservative on some things, we knew what we were doing and we were smart about it, we'd have someone watch it. But the flames, were a part—remember these were tiny little flames, and we did them in an isolated chamber but we're supposed to have the door shut. Most of the time we didn't, because there was no way to manipulate your hands and do all the stuff they wanted. It was tough, and you don't have anything—when you sit there, you use the torque in your body against it, as something solid. But when you're in orbit there's nothing to torque against, you're floating. And so you go to turn something and it's hard to turn it because you, you're not, unless you hold onto something, you turn. The whole thing, the whole physics on how to work in orbit, is a lesson onto itself, it's not simple. But you would just, like human beings do after a while, you get clever with it, like humans always do when you figure out ways to do things and then it just becomes a part of what you do, it's not like a big deal. But it's fun.

DM:

That's an incredible story.

AS:

It really is fun. Being in orbit was the best part of my life. Other than seeing my kids being born, which I was at home, my kids being born. Other than that, that was the greatest time of my life, I mean it's just fun, it's like a—especially a science person, you can do all sorts of stuff you just can't do on the ground here. You don't have to worry about convective flows, you don't have to worry about the density differences that move air around, you don't have to worry about any of that stuff. You can study flames in a pure form with it not being affected by the flows around them, and so you get a lot of basic science done and test theories people predict but never have been able to test on the ground. And so, it's fun, it's fun to be a part of doing something for the first time. A lot of times, it turned out, especially with surface tension, driven flows, and chaotic flows, that the predictions from some of our best people, national academy people, were wrong. And I remember them, one of them, yelling at me, "Come on you must've done the experiment wrong." I said, "No, I didn't do the experiment wrong, your theory's wrong or something." And I went over and over and we did it multiple times, and of course, I had done it correctly and I know I did, but they didn't think they did on the ground, they said, "You must've done something wrong." And it turned out that, it rewrote some of the textbooks, and I just ran the experiment. I mean it wasn't me that did anything special, but what they predict what was going to happen never happened. And they kept saying, "Oh you must be doing this wrong.", "No I'm not." And I've sent the film down of the experiment, everything that was going on, and they'd be

calculating things, “Well try this, maybe this, did you hit against it when you were doing it, did you bump against it. I said, “No.” But anyways, it was fun stuff, it’s fun to be part of something for the first time.

DM:

And cutting edge.

AS:

And cutting edge, stuff and things that people were just imagining. That’s the part of the space program that I think is missing now. We have the international space station but we’re not flying real scientists anymore, we’re flying professional astronauts, that’s not their bad, they’re good, they’re bright people. But if I had my way, I think you can train someone that has the right temperament for about six months and they go in space, if it’s not their permanent job, spend three or four months doing what they do, come back, they can learn a lot, then go back and do the laboratory and do what they do best, which is science. I don’t think—I think you need to learn the benefits of what you can be doing in orbit, you have to have a professional scientist, not a professional pilot or a professional astronaut that just learns how to fix the vehicle and all that kind. They’re bright people, don’t get me wrong, but they’re not going to be—they’re not in the discovery business. They’re in the procedure business. “This is how I do it, I do it well, I do it the first time, I do it right and if things go wrong, I adjust quickly.” But scientists are a whole different thing. They got to be able to look at something from a much different point of view, observe something for the first time and say, “Wow, we weren’t supposed to get that but they really mean something.” Where a guy or a lady that doesn’t do that for a living, she’s not going to know that. So that’s what we need to change. In my day, that’s what I did, I was—they call them a payload specialist, they use to call him a scientific astronaut but some of the other astronauts that had a PhD didn’t like that term so we changed it. But nevertheless, there’s egos involved of course. But that’s what we were gearing towards. In fact, I wrote a white paper on that before they left the agency that they ought to do the six-month thing and turn people around, they considered it and they decided because the liability and risk, they didn’t want to take the chance of doing it.

DM:

I really appreciate your insights and recounting your experiences. Is there anything else you want to add to conclude the interview?

AS:

No, just what I end up with all my talks, I always say the one thing that I learned from orbit, was they’re all part of the great human family. And that you realize that Hindus call it the blanket of life but you realize that everything’s interconnected and you see it, and it’s just a very strong feeling of one-ness with everything living and it really makes you wonder why we argue the

things we argue about. Astronauts, you'll find out, often have boring personalities. What I mean by that is that, we don't get excited about a lot of things because when you've seen the Earth from a distance and you realize that the things we argue about are really insignificantly overall scheme of things that, it puts a different perspective on things. What used to aggravate me before I was in the astronaut corps., used to get me quite agitated, I just smile at now.

DM:

Are you a different person since you've been to space in that regard?

AS:

Yeah, I'm a very different person. I'm still driven but not to the extent I was. [Knock on door 01:07:27]

US:

I'm sorry to interrupt. Your next appointment's here.

AS:

All right, thank you.

DM:

Thank you.

[End of Recording]

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