

**NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT**  
**ORAL HISTORY TRANSCRIPT**

GUION S. BLUFORD, JR.

INTERVIEWED BY JENNIFER ROSS-NAZZAL

HOUSTON, TEXAS – 2 AUGUST 2004

*The questions in this transcript were asked during an oral history session with Dr. Guion S. Bluford, Jr. Dr. Bluford has amended the answers and a few questions for clarification purposes. He has also added a few questions for readability. As a result, this transcript does not exactly match the audio recording.*

ROSS-NAZZAL: Today is August 2, 2004. This oral history with Guy Bluford is being conducted in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Jennifer Ross-Nazzal, assisted by Sandra Johnson and Rebecca Wright.

Thank you so much for joining us this afternoon, Dr. Bluford.

BLUFORD: It's good to be here.

ROSS-NAZZAL: Thank you. I'd like to begin by talking about your career in the Air Force. If you could, give us a brief outline of your career.

BLUFORD: I went to Penn State [Pennsylvania State University, University Park, Pennsylvania] to get a degree in aerospace engineering and went into the Air Force ROTC [Reserve Officers Training Corps] Program. I graduated in September of 1964 with a bachelor's degree in aerospace engineering and a commission as a second lieutenant in the United States Air Force. In January of 1965, I went to pilot training at Williams Air Force Base in Phoenix, Arizona. In February of 1966, I graduated and received my Air Force pilot wings.

Upon graduation, I received my assignment as a fighter pilot to fly F-4C Phantoms in Vietnam. Over the next six to seven months, I attended several courses in preparation for my new assignment. I went to the Air Force Survival School at Stead Air Force Base in Reno Nevada. Then I went to Davis-Monthan Air Force Base in Tucson, Arizona, for three months of radar and intercept training in the F-4C. After that I went to MacDill Air Force Base in Tampa Florida for flight training in the F-4C Phantom.

In October of 1966, I went to Cam Ranh Bay Air Base, Vietnam, and served as a F-4C fighter pilot in the 557 Tactical Fighter Squadron of the 12<sup>th</sup> Tactical Fighter Wing. From October of 1966 to June of 1967, I flew 144 combat missions throughout Southeast Asia. These missions included combat air patrol, close air-to-ground support, and air superiority flights throughout North and South Vietnam as well as Laos.

In June, 1967, I was assigned to Sheppard Air Force Base in Wichita Falls, Texas, as a T-38 instructor pilot. For the next five years, I taught both American and West German students how to fly all flight phases of the T-38 aircraft as part of the Air Force Undergraduate Pilot Training Program. This included takeoffs and landings, instrument flying, navigation flying, and formation flying. I served as an Assistant Flight Commander and Executive Support Officer to the Deputy Director of Operations of the 3630<sup>th</sup> Flying Training Wing. I got over 1,200 hours of IP [instructor pilot] time in T-38s and was awarded the West German Luftwaffe wings by the West German Air Force. Many of my German students went on to fly F-104 aircraft for the German Air Force and my American students went on to fly various aircraft in the U.S. Air Force inventory.

While serving as an instructor pilot at Sheppard Air Force Base, I sought several opportunities to become an aerospace engineer within the Air Force. Unfortunately, the Air

Force was critically short of pilots at that time and thus needed my skills as an instructor pilot versus as an engineer. The Air Force also indicated that I would need to get a master's degree in aerospace engineering if I wanted to serve in that career field. In preparation for going back to graduate school, I decided to take several advanced mathematics courses from the University of California, Berkeley, by correspondence. I elected to do my preparatory course work that way, because there were very few educational opportunities in Wichita Falls, Texas. In 1971, I applied to the Air Force Institute of Technology for the master's degree program in aerospace engineering. In June of 1972, I was accepted into the program and was assigned to the Air Force Institute of Technology (AFIT) at Wright-Patterson Air Force Base in Dayton, Ohio. This was the break I needed in order to get into the aerospace engineering career field.

When I arrived at the school, my goal was to get a master's degree in aerospace engineering and find a job in the Air Force which utilized both my flight skills as well as my technical skills. I was initially assigned to get a master's degree in AFIT's Air Weapons Program, however, I was able to change my major to aerospace engineering. After three semesters in the master's degree program, I had an AFIT professor recommend that I stay on for the Ph.D program. He said "You're doing so well in the master's degree program, you should stay on for a Ph.D."

I said, "Sounds fine with me." While in the master's degree program I was somewhat frustrated by the fact that there was a limit on the number of aerospace engineering courses I could take. By going into the Ph.D program, I was able to take more aerospace engineering courses, and thus take full advantage of the opportunity being offered me by the Air Force. Thus, I applied and got accepted into the Ph.D program at AFIT while still completing my master's degree requirements. I dovetailed some of the Ph.D course work among my master's

degree courses so that I could complete the course work for both programs in two and a quarter years. In March, 1974, after completing my Ph.D course work, I took my doctoral exams and then was assigned to the Air Force Flight Dynamics Laboratory at Wright-Patterson Air Force Base to complete my dissertation. I worked with Dr. Wilbur Hankey, Dr. Joe Shang and Major Scott McRae in the Aerodynamics and Airframe Branch of the Air Force Flight Dynamics Laboratory doing research in computational fluid dynamics. Major Roger Crawford, who served as my sponsor for my master's degree thesis, was also chairman of my doctoral committee. He was a major influence in my success at AFIT. I also served as the Deputy for Advanced Concepts for the Aeromechanics Division. In that role, I was responsible for identifying, planning, and coordinating various aerodynamic research projects. My boss was Major Kitowski, who had been an instructor at AFIT and who was serving as Branch Chief. For the next two years, I did my research and began writing my dissertation

At the end of that time period, I was selected as Branch Chief of the Aerodynamics and Airframe Branch. I had completed my research for the Ph.D. program and was in the midst of writing my dissertation. For me, at the time, being Branch Chief of the Aerodynamics and Airframe Branch was a job that I had always wanted. It was a great opportunity for me to use both my technical skills and my flying experience in developing advanced technologies for future aircraft. I led an organization of forty-five to fifty engineers, who were doing basic aerodynamic research, in such areas as forward swept wings, supercritical airfoils, advanced analytical aircraft design techniques, inlets, axisymmetric nozzles, and computational fluid dynamics. It was a great job and I was really enjoying the work.

In 1977, the Air Force informed me that I needed to return to a flying job. As an Air Force pilot, I needed to complete nine years of flying in the first eighteen years of service and I

had only completed six years of flying. I needed another three years of flying in order to continue to receive my flight pay.

So I started looking for a flying job in the Air Force. My flying background was primarily in tactical fighter aircraft and training aircraft. I wanted to return to the fighter pilot business with a job flying F-15 or F-16 aircraft. The Air Force wanted me to return as a T-37 instructor pilot. While I iterated with the Air Force about what flying assignment I would eventually go to, I spotted an ad in the newspaper for the Space Shuttle Program. NASA was starting to look for astronauts to fly the Space Shuttle and they opened up the opportunities for scientists and engineers (i.e. mission specialist astronauts) to be astronauts. This looked like a great opportunity for me to fulfill my flying requirements in the Air Force, utilize my technical skills, and expand my technical knowledge all at the same time. I could do it as a NASA astronaut. What a deal! So I applied in 1977. In the meantime, I was still writing my dissertation with plans on completing the document by the end of 1978.

Although I knew that there was going to be a lot of competition to be a NASA astronaut and that the possibility of selection was small, I decided to apply anyway. In 1977, I submitted my paperwork for the astronaut program within the Air Force. The Air Force had established a selection board and they were collecting applications from officers interested in the NASA astronaut program. More than 1000 officers applied for both the astronaut pilot and mission specialist jobs. I applied for both positions. The Air Force selected approximately 100 officers, for consideration as NASA pilots and NASA mission specialist astronauts. I was selected as one of those officers for the NASA mission specialist position.

The head of the Air Force selection board was Tom [Thomas P.] Stafford, and I still remember a conversation I had with Tom Stafford many years later about my astronaut

application. He said, "Yeah, I ran that board and I remember seeing your application." He was impressed with my credentials and thus supported my application to be an astronaut. After the selection process was completed, the Air Force sent our names to NASA to be included with the applicants from the Army, Navy, Marines and eight thousand civilians. So through the summer of 1977, I sat around wondering if I was going to make it or not.

As NASA proceeded through the selection process, they started sending out notices to people who were eliminated in the competition. They also, in the middle of 1977, started selecting astronaut finalists in groups of twenty. NASA selected ten groups of twenty astronaut finalists and asked them to come to the Johnson Space Center for a week of physicals and interviews. Because NASA hadn't selected any astronauts in over ten years and because this new group of astronauts would include both women and minorities, there was a lot of public interest in the selection process. The requirements to be an astronaut were not limited to only test pilots, but were open to scientists and engineers. NASA was looking for not only astronaut pilots but also astronaut mission specialists. So in the summer of 1977, there was a lot of public interest and newspaper articles highlighting those selected as astronaut finalists.

On Wednesday, in mid October, 1977, while on government travel in Washington, D.C., I was notified by NASA that I had been selected as an astronaut finalist. Someone from the Johnson Space Center (JSC) tried to contact me in Washington, D.C. They arranged to have a note left on my hotel room door asking that I contact them. I returned their call that evening and was notified that I had been selected as an astronaut finalist and that NASA wanted me to report to the Johnson Space Center in Houston, Texas, on Sunday. My travel plans had me returning to Dayton, Ohio, on Saturday and I wasn't sure that I could get permission from my boss to travel to Houston on that Sunday. I indicated to the caller that I would have to check with my boss

before I could commit to traveling to Houston on such short notice. On Thursday, I spoke with my boss, Col McKelvey who gave me his permission to go on such short notice and he arranged for my travel. I confirmed with NASA my travel plans, picked up my tickets on Saturday, and flew to Houston on Sunday. It was my first trip to Houston.

When I arrived in Houston, I discovered I was in the ninth group of astronaut finalists. There were quite a few members of that group that were eventually selected for the astronaut program. I think Judy [Judith A.] Resnik, John M. Fabian, Terry J. Hart, and Steven R. Nagel were in that group. From what I later learned, there were more astronauts candidates selected from that group than from any other astronaut finalist group.

During that week in Houston, we all received thorough physicals and interviews with two psychiatrists. We were briefed on the Space Shuttle Program and we got to meet some of the current astronauts. It was an exciting experience. During that week, NASA did not disclose any information on how we were doing and if we passed or failed the physical. NASA also promised not to reveal the results of our physicals to our parent armed services. This was done as a protection to the military pilots. Since my Air Force flight physical was scheduled in November, I asked NASA to notify the Air Force if I passed my annual flight physical to preclude my taking two physicals in a short period of time. NASA eventually did that in November and I found out that I passed both the Air Force and the NASA astronaut physicals. During that week, I was also impressed with the competition and I knew that NASA would have no difficulty finding the type of talent they were looking for to serve as NASA astronauts.

One of the nicest experiences during that trip was the opportunity to meet NASA astronauts. I had never met any astronauts and I was thrilled to have the opportunity to talk with John W. Young, T.K. [Thomas K.] Mattingly II, Mike [Michael] Collins, Vance D. Brand, and

Alan L. Bean. I found all of them easy to talk to and they were all highly dedicated to the NASA space program. I was particularly impressed with the opportunity to talk with Joe H. Engle, an X-15 test pilot.

During the visit to the Johnson Space Center, we were required to write an essay on why we wanted to be an astronaut. Our essays were read by a number of senior managers just before we were interviewed. The interviews were conducted in a conference room by a group of 10 to 15 people. The group included Mr. George (W.S.) Abbey, Vance Brand, Carolyn Huntoon, Joe Atkinson and many others. I did not know any of these individuals nor did I know what roles they played in the selection process. I was asked why I wanted to be an astronaut, and they asked me about my academic performance at Penn State University. I explained how I got interested in airplanes and spacecraft as a kid and why I decided as a youngster that I wanted to be an aerospace engineer. It was a nice, friendly conversation with me doing most of the talking.

As the week came to an end, I had no idea how I did. I was impressed with the NASA organization, and I found myself even more interested in participating in the space program. I had wanted to speak with the NASA engineers on the aerodynamic characteristics of the Space Shuttle during my visit to Houston; however, I found very little time for that. It was a great experience, and I was hopeful that I would eventually be one of the thirty-five finalists out of two hundred to be selected for the astronaut program.

ROSS-NAZZAL: Let me ask you, do you remember what you wrote in that letter “Why I want to be an astronaut”?

BLUFORD: No, I don’t remember what I wrote.

ROSS-NAZZAL: When did you learn that you were selected for the astronaut program?

BLUFORD: In January, 1978, NASA announced their selection of the astronauts for the eighth astronaut class. I heard about the announcement over the radio as I drove to work one Monday morning. I assumed that I had not been selected for the program when I heard the news. I made the assumption that NASA had already notified the finalists of their selection, and they were about to make the selection public. However, after arriving in the office, I received a call from Mr. George Abbey, who informed me that I had been selected. Mr. Abbey was head of the Flight Crew Operations Directorate (FCOD) at JSC. He told me not to divulge my selection to anyone until after NASA made the announcement to the press at 12:00 EST that day. I later discovered that NASA had called all two hundred finalists that morning and told them of their decision. Unfortunately, January was a bittersweet month for me. My mother had called me earlier in the month and told me that she was ill and that the doctors had given her only six months to live. As promised, I kept the announcement to myself, except for calling my wife to let her know of NASA's decision.

I also had an interesting problem. I was still writing my dissertation and I had given myself until the end of the year to complete the document. NASA wanted me in Houston in July and thus I had to expedite the writing. I later learned that both Sally K. Ride and Kathy [Kathryn D.] Sullivan were also in the same situation with their Ph.D dissertations. I defended my research and completed my dissertation in June of 1978 just before I left for my new assignment as a NASA astronaut.

As a matter of fact, we sold our house in Dayton and the family left for Philadelphia [Pennsylvania] in early June while I remained behind to finish up the dissertation. I eventually completed the document in late June, made six or seven copies of it, dropped it off on my dissertation advisor's desk one Sunday evening, and left for Philadelphia to pick up the family. Although I had worked on the dissertation at nights and on the weekends, while serving as Branch Chief, I had a lot of support from AFIT and the Air Force Flight Dynamics Laboratory in completing the project. I considered, earning a Ph.D from AFIT, one of the many crowning achievements of my Air Force career.

I went to Philadelphia and picked up the wife and kids and we drove down to Houston, where we had a house waiting for us. The wife and I had gone to Houston in April of 1978 and purchased a home and it was ready for us when we arrived in July. I wasn't in Houston more than a week when I got a letter in the mail from AFIT indicating that my dissertation had been accepted and that I had completed all the requirements for my Ph.D degree. That was a great moment, since I had been working on the project for more than two years.

In February of 1978, NASA arranged to have our group come to Houston for a series of orientation meetings. During that visit, I got to meet my fellow astronaut candidates for the first time. It was a stellar group. NASA had selected fifteen test pilots and twenty mission specialists as part of the first class of astronauts dedicated to flying on the Space Shuttle. The class included six women and three African-Americans. We were slated to join approximately twenty-eight other astronauts who were already training in the astronaut office. We received a warm welcome by the people in Houston and during our visit we were measured for flight suits and T-38 flight helmets. I was thrilled to be there, and I was looking forward to working with my fellow astronauts as NASA continued to prepare for the first flight of the Space Shuttle.

In July, I reported to work in the Astronaut Office. Each of us in our class was assigned an office which we shared with a fellow astronaut on the third floor of Bldg 4. I shared my office with Don [Donald E.] Williams, a Navy test pilot. Two weeks after beginning my training, my mother died. I knew she was proud of my accomplishments and my acceptance into the astronaut program. I promptly returned to Philadelphia for the funeral and to help close out her estate.

ROSS-NAZZAL: Why don't you tell us about the training period that you underwent as an astronaut candidate.

BLUFORD: When our class arrived in Houston, there were approximately twenty-eight astronauts in the Astronaut Office. Most of them were actively involved in the test and development of the Space Shuttle. The Space Shuttle *Enterprise* was being prepared for Approach and Landing Tests at Edwards Air Force Base [California]. The Space Shuttle Main Engines were being tested at NASA's Stennis Space Center in Mississippi. The flight software for the Shuttle was being developed at JSC and at Rockwell International Corporation in Downey, California. A scheduler and training coordinator was assigned to our group to facilitate our training. The role of the coordinator was to insure that all of us received the training we needed in order to qualify as NASA astronauts. We were considered astronaut candidates or AsCans when we arrived and it was assumed that we would need two years of training before we earned our silver astronaut pins. Astronauts are given silver astronaut pins when they complete their astronaut training, and they receive their gold astronaut pins when they fly in space.

The training consisted of classroom instruction, simulator training, flight training, Neutral Buoyancy Laboratory (NBL) training and field trips. The classroom training included courses in aerodynamics, orbital mechanics, materials science, physiology, biology, geology, astronomy, and Space Shuttle systems. Orbital mechanics was taught by a professor from the University of Texas at Austin. Geology training included a field trip to northern Arizona. Astronomy training was supplemented by several visits to the Houston Planetarium. Space Shuttle systems training was provided by the engineers at JSC. The classroom training provided the foundation for all of us to do the many things astronauts are required to do. There were lots of viewgraph presentations, wiring diagrams, and schematic drawings provided. However, there were no Space Shuttle training workbooks. At times, the training seemed haphazard, even though a lot of effort was provided to give us the technical knowledge that we needed.

We got simulator training in several different Space Shuttle simulators. These included the Single System Trainer or SST, and the Shuttle Motion Based (SMS) and Fixed Based Simulators. We learned how to use the Space Shuttle flight data file. This included the various checklists and cue cards used by the astronauts to fly the Shuttle. Simulator training gave us valuable exposure to how the Shuttle flies in space and how the Space Shuttle systems work. Mission specialist candidates were also trained in the RMS [Remote Manipulator System] simulator. This trainer was in Bldg 9 and it was used for procedure development and camera coordination. The best RMS training occurred in the SMS, in which the RMS was simulated by computer graphics.

All of us were checked out in NASA aircraft. The astronaut pilot candidates were checked out as pilots in the NASA T-38s as well as the Shuttle Training Aircraft or STA. The STAs were Gulfstream aircraft that were modified to fly like the Space Shuttle during approach

and landing. Mission specialists were trained to fly the T-38s only. For those mission specialists who had graduated from military flight school, we were trained as pilots in the aircraft. For me, flying the NASA T-38 as a pilot was a great responsibility and a great privilege. I had been a T-38 instructor pilot at Sheppard Air Force Base in Wichita Falls, Texas, six years earlier, so it was easy for me to transition back into the aircraft. I accumulated over 4,600 hours of flight time in T-38s during my NASA and Air Force career.

All the mission specialist astronauts were trained in spacesuit operations in the NASA NBL facility. This was a large water tank facility where astronauts could practice and develop their EVA [Extravehicular Activity] skills. To qualify to work in the NBL, we were given scuba training and were required to maintain our scuba proficiency as mission specialists.

Our class made trips to NASA Headquarters in Washington D.C. and to all the NASA Centers, including JPL [Jet Propulsion Laboratory, Pasadena, California], in order to become familiar with NASA and its operations. We also visited the Rockwell International Corporation in California and got to see the Space Shuttles in construction. In December, 1978, our group went down to Cape Canaveral, Florida (the Cape) to watch a rocket launch. Unfortunately, I missed that trip. I took my family to Dayton, Ohio, to attend my Ph.D graduation from AFIT. Personally, that was a great day for me.

As we trained as AsCans, there was a lot of activity going on in the Astronaut Office. There were more requirements for astronauts than there were astronauts to fill them. It became very apparent that the Astronaut Office needed the AsCans as soon as possible to support the flight preparation for the first Space Shuttle flight. After one year of training, John Young, head of the Astronaut Office, declared that we were astronauts and we were given our silver astronaut pins. Thus we began to support the efforts in the Astronaut Office full time.

During the first year of training, I worked with Bob McCall, the artist, to develop a patch that represented our class. Bob had designed the flight patch for STS-1 and I asked him to do the same for our class. He came up with a design which highlighted the Space Shuttle, the thirty-five members of our class and 1978, the year that we arrived in Houston. As AsCans, we called ourselves the “TFNGs” or “Thirty Five New Guys” and Judy Resnik came up with a T-shirt design that illustrated that identity.

ROSS-NAZZAL: Let me go back. I wanted to ask you a question. You said that you were able to actually fly the T-38s. Were you given the opportunity to teach some of the mission specialists how to fly? I know that some of them had acquired pilot’s licenses after they became astronauts.

BLUFORD: No. The astronaut candidates were checked out in T-38s by the support pilots in Aircraft Ops. Very few of the old astronauts participated in checking us out in NASA aircraft. I once had a training ride with T.K. Mattingly; however, I finally was sent solo by an aircraft ops [operations] pilot.

ROSS-NAZZAL: You just mentioned the fact that the Space Shuttle astronauts had to play an essential role in sort of finishing up the Space Shuttle so that it could actually fly. You had a number of positions after you participated in training. You worked on the RMS; you worked with the Shuttle systems and the Spacelab 3 experiments, in addition with working with SAIL [Shuttle Avionics Integration Laboratory] and the Flight [Systems] Laboratory. Can you tell us more about what you did?

BLUFORD: After a year of training and a strong demand for our talents in the astronaut office, John Young decided to put the AsCans to work. Several jobs were parceled out to us as the Johnson Space Center prepared to fly the Space Shuttle for the first time. My first assignment was to work with Bill [William B.] Lenoir on the Remote Manipulator System. Bill was working with the Canadians as well as with the JSC Engineering Directorate to understand the operation of the RMS. This meant not only understanding the mechanical operation of the RMS but also the software and firmware that was used to operate the arm. A lot of time was spent in Toronto, Canada at the SPAR Corporation learning about the RMS. I worked with Bill Lenoir for about six months before I was transferred to support Don L. Lind in his support of Spacelab 3.

Frequent shifting of jobs among the AsCans was the normal way to expand our knowledge and experience base in the astronaut office. I supported Don Lind for about 9 months as we flew around the country talking to Principal Investigators (PIs) about their experiments. We gave them suggestions on how to improve the design of their experiments in order to maximize the scientific return of their experiments when flown in space. Working with Don Lind gave me insight into payload preparations, Spacelab operations, and how experiments are integrated into the Space Shuttle. As we got closer to flying STS-1, I was sent to work in the Shuttle Avionics Integration Laboratory.

SAIL was an engineering mockup of all the avionics and electrical components of the Space Shuttle. The SAIL contained a high fidelity Shuttle cockpit that was used to check out the flight procedures of the Space Shuttle. For me this was a great job. I flew various ascent and on-orbit flight scenarios verifying the nominal and off-nominal operations of the Shuttle. I became very familiar with the nominal and off-nominal flight procedures as well as the flight data file. I

flew multiple ascents and various ascent abort modes with numerous malfunctions to verify the performance of the flight software. I also flew on-orbit scenarios with simulated payloads, including the RMS. My job was to verify the performance of the flight software in preparation for STS-1.

In addition to working in the SAIL, I was also assigned to work in the Flight Systems Laboratory (FSL) at the Rockwell International Corporation facility in Downey, California. This facility was used to verify the flight software for deorbit burns, entry, and landing. As part of that job, I was also checked out to fly simulated Shuttle approaches with T-38s on the White Sands Test Facility (WSTF) range in New Mexico. NASA put large speed brakes on the T-38s so as to simulate Shuttle approaches. This was done to help train pilot astronauts. This was an exciting time for me, because it gave me an opportunity to see and verify the flight software for all flight phases of space operations. I would spend a week in Houston flying Shuttle ascents in the SAIL and then the following week I would fly a T-38 out to El Paso, Texas, fly simulated Shuttle approaches on the White Sands Test Facility range, and then fly to Downey, California, to fly Space Shuttle approaches in the FSL. I did this for several years as we prepared for the first four flights of the Space Shuttle.

ROSS-NAZZAL: Let me ask you about STS-1. You mentioned STS-1 a little bit ago. I understand that everyone was helping out for STS-1.

BLUFORD: Yes. Most of the NASA manned space effort at the time was dedicated towards getting the Space Shuttle ready to fly on STS-1.

ROSS-NAZZAL: What was your job during the STS-1 mission?

BLUFORD: Before the mission, my job was to help develop and verify the flight software for STS-1. We ran a lot of nominal and off-nominal flight simulations in both the SAIL and FSL in order to fully understand the operation of the flight software. We would then provide that information to the flight test engineers and to John Young and Bob [Robert L.] Crippen as they prepared for STS-1. Also, the lessons learned from flying the SAIL and FSL were directly fed back to the flight simulator folks so as to enhance the astronaut training for the first four Space Shuttle crews.

During the STS-1 mission, I was assigned to work with Frank Reynolds of ABC News out at Edwards [Air Force Base]. My job was to provide technical support to the network during the final phases of the flight. I went out to Edwards a couple of days before liftoff and followed the mission from NASA Dryden Flight Research Center [Edwards, California]. The launch was delayed a couple of days. The liftoff was successful and the entry and landing were spectacular. You could see *Columbia* come in overhead, and then circle around to its final approach point and then fly down final, with the chase aircraft following it. *Columbia* made a spectacular landing on the lakebed at Edwards Air Force Base. I was on the TV set with Frank Reynolds during the entire broadcast coverage of STS-1's landing. I was out of sight of the TV audience during most of the broadcast. As Frank Reynolds wrapped up the TV coverage of the event, I appeared with Frank on the set and we finished up the broadcast together. It was an exciting day for all of us to see John Young and Bob Crippen bring the vehicle home and confirm that the Shuttle was a safe and viable vehicle to fly.

That evening, I got to meet both Chuck [Charles E.] Yeager and Dan Rather of NBC News for the first time. I was also on Ted Koppel's *Nightline* that evening. There was definitely a lot of celebration that evening among news people and NASA folks with the successful completion of the STS-1 Space Shuttle mission.

ROSS-NAZZAL: How did you learn that you were selected for STS-8?

BLUFORD: I found out about my selection early in 1982. After the normal Monday morning Astronaut Office meeting, John Young, head of the Astronaut Office, came up to me and said "Mr. George Abbey wants to talk with you and you need to go over to George's Office. Be over there by eleven o'clock." John did not indicate what the meeting was about, and so I assumed that Mr. Abbey wanted to talk with me about a new assignment or some aspect of what's going on at SAIL or FSL.

As I was walking over to Mr. Abbey's office in Bldg 1, I ran into Dale [A.] Gardner. I discovered he was going to the same meeting. I asked Dale, "What's the meeting for?" He said he didn't know. We both speculated back and forth as to why Mr. Abbey wanted to talk with us as we headed to his office. When we arrived, we found Dan [Daniel C.] Brandenstein sitting outside of Mr. Abbey's office. He had been invited to the same meeting and he didn't know why we were there either.

After a few minutes of waiting, the door to Mr. Abbey's office opened and he motioned for us to come in. He had been having a conversation with Dick [Richard H.] Truly in his conference room and the three of us joined both of them. After some small talk, Mr. Abbey said "You know, you guys have really been doing a nice job in supporting the Space Shuttle flights;

Dan, you have been working on the various flight data file items. Dale, you've been working software issues, and Guy, you've been performing tests in the SAIL and FSL. I know you guys really enjoy what you're doing: however, I need some astronauts to fly on STS-8 and I was wondering if you guys were interested in flying on STS-8?" We all responded with a resounding "Yes." We definitely wanted to fly on STS-8. In our excitement, Dan Brandenstein asked who the commander was going to be on the flight. At that moment, Dick Truly looked over at Mr. Abbey and said, "George, can I fly on STS-8? Can I fly with these guys on STS-8?" George sort of looked over at him and said, "Yeah, why don't you fly on STS-8 as well." So that was how we were notified that we were going to be the crew on STS-8. It was an exciting moment for all of us as we left Mr. Abbey's office. Later that day NASA made the announcement for both the STS-7 and STS-8 crews.

We started out with a crew of four. Dick Truly had flown with Joe H. Engle on the Space Shuttle Approach and Landing Tests and as a pilot on STS-2. Dan and Dale were astronaut classmates of mine. Dan was a naval test pilot who was ascent CapCom [Capsule Communicator] and a member of the astronaut support crew for STS-1 and STS-2. Dale was a naval flight officer and served as a member of the STS-4 support crew. The mission required a night launch, and a night landing which had never been done before in the Space Shuttle. Dan Brandenstein was designated the pilot of the flight and Dale was MS-1 [mission specialist]-1. I was selected as MS-2 and thus served as the flight engineer for the mission. My job was to sit between the commander and pilot during ascent and entry and assist them in all phases of flight operation. For me I felt very comfortable in that role since I had quite a bit of simulator time in the SAIL and FSL and was quite familiar with the flight data file and flight procedures. The

EVA crew members for our flight were Dick Truly and Dale Gardner. Dick had been the EVA crew member on STS-2 and thus decided to keep that role on STS-8.

The mission required a night launch and a night landing because of the orbital requirements of the Indian satellite called INSAT 1-B. This was a weather and communication satellite with a Payload Assist Module (PAM) rocket that would boost the satellite into a geosynchronous transfer orbit. We were also manifested to carry a Tracking & Data Relay Satellite (TDRS) on an IUS [Inertial Upper Stage]. Our payload was to weigh over 65,000 pounds. It was going to be the heaviest Space Shuttle flight to date, with very little weight growth margin.

One of the challenges for the flight was to develop the procedures and techniques for launching and landing the Space Shuttle at night. Dick Truly and Dan Brandenstein spent a lot of time with the NASA aircraft ops people at both the Cape and at Edwards Air Force Base looking at various ground lighting configurations for supporting a Shuttle landing. Numerous approaches and landings were made in the STA to determine the best lighting configuration for our flight. Several flights were flown in the NASA 707 aircraft in order to give the flight crew some experience in heavy aircraft operations. After a lot of trial and error, a lighting configuration was established, which best supported our mission. This included flood lights on the approach end of the runway and additional lights along the sides of the runway. Although I was the flight engineer for the mission, I spent very little time in this evaluation project.

During the training, Dale and I made several trips to Boeing Aircraft Corporation in Seattle, Washington, to learn about the IUS. We were becoming well versed in the operation of the IUS when an IUS malfunctioned on STS-6. During that flight, the IUS put the TDRS-1 satellite into a stable but wrong orbit. Because of that, NASA decided not to fly the TDRS/IUS

on our flight until after the mishap was investigated. As a result of that, our manifest was changed to carry the Payload Flight Test Article (PFTA) and the Canadian RMS. The purpose of the PFTA was to evaluate the dynamics of the RMS while handling a large payload. Dale and Dick Truly were responsible for operating the arm with the PFTA, while I was responsible for deploying the INSAT-1B satellite. In addition to the PFTA/RMS, the Continuous Flow Electrophoresis System (CFES) was also added to the manifest. The purpose of the CFES was to separate out living cells with an electromagnetic current. Both Dale and I were trained to operate this system by Charles D. Walker, a McDonnell Douglas test engineer. Charlie later served as a Payload Specialist on STS 41-D, 51-D, and 61-B, to specifically operate the CFES experiment.

About four to five months into the training, we added Bill [William E.] Thornton to the crew. NASA had noted that several astronauts were suffering from space adaptation syndrome (SAS) or space sickness and they wanted to investigate this problem. Thus, they assigned Dr. Norman E. Thagard to STS-7 and Bill Thornton to STS-8. Bill came onboard as MS-3. Bill brought a lot of additional equipment with him to study the physiological changes associated with SAS. We all participated in some of Bill's experiments. I discovered on this flight that I did not suffer from SAS.

Twelve Getaway Special (GAS) canisters were added to our flight, eight of which carried specially-stamped postal covers. These postal covers were consecutively numbered with the President of the United States receiving postal cover number one. After the mission, the postal covers were sold, by mail order only, from the Postal Service's Philatelic Sales Division. Many of these postal covers were subsequently sent to us by people who wanted our autographs on them.

Training for the flight went very smoothly. We concentrated on flying night launches and night landings in a darkened Space Shuttle Simulator. We learned to set our light levels low enough in the cockpit so that we could maintain our night vision, and I had a special lamp mounted on the back of my seat so that I could read the checklist in the dark. The only thing that wasn't simulated in our launch simulations was the lighting associated with the Solid Rocket Boosters (SRB) ignition and the lighting associated with the firing of the pyros for SRB and External Tank (ET) separation. No one seemed to notice this omission until after we flew.

Although there was a lot of interest in my participation on the mission, I focused my attention on making the mission a success and stopped doing PR [Public Relations] events during the last six months of training. Dick Truly ran the team and worked with the scheduler assigned to our flight to insure that we received all the training we needed. As a crew, we were put in the same office early in the training and we learned to work well together as a team. We designed our crew patch as well as a "joke patch." The "joke patch" was shaped like an eight-ball with the front of the Shuttle on it. Dick Truly was depicted as half asleep looking out one of the windows while the rest of the crew was shown "wide-eyed" looking out of the other window. An *Aviation Week* article on our flight highlighted the "joke or eight ball" patch when they described our mission. When we finished training, we felt well prepared to fly.

ROSS-NAZZAL: What was it like to fly in space on STS-8?

BLUFORD: About a week to ten days before flight, we went into quarantine and began to shift our circadian rhythm. This would be the first of three times I would have to shift my circadian rhythm by twelve hours in preparation for flight. It took us about a week to get comfortable with

living at night and sleeping in the daytime. Some of the crew members slept at home while others slept in crew quarters at JSC. We ate food prepared by the food people on the Center and we practiced in the simulators at night. About three to four days before launch, we flew to the Cape in T-38s for the final launch countdown and liftoff.

During the last few days in quarantine at the Cape, we relaxed and did some last minute reviews of flight procedures. The families came down to the Cape several days before launch and we spent some time with them at the KSC [Kennedy Space Center, Florida] Beach House. Because of the interest shown by the public, NASA leased an airplane to fly dignitaries to the Cape to witness the launch. A party was held for the invited guests and dignitaries the evening before the launch, and my son ran around and took pictures of some of those who attended the party. My family escort was Jim [James] F. Buchli, who did an excellent job supporting my family. I was most concerned about my wife who suffers from retinitis pigmentosa. Jim did a great job in handling my wife's night blindness situation and made sure that she had a good view of the launch. Ron [Ronald E.] McNair called me the evening before launch and wished me well on my mission. I greatly appreciated his comments and encouragement.

On August 29<sup>th</sup>, we were awakened at 10:00 P.M. We had breakfast and suited up for the mission. We put on our NASA blue flight coveralls and then headed downstairs for the van ride to the launch pad. As we climbed into the van that evening, I noticed it was raining. There was lightning in the area and there was some concern by the Launch Control Center (LCC) about our safety as we proceeded out to the launch pad. Dick Truly discussed the safety and weather issues with LCC, while we rode out to the pad. Finally, LCC left it up to Dick to decide if it was safe for the crew to go to the pad. Dick made the decision for us to proceed and we went out to Space Shuttle *Challenger*. As we climbed into the vehicle and completed our preflight checks with the

Launch Control Center, the rains began to subside and the clouds began to clear away. Our launch window extended 34 minutes from 2:15 A.M. EDT until 2:49A.M. EDT. Because of the weather, we launched 17 minutes late at 2:32A.M EDT. The ride into orbit was really exciting. We had darkened the cockpit to prepare for liftoff; however, when the SRBs ignited, they turned night into day inside the cockpit. Whatever night vision we had hoped to maintain we lost right away at liftoff. The ride up on the SRBs was noisy and bumpy as *Challenger* lifted off and rotated to align us to a 28.45-degree inclination. The Orbiter pitched down as we headed down range, upside down. Approximately, 2 minutes and 15 seconds into the mission, we jettisoned the Solid Rocket Boosters. There was a large momentary flash of light in the windows when the SRB pyros fired. We continued our ride on the three Main Engines of the Shuttle for the next six and a half minutes and then jettisoned the External Tank at 8 minutes and 45 seconds into the flight. Once again, we were startled by the firing of the ET pyros. We made two Orbital Maneuvering System (OMS) burns, one at 10 minutes, 19 seconds into the flight and the other at 44 minutes, 49 seconds into the flight. This put us into an orbit of 160 nautical miles above the earth. It was a great trip. I still remember seeing the African coast and the Sahara desert coming up over the horizon. It was a beautiful sight. Once we completed our OMS burns, I unstrapped from my seat and started floating on the top of the cockpit. I remember saying to myself “Oh, my goodness, zero-G.” And like all the other astronauts before me, I fumbled around in zero-G for quite a while before I got my space legs. However, it was a great feeling, and I knew right away that I was going to enjoy this experience. We finally completed all of our ascent checks, configured the Orbiter for on-orbit operations, and then had lunch. For the next six days we were busy accomplishing the planned timeline and enjoying the view out the window. For the rookie astronauts, it was a fabulous adventure.

For me, most of my planned activities were accomplished in the first several days. We successfully deployed the INSAT-1B satellite on flight day one. Forty-five minutes after deploying the satellite, we ignited the PAM which rocketed the satellite into a geosynchronous transfer orbit of 22,300 miles above the earth. Ground control took over command of the satellite and fired its onboard solid propellant kick motor to circularize the orbit. During the rest of the mission, I performed some of the CFES experiments and helped Bill gather some physiological data. For the next several days, Dick and Dale operated the RMS with the PFTA on it, while I took pictures out the windows. The view from on-orbit was spectacular as we circled the Earth. I also tried to capture some of the crew activity in the cockpit on film. We were having a good time in space.

We had a telecom with President Ronald Regan during the flight. He praised us on our accomplishments and wished us well for the remainder of the flight. We also had daily messages from the families and the CapComs kept us apprised as to what was going on, on the ground. During our flight, the CapCom kept me abreast on how Penn State was doing in football and how the Philadelphia Phillies were doing in baseball. Each morning we were awakened by a school song. The Penn State song was played on flight day four. During the mission, we were informed about the shooting down of the Korean airliner over China. This was good for us to know, as we prepared for our on-orbit news conference with the press. During the mission, Dick Truly told me he was leaving the astronaut office after this flight to become Commander of the Naval Space Command, and my wife sent me a message saying that we had termites in our house. Overall the mission went well and we accomplished all of our flight goals.

On flight day five, we configured *Challenger* for the flight home. The mission seemed to go faster than we had wanted it to and all of us were hoping that we would have the chance to fly

again. We rotated the vehicle so that it was flying backwards; we performed the deorbit burn, and then we rotated the vehicle so that it was facing forward and re-entered the Earth's atmosphere. As we re-entered the Earth's atmosphere, we began to feel the effects of gravity and see the fiery plasma of hot air burn outside the front windows of the Orbiter. Dale took pictures of the hot plasma as it enveloped us during entry, and he would occasionally hand me the camera. I could feel the camera getting heavier and heavier as we got closer to home. Dick flew us home, and we landed at Edwards Air Force Base a little after midnight on the sixth day. There was an enthusiastic crowd to greet us at our brief post flight press conference. We joined up with our wives, who were waiting for us, and NASA flew us back to Houston.

ROSS-NAZZAL: Did you fly any personal items into space on STS-8?

BLUFORD: I flew my Air Force Command Pilot Astronaut Wings, my gold astronaut pin, and 20 silver and gold STS-8 medallions. I used the medallions as Christmas gifts at the end of the year. On later flights, I also flew mission medallions.

ROSS-NAZZAL: Can you tell us about your post-flight PR trips?

BLUFORD: After the mission, NASA Headquarters assigned Mary Weatherspoon to work my PR agenda. Mary was a public relations specialist from NASA Headquarters who had lots of experience doing PR support for the NASA Administrator. We worked together to determine which events we should do and how best to support all the speaking requests. She handled all the transportation and logistics for each PR trip and she served as my escort at many PR

functions. We worked well together as a team. From October to December of 1983, we made three to four trips a month to various parts of the country. We tried not to spend a lot of time crisscrossing the country, but tried to focus on a particular area of the country on each trip. In several cases, we convinced people to change the date of their events in order to best accommodate my schedule. Between trips I would spend a lot of time answering the mail and preparing for the next trip. On each trip, I talked about my experiences of flying on STS-8, the importance of the space program, the need for more scientists and engineers in this country, and I tried to acknowledge the role of teachers, parents, and role models in my life. I used the PR trips to thank the American people for giving me the opportunity to fly in space and tried to show my appreciation to those organizations that helped me the most in life. I particularly focused my gratitude on Penn State University, the City of Philadelphia, the United States Air Force and the Tuskegee Airman. It was a wonderful three months.

I went back home to Philadelphia for four days in November and rode in the Thanksgiving Day Parade. I met with Mayor Wilson Goode of Philadelphia and Governor Richard Thornburgh of Pennsylvania. I visited the University of Pennsylvania's Children's Hospital and several schools in Philadelphia, including Overbrook Senior High, my alma mater. I spent time at the Franklin Institute in downtown Philadelphia talking with school kids about the importance of studying math and science and I participated in numerous press conferences. It was a busy four days.

I went to Hollywood [California] and joined up with Bob Crippen to do a TV special on the 25<sup>th</sup> anniversary of NASA. Bob Hope hosted the event, as we highlighted some of the many accomplishments of the Agency. I also attended an awards program for the NAACP [National Association for the Advancement of Colored People], and received the NAACP Image Award.

Miss America's Vanessa Williams also received the same award at this event. I had an opportunity to meet Billy Dee Williams who was in the midst of filming several *Star Wars* movies. He seemed as excited to see me as I was to meet him. I also met Johnny Carson, Redd Foxx, Jim Brown and many other Hollywood celebrities on the trip. It was an exciting experience.

In October, my wife and I went to Washington D.C. to attend several events. We attended a ceremony in the Pentagon, hosted by the Chief of Staff of the Air Force, General Charles A. Gabriel, who presented me my Air Force Command Pilot Astronaut Wings. John Fabian also received his Air Force Astronaut Wings at the same event. There was a small reception, after the ceremony, with quite a few flag officers. From there, the wife and I went to the Smithsonian National Air & Space Museum to join President Reagan. The President gave a speech recognizing NASA on its 25<sup>th</sup> Anniversary. I participated in that event with Sally Ride, several other astronauts, and with the NASA Administrator. NASA donated my STS-8 spacesuit to the National Air & Space Museum for permanent display. Finally, that evening, the wife and I went to Blair House, across the street from the White House for a dinner and a reception with Frank C. Carlucci, Secretary of Defense. We got to meet Colin Powell and his wife as well as some ambassadors and several senior military officials and their wives. It was a remarkable day for both of us in the Nation's capitol.

By the end of the year, I decided to get off the PR circuit and return to my normal duties in the astronaut office. Although I enjoyed my experience giving speeches and signing autographs, I felt it was time for me to support some of the other astronauts who were getting ready to fly. I had accumulated a lot of memorabilia on these trips as a reminder on how the country felt about me and the NASA space program.

However, I had one more surprise that occurred after the Christmas and New Year's holidays. Among the mail that I had received during the holidays there was a letter from the Undersecretary of Defense for Personnel. In the letter, he congratulated me on my accomplishments and officially notified me that I was promoted to full colonel. The Department of Defense had decided to re-initiate an old policy of promoting astronauts when they flew in space. I was authorized to wear the new rank, as the Air Force got approval from Congress for my promotion. It was a great gift from an organization that I felt very proud of.

In January of 1984, I was assigned to be a "Cape Crusader," in the Astronaut Office. I was going to be one of the astronauts working at the Kennedy Space Center in Florida, monitoring the flow of payloads and the work on the Space Shuttles. However, before I could get started on my new job, Mr. Abbey assigned me to fly as the payload commander and mission specialist on STS 61-A. He wanted me to leave for West Germany in the next couple of weeks for six to eight weeks of training. I would be teaming up with Bonnie J. Dunbar and three European astronauts for payload training. Once again, I was ecstatic as I began training again for my second spaceflight.

ROSS-NAZZAL: Were you assigned to the mission because you had previously worked with Germans?

BLUFORD: No, I don't think so. Although I was a flight instructor for West German Undergraduate Pilot Training students and had been awarded the West German Luftwaffe Wings, I don't think this had any effect on Mr. Abbey's decision.

ROSS-NAZZAL: Why don't you tell me about training and working with the PIs in Europe.

BLUFORD: The STS 61-A crew was selected in segments. Bonnie Dunbar and I were selected first from the Astronaut Office to join the team. The rest of the flight crew was to be selected at a later date. This was going to be Bonnie's first spaceflight. She was a first-rate engineer with bachelor's and master's degrees in ceramic engineering and a Ph.D in mechanical/biomedical engineering. She had been a payload officer/flight controller at JSC since 1978 and became an astronaut in 1981. She was a welcomed member of the team and I really enjoyed training and flying with her on STS 61-A.

Early in 1984, Bonnie Dunbar and I went to Europe, on the first of many trips, to join with our European payload specialist astronauts for training on STS 61-A. This mission, called "Deutschland Spacelab Mission D-1" was the first of a series of dedicated West German missions to fly in the Space Shuttle. This mission was managed by the Federal German Aerospace Research Establishment (DFVLR) for the German Federal Ministry of Research and Technology (BMFT). Bonnie arrived for training slightly ahead of me. I got delayed by Lt. General James A. Abramson, the NASA Shuttle Program Manager, who wanted me to speak at Bolling Air Force Base in Washington, D.C. before I left. Once I completed that PR event, I joined Bonnie Dunbar in Porz Wahnheide, Germany at the DFVLR Astronaut Office.

We teamed with three very capable payload specialist (PS) astronauts who had been training for some time on the experiments for this Spacelab flight. Ernst Messerschmid (Ph.D) was a research physicist from Reutlinger, Germany; Reinhard Furrer (Ph.D) was an assistant professor from Worgl, Germany; and Wubbo J. Ockels (Ph.D) was a backup payload specialist on Spacelab 1, from Groningen, Netherlands. These payload specialists were to be the prime

operators of the European Space Agency (ESA) space experiments. Bonnie Dunbar and I were responsible for managing the Spacelab and its systems as well as performing a variety of experiments. The Spacelab D-1 Mission Manager was Hans-Ulrich Steimle and the Operations Manager was Hans Joachim Panitz. The training team was very fortunate to have Ulf Merbold (Ph.D), ESA payload specialist on STS-9, to serve as Crew Interface Coordinator (CIC) for the mission. Dr. Merbold participated in the entire D-1 training as a backup payload specialist.

Our primary training was conducted at Porz Wahnheide, Germany, a small, very picturesque town south of Koln, Germany. This European Astronaut Office housed the ground training units for several Spacelab experiment modules. These included: the Werkstofflabor (WL), a materials science and space processing facility; the Prozesskammer (PK), a materials processing chamber; the Biowissenschaften (BW), a life science experiment package; and the Biorack (BR), a biological glove box and two incubators. The Vestibular Sled training was conducted at Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts. Bonnie Dunbar and I trained on Spacelab systems at Marshall Space Flight Center [Huntsville, Alabama] and Space Shuttle procedures at JSC. While in Europe, all of us trained at several locations. These included the European Space Technology Center (ESTEC) in Noordwijk, Holland, the University of Paris in Paris, France, the University of Tubingen in Reutlinger, Germany, and the University of Bremen, in Bremen, Germany. Bonnie Dunbar and I spent about six months in Europe, three to four weeks at a time, training on the experiments. In addition, we made several trips to Cambridge, Massachusetts, to train with Dr. Larry Young and his team on the vestibular sled. Our Astronaut Office scheduler and training coordinator insured that the Europeans had a training plan and syllabus for us to work from for this flight. He also made sure that when we went to Europe or to MIT, our time was productively used. We served

as experimental test subjects on several of the experiments while at the same time learning how to perform the experiments. We also trained with the PIs and CICs at the German Space Operations Center (GSOC) in Oberpfaffenhofen, Germany, near Munich. In addition, Bonnie Dunbar and I took Berlitz lessons in German. Although all spaceflight operations were conducted in English, learning to speak German helped us in working with our European partners.

Late in the training, we picked up the rest of the crew. Hank [Henry W.] Hartsfield [Jr.] was named as Shuttle commander, Steve Nagel was named as Shuttle pilot, and Jim Buchli came onboard as flight engineer and mission specialist MS-2. Hank Hartsfield was a test pilot who had been the backup pilot for STS-2 and STS-3, the Shuttle pilot on STS-4, and Shuttle commander on STS 41-D in August, 1984. Steve Nagel was an Air Force test pilot, who served as mission specialist on STS 51-G and Jim Buchli was a naval flight officer, who had flown as mission specialist MS-2 on STS 51-C. The team was complete and thus we began to train together on Shuttle and Spacelab systems. On several occasions, the entire team came to Europe for orientation and training. Hank Hartsfield was our leader, who was also fluent in German.

STS 61-A was a unique mission. We had two mission control centers. The Mission Control Center in Houston was responsible for managing the total mission and all the Space Shuttle and Spacelab systems. The German Space Operations Center in Oberpfaffenhofen, Germany, was responsible for payload operations. The payload crew worked with the PIs and the CICs in the GSOC and the flight crew worked with the CapComs in Houston. We spoke with both mission control centers during the flight. Since we were going to operate the Spacelab around the clock, we broke the crew up into two teams called the Red Team and the Blue Team. The Blue Team consisted of Hank Hartsfield, Steve Nagel, Bonnie Dunbar, Reinhard Furrer, and

Wubbo Ockels. I was on the Red Team with Jim Buchli and Ernst Messerschmid. Late in the training flow, we started training as separate teams. This gave us an opportunity to become familiar with our own CapComs and CICs. For my team, Ulf Merbold was our CIC. After eighteen months of training, the STS 61-A, D-1 team was ready to fly.

ROSS-NAZZAL: Tell me about the STS 61-A flight

BLUFORD: STS 61-A was the first flight to carry a crew of eight. The planned launch time was noon, EST so as to give maximum TV coverage to Germany. The Red Team of Jim Buchli, Ernst Messerschmid, and I had to do a twelve hour circadian rhythm shift, so for us, the launch was occurring near the end of our work day. While in quarantine at JSC and at the Cape, one team was up while the other team was in bed. A new lighting system had been installed in the crew quarters to facilitate the shift in circadian rhythm. The new system made the shift easier and less painful for the Red Team.

The activities, the day of the launch, were normal. As MS-3, I was in the Orbiter middeck during ascent with the three payload specialists. Once we got on orbit, the Blue Team activated Spacelab while the Red Team went to bed. We had four soundproof bunks to sleep in while the Blue Team was at work. The two shift operations worked very well on-orbit with both teams up at the same time during breakfast/dinner when we transferred Spacelab operations. The simultaneous transfer of responsibility, both on-orbit as well as on the ground, went smoothly as we exchanged information and updated our flight data files. Each of the crew members shared a sleep bunk with a crew member from the opposite team. Only Hank Hartsfield had a sleep bunk to himself, which gave him the flexibility to work on either shift. The payload crew worked

almost non-stop in the Spacelab, while the flight crew worked in the cockpit. For the commander, pilot, and MS-2, there seemingly wasn't a lot to do so they took quite a few pictures of the Earth and performed all of the routine housekeeping functions. The coordination between the CapComs in Houston and the CICs in Germany went well, even during shift handover. Ulf Merbold was our CIC and he did an excellent job supporting us on-orbit as well as working with the PIs on the ground. For me, it was a great pleasure to work with both Ernst Messerschmid and Ulf Merbold. They were true professionals.

During Red Team shift operations, Jim Buchli and I had to work a persistent cabin leak problem. We had cabin leak alarms on a couple of days in space. We discovered, later on, the leak was due to one of the experiments inadvertently venting into space. We also had a false fire alarm go off on us during flight. This occurred on STS-8 as well and both times we had to turn off the sensor giving the false alarm. Both teams had to do in-flight maintenance (IFM) on several experiments which required a lot of coordination between us and the GSOC. The expert knowledge that the payload specialists had of the different experiment modules was crucial in resolving several of these problems. During my shift, Ernst and I got to speak to the head of Bavaria. The conversation was conducted in German with Ernst doing all the talking. Although the mission was conducted primarily in English, infrequently, the PSs would revert to German during on-orbit discussions. Each payload team worked twelve-hour shifts in the Spacelab. We were so busy on the Red Team that Ernst and I would have to rely on Jim Buchli to fix our meals. There was a lot of communication between the payload crew and the PIs and the CICs on each shift. We conducted seventy-six different experiments during the flight. Discussions with the CapComs in Houston were kept to a minimum. The working environment was very comfortable for both teams during the seven day flight and the mission was very successful. On

the last day of the mission, I gave Ernst some time off so that he could enjoy the view out the windows. We had been so busy on this flight that there was little time to savor the experience. We closed up Spacelab and readied the vehicle for entry as the Blue was getting up. I rode upstairs in the cockpit, next to MS-2, as we came home. Hank Hartsfield and Steve Nagel flew us home, and we made a safe landing at Edwards Air Force Base in California.

Once we got on the ground, we met up with our wives. My wife, Linda was standing there on crutches. Her knee had collapsed on her, while waiting for us at Edwards Air Force Base. She eventually had to have her knee operated on to correct the problem. We all flew back to Houston and dropped everybody off, except the payload crew, who then flew to the Cape for several days of ground testing. We were guinea pigs on this flight and one of the mission requirements was to look at how we adapted to zero-G and also how we adapted to one-G on our return. We spent several days in crew quarters at KSC, doing post flight specific experiments for the scientists. The mission was a total success.

After the mission, DFVLR invited us and our wives to Germany to attend a technical conference highlighting the results of our mission. It was a proud moment for all of us as we learned the results of some of the experiments that we performed during flight. The trip also gave me an opportunity to tour Europe with the wife and show her some of the sights that I had seen while training there. After all the STS 61-A post flight activities were completed, the PSs were assigned to various spaceflight operations positions within DFVLR and ESTEC.

STS 61-A was the last successful flight of *Challenger*.

ROSS-NAZZAL: Where were you when you heard about the accident?

BLUFORD: I was at home at the time of the accident. My wife called me from work and said, “Hey, I heard we had a problem with 51-L, this morning.”

I said, “Huh?”

“They had a problem with the launch of 51-L. Have you heard?”

I said, “Hold on, just a moment,” and I put down the telephone and ran into the den and turned on the TV. There, on all the network stations, they were showing the accident over and over again. I could tell immediately that we had a serious problem.

So I returned to the telephone and said, “We’ve got a real problem. I need to go into work right away.” I hung up the phone, hurriedly got dressed and went to work. As I wondered around the Center, I could tell that people were in shock. Meetings had been cancelled and everybody seemed stunned at what had happened. I could imagine the challenge the astronaut family escorts faced standing next to the families when the accident occurred.

That evening, the STS 51-L families returned home to Houston. NASA flew them back to Ellington Field [Houston, Texas] on NASA aircraft. I knew that NASA was going to face some real challenges ahead as we prepared for an accident investigation. No one knew the cause of the accident at the time, and I knew that we would have to find the cause, fix the problem, before we flew again.

ROSS-NAZZAL: What sort of assignments did you have immediately following the accident?

BLUFORD: I had just completed flying on STS 61-A and thus was the astronaut most current in Spacelab operations and the associated payloads. So I worked payload safety issues in the office. Safety became a number one issue at NASA as the Rogers Commission began their

investigation. Astronauts were assigned to various functions associated with safety and reliability through out the Agency. Besides working payload safety issues, I was also assigned to the safety investigation board associated with the External Tank. I spent quite a bit of time at NASA's Michoud Assembly Facility in New Orleans, Louisiana, going over the fault trees to determine if the ET had anything to do with the accident.

I knew the next few years were going to be difficult years for NASA. The Rogers Commission investigation uncovered both the primary and secondary causes of the accident. Management processes and faulty management decisions were key factors in the cause of the mishap and it was obvious that NASA was going to have to change. More focus was needed by all on the safety and operational aspects of flying in space. Astronauts were needed in management positions throughout the agency to help insure that operational as well as engineering considerations were included in management decisions. The nation was disappointed with NASA, and they demanded that we get to the bottom of the problem and fix it. President Ronald Reagan came to Houston for the memorial service and the Nation mourned the loss of our fellow comrades.

ROSS-NAZZAL: What effect do you think that the accident had on the astronaut corps?

BLUFORD: I think all of us in the Astronaut Office wanted to help the families who lost loved ones in the accident, and we were determined to fix the problem. Many of us were assigned to various safety boards; others were tasked to review processes and procedures on all aspects of spaceflight operations. Some of the astronauts left the program, not knowing when they would ever fly again. Some of us, like me, felt it was even more important that we stay and fix the

problem so that others may safely fly again. There were four members of my astronaut class that were killed in the accident. They were Judy Resnik, Ellison S. Onizuka, Francis R. “Dick” Scobee and Ron McNair. I dedicated my efforts to them to insure that those that follow them will fly a safer vehicle.

In the Astronaut Office, we had mock keys for each of the different Space Shuttle vehicles. Our team had the *Challenger* key, and I maintained the key for our crew. Unfortunately, we didn’t get a chance to turn the key over to the STS-51L crew before they flew. After the accident, I continued to display the *Challenger* key in my office as a reminder to all that flying in space was dangerous and that we needed to be vigilant if we were going to pursue this profession safely.

ROSS-NAZZAL: You mentioned you worked on general Spacelab issues and then payload issues. Aside from that, what did you do until you were assigned to your next flight?

BLUFORD: For some time, I had felt it was important that I prepare myself for a life after being an astronaut. Although, I really enjoyed my experience in the Astronaut Office, I knew that one day I would most likely leave and pursue other challenges. In an effort to prepare myself for that change, I had started taking preparatory courses at the University of Houston-Clear Lake for a master’s degree in business administration. During this hiatus in the space program, I accelerated my efforts towards getting an MBA [Master’s of Business Administration] and thus completed those requirements in 1987.

ROSS-NAZZAL: Why don’t we talk about your next mission, STS-39.

BLUFORD: After the successful flight of STS-26, the Astronaut Office got back to the business of flying multiple missions in space. During the accident investigation, we all concentrated on the accident investigation and its aftermath. Now it was time to fly again. As a result of the accident, all the flight teams that were assigned to fly after STS 51-L had been disbanded. Payload specialist training was cancelled. Now, it was time for us to select new flight crews and make new support assignments. As a result, I was teamed with [Charles] Lacy Veach to work with the Air Force in developing their manned payloads for the Space Shuttle. Most of that effort was focused at the Air Force Systems Command, Space Systems Division (SSD) and the Aerospace Corporation, in El Segundo, California. The Air Force started developing their cadre of payload specialists to support various military payloads on the Shuttle. Lacy Veach and I were assigned to work with the SSD folks on their Air Force Program 675 (AFP-675) and with the Strategic Defense Initiative Office (SDIO) on their Infrared Background Signature Survey (IBSS). The AFP 675 was a collection of experiments designed to measure background infrared and ultraviolet emissions, identify contamination in the Orbiter environment, and demonstrate X-ray imaging. The five AFP 675 experiments included the Cryogenic Infrared Radiance Instrument for Shuttle (CIRRIS-1A); the Far Ultraviolet Camera (FARUV); the Uniformly Redundant Array (URA); the Horizon Ultraviolet Program (HUP); and the Quadropole Ion Neutral Mass Spectrometer (QUNMS). The IBSS was an experiment designed to collect infrared, ultraviolet, and visible data for use in the development of ballistic missile defense sensor systems. Phenomena to be observed included OMS and RCS [Reaction Control System] engine firing exhaust plumes, the Orbiter environment, the Earth and its background, chemical and gas releases, and celestial calibration sources. IBSS was mounted on a deployable Shuttle

Pallet Satellite (SPAS-II) platform. Two elements of the IBSS, the Critical Ionization Velocity (CIV) experiment and the Chemical Release Observation (CRO) sub experiments, were mounted in the cargo bay. The CIV consisted of four canisters, containing different gases. These gases would be released into the payload bay and would be observed by the deployed IBSS. The CRO was three sub satellites, containing different chemicals. After CRO deployment, these chemicals would be released by ground command and observed by the IBSS. The secondary payloads for our flight were the Space Test Payload (STP-1) and a classified payload in a Multi-Purpose Experiment Canister (MPEC). The STP-1 was a collection of five diverse experiments mounted on a Hitchhiker payload carrier.

Major Robert "Rob" Crombie, an Air Force PS, was assigned to work with us on these payloads. He was an Air Force Academy graduate with both a bachelor's and master's degrees in engineering. He had extensive experience working at Wright-Patterson AFB in Dayton, Ohio, and at SSD in developing flight hardware. Together, we developed the flight procedures and malfunction procedures for the AFP-675 and IBSS payloads. Lacy Veach and I would fly out to the Lockheed Martin Space & Missile facility in San Jose, California, two to three times a month, to work on this project. Lockheed had a Space Shuttle cockpit simulator with payload controls and CRT monitors where we could check out the payload procedures and train for the flight.

Lacy Veach was a great guy to work with. He was a former Air Force fighter pilot and member of the Thunderbirds. Lacy had left the Air Force, joined the Texas Air National Guard, and flew as a NASA support pilot when he was selected for the astronaut program. Once this payload was designated for STS-39, we were selected as mission specialists for the flight. Once

again, the crew was selected in segments and we didn't know for quite a while who the other crew members would be.

During this initial phase, Lacy Veach and I would go out together to San Jose, California for training on AFP 675 and IBSS. Later on, we decided to do the training separately, in order for each of us to better grasp the material. During the procedure development phase, Lacy had to take three to four months off to go to McConnell Air Force Base in Wichita, Kansas, for training in the F-16. We adjusted his training flow to take that into account and Lacy never missed a beat when he returned. Through all of this, Major Crombie served as our crew representative when we weren't in California. His efforts were critical to our success. The Air Force designated him as our backup, and he did a great job in supporting our efforts. Lacy and I also did training on the CIRRIS at the Air Force Geophysics Laboratory at Hanscom Air Force Base in Massachusetts, the URA at the Los Alamos National Laboratory in New Mexico and the FARUV at the Naval Research Laboratory in Washington D.C.

Eventually, Mr. Abbey selected the rest of the crew for STS-39. Michael "Mike" L. Coats was named commander of the flight; L. Blaine Hammond was named pilot; Gregory J. Harbaugh was selected as MS-1; Donald R. McMonagle, was chosen as flight engineer and MS-2, and Richard "Rick" Hieb was selected as MS-5. Lacy Veach was designated as MS-4 and I was named as MS-3. Mr. Abbey had selected a great team for this flight. We had two experienced astronauts, Mike Coats and I flying for the third time, and five astronauts who were flying for the first time. Mike Coats was a naval test pilot who was a pilot on STS 41-D and commander on STS-29. Blaine Hammond was an Air Force test pilot; Gregory Harbaugh was a senior NASA flight controller; Rick Hieb was a NASA engineer; and Don McMonagle was an Air Force test pilot before becoming astronauts.

Because of the demands of the flight, the crew was broken into two teams, the Red Team and the Blue Team. The Red Team consisted of Blaine Hammond, Lacy Veach and Rick Hieb, while the Blue Team had Greg Harbaugh, Don McMonagle and I. Mike Coats was free to operate on either team; however, he was mostly a part of the Red Team. Each team would work twelve-hour alternating shifts. RMS operations were assigned to Greg Harbaugh and Rick Hieb, while Lacy and I performed the payload operations of AFP-675 and IBSS.

The training syllabus was particularly demanding. We had to do rendezvous, multiple translational maneuvers, extended station keeping and deployment and retrieval of the SPAS with the RMS. This involved precision Orbiter maneuvering, IBSS/SPAS commanding, CIRRIS and IBSS observation sequences, and multibody management in a very intensive timeline. A lot of coordination was required on the flight deck, synchronizing Orbiter and SPAS maneuvers, and documenting key events. There was approximately thirty-six hours planned for rendezvous and proximity operations. Lacy Veach and I commanded the IBSS; Rick Hieb and Greg Harbaugh operated the RMS; and Mike Coats maneuvered the vehicle. All of this had to be done simultaneously. It was quite a challenging flight plan and training was intensive.

Four months prior to our original launch date on March 9, 1991, I came down with a herniated disk. I had been having intermittent problems with my back for quite a while. When I complained about it to the flight surgeons, they would send me to a physical therapist for treatment. That seemed to work well. However, when I had back problems during STS-39 training, a closer look indicated that I had a more serious problem. I started sensing numbness in my right shin and found that I couldn't stand for any longer than thirty minutes before my leg started aching. I could relieve the pain immediately, if I sat down. The NASA flight surgeons grounded me and indicated that I would need an operation to correct the problem. There was

some concern from the training folks that I might not be able to complete the training syllabus in time for the flight. Mike Coats altered some of the responsibilities on the crew, so that I could be operated on and still make the flight. The operation took place on a Friday afternoon and I was out of the hospital on Sunday. I convalesced at home for a week and then returned to training. The flight surgeons cleared me for flight a month after the operation. If I had missed the flight, Major Rob Crombie probably would have replaced me on STS-39. He would have done an excellent job, if the circumstances dictated. However, I recovered, the mission was slipped, and we flew on April 28<sup>th</sup>.

Prior to each mission, the official crew photo is taken. In our photo, I was positioned at the far right side of the crew. I was still suffering the effects of the herniated disk and needed to stand near a chair, which was out of sight of the camera. In addition to our official photo, we had a humorous photo taken of the crew. It consisted of the five “new” astronauts standing in Houston Rocket basketball uniforms with me dressed as a referee and Mike dressed as the coach. Although the training was demanding, I really enjoyed working with this team. After almost two years of training, we were ready to fly.

ROSS-NAZZAL: What was it like to fly on STS-39?

BLUFORD: This was a two-shift operation. I was on the Blue Team and we had to shift our circadian rhythm almost twelve hours. The crew quarters at the KSC and JSC had been modified with large overhead lights to ease the transition. So, while in quarantine, my team made the shift to nighttime operations. That meant, that we were launching at the end of my day and that our team would be going to sleep once we got on orbit.

We had an uneventful early morning launch and the Red Team started the mission by initializing and checking out the AFP-675 and the IBSS. The STP was activated and the Orbiter was put in a Group B power down mode to save energy. On flight day two, we did AFP 675 operations and unberthed the IBSS/SPAS payload but kept it attached to the RMS. The next two days we deployed the IBSS/SPAS and made numerous observations of OMS and RCS plumes, and CRO and CIV gas releases. The Red Team captured and berthed the IBSS/SPAS on flight day four and we resumed AFP 675 operations. Later on in the mission we conducted additional observations with the IBSS/SPAS berthed in the payload bay and attached to the RMS.

During the mission, Greg Harbaugh and I used the CIRRIS to capture some data on a passing satellite. That was a challenging and exciting experience for me, since I knew that was going to be a difficult task. On flight day eight, I deployed the classified MPEC payload alone from the flight deck. Only Mike Coats and I were privy to the classified nature of the MPEC payload. The STP operated continuously throughout the mission and we took pictures and collected data of the Southern aurora. It was a challenging and exciting mission. However, on the last day of the flight, we were all exhausted and we were ready to return home.

Our planned landing site was Edwards Air Force Base in California. The spouses went out a day early to meet us when we landed. However, on the day of landing, due to weather, we ended up landing at KSC. We met the wives when we were both flown back to Houston.

Overall, Mike Coats did an excellent job leading our team and our customers, SSD and SDIO, were very proud of the mission results. Because of our efforts, we were recognized in 1991 by the *Aviation Week & Space Technology* magazine with the Aerospace Laureate Award for the Space/Missiles category.

ROSS-NAZZAL: Okay. Why don't we talk about your last mission.

BLUFORD: After flying on STS-39, I began to consider leaving the Astronaut Office. I really enjoyed the work in the office and the camaraderie with my fellow astronauts, but my problem with my back just before STS-39, reminded me that it may be time to leave. I had no specific plans about leaving, when I got a call from Don [Donald R.] Puddy, the Director of FCOD [Flight Crew Operations Directorate]. He assigned me to fly on STS-53. STS-53 was going to be a classified DOD [Department of Defense] mission. I would get to work in the classified world, an environment that I had only briefly seen on STS-39. The other crew members on the flight would be David M. Walker, commander, Robert D. Cabana, pilot, and James S. Voss and Michael Richard "Rich" Clifford as mission specialists. Dave was a Navy test pilot who had been pilot on STS 51-A and commander on STS-30; Bob Cabana was a Marine test pilot, who had flown as pilot on STS-41; Jim Voss was an Army officer who had flown on STS-44, and Rich Clifford was an Army test pilot who was flying for the first time. This was a great team.

In order to make training an enjoyable experience, Dave Walker decided that we would be called the "Dog Team." He assigned everybody on the crew dog names. He bought a jalopy and painted our dog names on the side. The trainers and support people in Mission Control all had dog names. We would drive around JSC in the "Dog Mobile." Dave had red hair, so his dog name was "Red Dog." Bob Cabana was a Marine, so his dog name was "Mighty Dog." Jim Voss was an Army guy, so we called him "Dog Face," and Rich Clifford, was an Army aviator, who was flying for the first time, so we called him "Puppy Dog."

ROSS-NAZZAL: What was your dog name, if you don't mind me asking?

BLUFORD: My dog name was “Dog Gone.” I had been in Europe on a PR trip when Dave handed out the dog names, so I was called Dog Gone. We even had a paper dog mascot stored in the lockers, which we took into space and hung up, in the Orbiter middeck. Although we had a lot of fun with our dog names, we took our tasks seriously when we trained. The training flow went well with most of the training occurring in Houston.

Our primary payload was a classified payload called DOD-1. With the development of the Space Shuttle, DOD was directed to shift more of its payloads from expendable boosters to the Space Shuttle. STS-53 represented the ninth and last mission dedicated to DOD. After the *Challenger* accident, the DOD reversed course and returned to expendable boosters. However, there were still some payloads in the pipeline manifested on the Shuttle and we carried the last of the DOD payloads into orbit. In addition to DOD-1, we carried a bunch of unclassified secondary payloads both in the cockpit and in the payload bay. These included the Shuttle Glow (GLO), the Cryogenic Heat Pipe Experiment (CRYOHP) and the Orbital Debris Radar Calibration System (ODERCS) in the payload bay. The primary in-cabin secondary experiments were the Battlefield Laser Acquisition Sensor Test (BLAST), the Fluid Acquisition and Resupply Experiment (FARE), and the Hand-held Earth-oriented, Real-time, Cooperative, User-friendly, Location-targeting and Environmental System (HERCULES). Additionally, we operated the Cosmic Radiation Effects and Activation Monitor (CREAM), the Cloud Logic to Optimize Use of Defense Systems (CLOUDS), the Microencapsulation in Space (MIS), the Radiation Monitoring Equipment (RME), the Space Tissue Loss (STL), and the Visual Function Tester (VFT). Most of our training was done at JSC with support from a Detachment of the Air Force Systems Command, Space Systems Division, in Houston.

During one of our training trips to the Cape we got to ride on the “Crawler.” This is the vehicle that takes the Space Shuttle stack out to the pad. We spent most of the day riding the crawler carrying the Space Shuttle *Discovery* with our payload out to launch pad. It was a wonderful ride.

ROSS-NAZZAL: Tell me about the flight

BLUFORD: We launched in the daytime. I didn’t have to do a twelve-hour circadian rhythm shift. That was a wonderful experience. We deployed DOD-1 on flight day one and activated CREAM, RME, GLO and CROHP. The rest of the mission was devoted to operating the secondary payloads. Jim Voss and I operated HERCULES and I worked with Rich Clifford on FARE. We attempted to operate BLAST; however, we failed to get it to work properly. Rich Clifford deployed the six metal spheres from ODERCS on flight day three. We took lots of pictures and thoroughly enjoyed the experience. Flying with the “Dog Crew” was a lot of fun.

The day prior to landing the wives went to KSC on a NASA aircraft to meet us. However, due to weather, we deorbited and landed at Edwards Air Force Base. For the second time in a row, I rendezvoused with my wife when we were both flown back to Houston after the mission.

ROSS-NAZZAL: What did you do after STS-53?

BLUFORD: Once again, I had to seriously decide what I wanted to do with my career. I loved working in the astronaut office; however, I felt it was time for me to pursue other challenges.

After some serious thought, I decided to talk with Hoot [Robert L] Gibson, head of the Astronaut Office, on the subject and told him not to schedule me for another spaceflight until after I make up my mind about what I really want to do. I felt it was important for me to evaluate the other opportunities I had and then make a decision about my astronaut career versus not doing anything at all. Thus, I prepared a resume and sent it out to perspective employers in search for other possible opportunities.

In February of 1993, Mr. Abbey called me from Washington D.C. and asked me about my future plans. I told him that I had no specific plans and that I was trying to determine what I really wanted to do. He arranged a meeting for me with the NASA Administrator to talk about other opportunities within NASA. I flew to Washington D.C. and talked with Dan [Daniel S.] Goldin on the subject. He suggested several opportunities that I should consider and offered his help when I decided what I really wanted to do. It was a cordial meeting with Mr. Goldin. I left the meeting feeling that I could still contribute to NASA in many different ways. However, I got a job offer from a fellow high school classmate of mine, which eventually led me to taking a job in Cleveland, Ohio. I was going to be Vice President of the Engineering Services Division of NYMA Inc. and Program Manager of the SETAR [Scientific, Engineering, Technical and Administrative Related Services] contract at the NASA Lewis Research Center [Cleveland, Ohio].

ROSS-NAZZAL: You did some work with the CAIB [*Columbia Accident Investigation Board*].

BLUFORD: Yes.

ROSS-NAZZAL: How did you get involved with the CAIB?

BLUFORD: Admiral Harold W. “Hal” Gehman called me in April of 2003 and asked if I would be willing to come to Houston to provide some support to the CAIB. He needed somebody, right away, to work with the Board and help prepare the final accident report. I had some commitments that summer, so I knew that my participation would be limited; however, I agreed to help. I had been following the efforts of the CAIB in *Aviation Week*, so I had a general idea of what was going on. He needed somebody to replace Theron Bradley, NASA’s Chief Engineer, who was returning to NASA Headquarters. I was free at the time, so I agreed to support him for two months.

When I arrived, I immediately reported to Admiral Gehman to find out what he wanted me to do. He gave me a warm welcome and indicated that he wanted me to work with the writers and try and get a first draft of the accident report written before I left in June. I joined the Board Members as a support person and attended the daily briefings and monitored the testimony of the witnesses before the Board. I knew some of the Board Members, including Sally K. Ride, John M. Logsdon, and Sheila E. Widnall. Admiral Gehman had put together a first rate team determined to find the root and the secondary causes of the accident.

I went down to KSC with some of the Board Members to examine the debris of *Columbia*. It was laid out on a large hangar floor in a pattern of the Space Shuttle Orbiter. Over 84,000 pieces were recovered, representing 38 percent by dry weight of the Orbiter. In an enclosed restricted area in the hanger, pieces of the cockpit were collected and stored. I had an opportunity to see some of those cockpit remains, including the crew helmets. Marsha [S.] Ivins, the astronaut assigned to the recovery team, helped identify and catalogue the cockpit debris. Of

particular interest to the investigators was the debris associated with *Columbia's* left wing. A three dimensional reconstruction of that structure was being assembled to better understand what happened. Besides the downlink, one of the key sources of information about the accident came from the Modular Auxiliary Data System (MADS) recorder. This was a recorder originally used to capture data from hundreds of sensors implanted throughout the vehicle during initial flight testing of *Columbia*. The data from those 800 sensors, recorded on 9,400 feet of magnetic tape, provided investigators with millions of data points of information, including temperature and pressure readings in the left wing. This data was crucial in unraveling what happened during the last few seconds before vehicle breakup.

I sat in on the testimonies of several witnesses before the Board, some of whom I knew. One of the most telling witnesses was Dr. Diane Vaughan, Sociology Professor at Boston College [Boston, Massachusetts]. She had written a book on the *Challenger* Accident [*The Challenger Launch Decision: Risky Technology, Culture and Deviance at NASA*] and indicated that one of the contributing causes of the *Challenger* accident was due to “normalization of deviation.” She indicated that the same thing occurred again on the *Columbia* accident. NASA had not taken the warning signs associated with foam coming off the External Tank during launch seriously enough. The pressure to fly the Space Shuttle to meet requirements of the International Space Station seemingly took precedence over numerous safety concerns.

I worked with Lester A. Reingold and Christopher M. Kirchhoff, the writers on the report, during my two months with the Board. We helped compile data; we drafted a rough outline and we gave writing assignments to various Board members, before I left the team. After gathering testimony from the witnesses and collecting results from the impact tests at the Southwest Research Institute facilities in San Antonio, Texas, the Board moved to Washington

D.C. They finished up the report at the ANSER's Headquarters facilities and released the document in August, 2003. I felt very honored to have played a small part on the team and to have served with Admiral Gehman, a fellow Penn State classmate, in this investigation.

ROSS-NAZZAL: How did you get involved with the *Columbia* Memorial Trust Fund?

BLUFORD: After the *Columbia* accident, Elliot Pulham, President of the U.S. Space Foundation, in Colorado Springs, Colorado called me one day and asked if I would participate in the *Columbia* Memorial Trust Fund activity. A group of individuals led by Richard Gelfond, Co-Chairman & CEO of IMAX along with Frank L. Culbertson, Kathy Sullivan, Charlie [Charles F.] Bolden [Jr.], and many others wanted to develop a trust fund for the families of those killed in the *Columbia* accident. The goal of the effort was to raise a million dollars for each family to cover expenses not covered by insurance. We were eventually able to raise over \$3 million from corporate and private donations, which we distributed to the families, tax free in 2004.

ROSS-NAZZAL: What do you think was your most significant accomplishment while working as a NASA astronaut?

BLUFORD: I was very proud to have served in the astronaut program and to have participated on four very successful Space Shuttle flights. I also felt very privileged to have been a role model for many youngsters, including African-Americans kids, who aspired to be scientists, engineers and astronauts in this country. For me, being a NASA astronaut was a great experience for which I will always cherish.

ROSS-NAZZAL: We thank you for coming in today and spending time with us. We very much enjoyed it.

[END OF INTERVIEW]