

NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT

ORAL HISTORY TRANSCRIPT

JOE H. ENGLE
INTERVIEWED BY REBECCA WRIGHT
HOUSTON, TEXAS – 5 MAY 2004

WRIGHT: Today is May 5th, 2004. This oral history interview with General Joe Henry Engle is being conducted for the NASA Johnson Space Center Oral History Project in Houston, Texas. The interviewer is Rebecca Wright, assisted by Sandra Johnson. This session is a continuation of the oral history session begun on April 22nd, where we talked to General Engle about his days with the United States Air Force at Edwards Air Force Base [California]. We're going to start again today with him sharing some more memories of those days as a test pilot.

We thank you again for taking time this morning to come in and visit with us. You mentioned some of the aircraft that you flew in our previous session, and I wanted to visit that topic one more time before we moved on. Are there others that you would like to talk about, especially the lifting bodies?

ENGLE: I was really lucky to get to fly the lifting bodies. Not very much, only one or two flights, but the lifting bodies, particularly the early versions of the lifting bodies, were very unique flying airplanes. They were difficult to fly. They required tremendous pilot attention to the task, because they had very poor roll-yaw coupling in the flight controls. There was no augmented flight control system and no stabilization in any of the axes, so it was all manual.

In fact, the one that I flew was the M2-F1, which was kind of the prototype, really, for all the lifting bodies. It was even made out of plywood by a fellow named [William "Gus"] Briegleb, who built gliders in the area out there. Paul [F.] Bikle, who was the head of what is

now [NASA] Dryden [Flight] Research Center [Edwards, California], was an avid glider pilot/sailplane pilot, and knew him very well and knew that he could construct a very low-cost vehicle of the right shape to check out the aerodynamic characteristics for that shape.

So the first of the lifting bodies was a plywood version and looked just like a bathtub. Probably flew about the same as a bathtub, too. It was not an easy, relaxing, fun vehicle to fly, but it was challenging and it was very, very interesting. It had a very, very low lift-to-drag ratio, which meant that you had to glide in very, very steep, in order to keep energy built up to flare and touch down and land then.

The flights in the lifting bodies were preceded by a course in glider flying, mainly so that we could get some time on a towrope behind a tow vehicle, and that was very useful. I had not done any soaring to speak of before then, but really thoroughly enjoyed that as well.

The first lifting-body flights were ground tows, towed behind a vehicle, behind a Pontiac GTO convertible. It had a 427 engine in it, I believe, a souped-up 427 engine and flat racing tires on the back end so that it had good traction out on the dry lakebed, and a five-speed manual transmission. I remember it was every hotrodder's dream, and Mr. Bickle very, very adamantly forbade any of the test pilots from driving it out on the lakebed, because he knew that we would just have too much fun with it out there. So we were restricted from driving the vehicle, but we were towed by that vehicle on our first lifting-body flights. Get us off the ground, familiar with the handling qualities of the lifting body, and then cut loose and glide back in.

Normally, the lifting bodies were towed behind a [Douglas] C-47 [Skytrain]. They were towed right up over the lakebed, circled up over the lakebed, then you'd cut loose and glide down and land.

Let's see. The lifting bodies were thought to probably be predecessors to controlled entry vehicles and horizontal landing vehicles, space vehicles. It turned out that because of the high demand on the piloting task for control of the vehicle and for landing, they were not really the right choice. There needed to be some wing on a vehicle to give it a little better glide ratio, give it a little better controllability and stability than the lifting bodies exhibited. Today, lifting body would probably be a conceivable thing to do because flight control systems and avionics have advanced so far that you can build in automatic or artificial stability and artificial control, as a matter of fact. So now it might be a more reasonable thing to pursue.

The purpose of the lifting body was to attain a very, very blunt shape that didn't have any sharp leading edges like a wing does, because those small-radius leading edges are very, very susceptible to high heating during the entry. The shock wave can stand in very close to them and transfer that heat of reentry to the structure of the vehicle much more efficiently than if you have a blunt body, kind of like a blunt prow on a boat as it goes through the water, the bow wave stands out in front of it, much the same as happens in a vehicle when it's reentering the atmosphere. So although the goal and the concept was good at that time, I think they were just a little ahead of their time.

The final modification to the lifting bodies was the X-24C. The X-24 was the third in a series of basic lifting-body shapes that were designed and attempted. Then the X-24 was modified and kind of a wing was put on it, which made it a much more controllable airplane, much more easy to land. The pilot task was reduced tremendously. And the X-24C probably had a lift-to-drag ratio or glide ratio very similar to the Space Shuttle.

The lifting bodies eventually, after the M2-F1, which was the plywood one that I talked about, all the rest were aluminum construction, and all the rest had one form or another of a

small rocket engine in them, either for landing in the pattern to flatten out the approach and flatten out the landing, give the pilot more time to land.

Or, in the case of the X-24, the engine was ignited, carried up—it was carried up much like the [North American] X-15, under the wing of the [Boeing] B-52. After launch, the engine would be lit and accelerated out, and the X-24C got to, I believe, almost Mach 2, and I don't recall the altitude, but it expanded the envelope enough to see that landing a vehicle of that type was very, very reasonable to proceed with.

That kind of summarizes what I can think of right now on lifting bodies. I didn't fly the lifting body very much at all. Mr. Bikle, once I started flying the X-15, my other flying duties down at Fighter Test Operations at the Air Force side of the ramp just about took up all my time, so I really didn't have any time to devote to the lifting bodies.

WRIGHT: Out of the three X-15 planes, you flew numbers one and number three. Did you ever have an opportunity to fly the modified X-15, number two?

ENGLE: No, I didn't. The -2, the modified airplane was, as you know, a rebuild of the airplane that [John B.] Jack McKay had had the landing accident with at Mud Lake, actually rolled over on its back and did extensive damage to the airplane. But the airplane is pretty tough. So the decision was made not only because the structure of the airplane, the fuselage was repairable, but also because there was a desire to provide a platform to take the scramjet engine, which was an engine design concept at that time to try and have an engine that would operate in the atmosphere at speeds up to Mach 8. The desire was to have some platform to get this engine out

to Mach 8, try the ignition, see if it could propagate the flame in the engine, and propagate ignition.

So the decision was made to rebuild X-15-2, put tanks on it to give it more propellant to accelerate out faster, and mount this small prototype scramjet engine on the lower ventral fin of the X-15.

[Robert A.] Bob Rushworth had begun the initial checkout on the X-15-2 and he received his orders to go to his next assignment, which was not imminent, but it was a few months, six to eight months down the pike. I was the backup Air Force X-15 pilot, and so I was designated to take over and do the envelope expansion on the number two airplane, on -2. But before starting the checkout program, the next NASA selection had come along and it was pretty obvious that I needed to make a longer-range career choice, whether to apply to come down here to NASA or to finish out the envelope expansion on the X-15 and then go to the next Air Force assignment, which there was no way of telling what that would be.

I chose to take the assignment to NASA here, and when I did that, then [William J.] Pete Knight was brought on board as actually Bob's replacement—actually my replacement on the program—and Pete was the one who then eventually flew the X-15 too and expanded the envelope on out, after Bob Rushworth left.

WRIGHT: Before you moved on to your assignment to NASA, you had more duties at Edwards, including one being a chase pilot. Could you share with us the duties of a chase pilot and how important it is to the success of the whole program to have that person in that place?

ENGLE: Chase pilots and chase planes were used extensively at Edwards, and they are very, very valuable. They're a safety item that provides visual observation and provides a lot of good operational information. If you're having an emergency onboard, the chase pilot always had a checklist for the type of aircraft you were flying, and he could go through and read off checklist items, emergency items, to make sure you didn't miss anything in taking care of an emergency that you were having.

It was very valuable in confirming that configuration on an airplane, particularly for any test data point, if you had flaps set in a certain position or a gear up or down, or if you had external stores on the airplane, confirmation that these were in place and that they were stable, the gear was down if you were going to land, or stores had separated, in many cases, at different speeds and flight conditions. And if you had some sort of indication that you had either a fire or a hydraulic leaks, the chase pilot could confirm or at least tell you that there was no visual indication of smoke coming out of the airplane or of a hydraulic leak, hydraulics coming out.

In the case of the X-15, probably one of the more valuable contributions of the chase pilot was after joining up in the pattern and following you down in the pattern, he could confirm that either the lower ventral fin had separated so that you could land the airplane okay, then as you flared and started to float into the touchdown and put the gear down, he could confirm that the gear was down.

On the X-15, it was very critical that the gear come down, of course like in any airplane, but particularly the nose gear, because the main gear, the skids, were located at the very aft end of the X-15, so as soon as they touched, there was no fulcrum for the horizontal stabilizer to allow the pilot to ease the nose down slowly. The nose was going to slam down very hard. It

was designed to do that for stability on the lakebed. The nose wheel had no steering, so the skids in the back created drag and that created the stabilization for the slideout.

But the nose came down so hard, that without the shock absorbing of the nose strut to absorb that impact, it would have crushed the pilot, vertebrae certainly, and done damage to the airplane. And the gear was not put down until after the flare and the float into touchdown because of the additional drag. So if the nose gear didn't come down, the chase pilot would call that out, and the X-15 pilot really had no recourse but to then punch out, bail out, right there, just before the airplane touched down, to avoid injury.

You couldn't tell how high off the ground you were and you didn't have power in the X-15—it was an unpowered landing—so being able to go in while your air speed was bleeding off very rapidly and get down close to the ground, be ready to touch down at the right speed, was very important in the X-15. And the chase pilot would fly in very close formation with you all the way down to touchdown and call out the height of the skids above the ground so you knew how high you were. It was a skill that good test pilots really developed in calling a very steady chant and a very even chant on height above the ground, every three feet, two feet, one foot, six inches, six inches, and if you ballooned a little, they'd call one foot, back to one and a half, so that you knew exactly what was happening and how far off the ground you were, and that was very useful. In fact, we did that on the initial flights on the Space Shuttle, using chase pilots to call the height of the gear above the ground, because at that point in time we didn't really have confidence in the calibration of the radar altimeter in the Space Shuttle, and we didn't have radar altimeters in the X-15.

Other instances, we spoke earlier of chasing [Jacqueline] Jackie Cochran when she set her speed record, the chase pilot could be a tremendous help in offloading the prime pilot, in this

case, Jackie. She was flying closed course, which meant essentially a continuous circle. She had to go outside of the imaginary pylons, which were determined by radar points on the ground, and had to hold a certain altitude. She had to end up, after completing the 15 kilometer closed course, she had to end up at an altitude equal to or higher than what she entered or it would be an invalid run. So it was a matter of her accelerating into the tangent of the circle she was going to fly, rolling in, holding a certain G-load, which meant a bank angle and back-stick pressure, not too much so that she cut inside the course, and not too little so that she drifted outside and had a longer course to traverse and therefore take her more time. In addition to that, she had to hold the altitude or at least end up with a positive altitude.

When she was developing her proficiency in this maneuver, the chase pilot, while she was concentrating on whichever variable she wanted to concentrate on, whether she wanted to concentrate on Gs or bank angle or altitude or what, there were a lot of variables shifting around, and the chase pilot was really valuable in helping the pilot develop those skills by calling out her altitude precisely if she started to drop a little, calling out the G-load if she started to deviate from the Gs at all.

It was interesting from the chase pilot's standpoint as well. In fact, it was probably more work from the chase pilot's standpoint than it was from the pilot flying the speed course.

WRIGHT: Did you have an opportunity to work as a chase pilot with her?

ENGLE: I did. Jackie and [Charles E.] Chuck Yeager were very, very close friends. They had flown together a lot. Jackie had taken Chuck on several overseas—in fact, one round-the-world trip in her [Lockheed] Lodestar—because they both loved to fly. And I think because everybody

knew Chuck Yeager, too, that she didn't mind having some doors opened whenever she needed to have doors opened, although she could open all of them she needed to herself.

But she also had a very strong desire to set the world's speed record for women. She did it in a [Northrop] T-38 [Talon] initially, and then it was broken again by Jacqueline [Marie-Thérèse Suzanne Auriol], a French aviatrix. And Jackie was determined to take it back in an [Lockheed] F-104 [Starfighter]. She was not current in the F-104, but was able to get permission to check out and fly one of Lockheed's bailed F-104s. It didn't belong to the Air Force, but it was a standard F-104. She had asked Chuck to help her get ready for it, practice and get ready for this run, and Chuck was working with her very, very intensely, and had a commitment—I think some weather delayed the attempt, the FAA [Federal Aviation Administration] attempt. It slipped into a time period when Chuck had a commitment on the East Coast, and I can't recall whether it was a Pentagon commitment or some kind of a commitment that—he was very good about keeping commitments. It was going to be practice weekend, so he asked if I would like to—he didn't ask me if I'd like to; he told me I was going to fly chase for Jackie that weekend. And I was really thrilled to death. He briefed me on the things to watch, things to do, things to tell her.

So Jackie and I flew together I think about eight flights over that weekend, with her practicing the techniques to use to polish and refine the course, the ground track, and the altitude that she would fly a couple weeks later on her attempt, and she successfully smashed the world's record for women with that 104 flight.

I was very thankful to Chuck in many ways, because I had known and admired her very much anyway, and it gave me an opportunity to get to know her, and she invited us down with

Chuck to her ranch on several weekends, several times, several occasions, and it was really a good friendship. She was a great aviatrix.

WRIGHT: Another time as a chase pilot, [Milton O.] Milt Thompson gives you credit for saving Bob Rushworth's life from a potentially serious accident by a timely call just before touchdown. Do you recall the situation?

ENGLE: Oh, boy, I sure do. It was during one of the envelope expansion flights on the -2, on the number two X-15, the one that had been rebuilt. The landing gear was deployed by a purely mechanical cable and hook mechanism, very simple thing, where you just pulled on a handle and the cable went over some pulleys and released a hook and the nose gear would drop down.

In the rebuilding of the -2 airplane, there were some parts of the airplane that were extended and expanded to accommodate for more fuel on board. The X-15 would expand, stretch, or swell up and stretch just like any metal does when you heat it up, so at high speeds it would heat up, it would expand in length. In fact, at Mach 6, it would expand over two inches almost, two and a half inches. And this cable, of course, was inside where it wasn't exposed to that heating, so it didn't expand as much.

In the rerouting of this cable, they forgot to take into account that the airplane was going to expand and the cable was not, so at about Mach 4.5, 4.2, I believe it was, the airplane expanded enough to release the cable and the nose gear had come down. There was a modification made to it, so Bob went up to get the next datapoint. And on this one, the little door which extends first before the gear came down, it was released, although the gear didn't

come down. It had opened up and the hot gas had gone inside, so we knew there was some damage in the nose wheel well.

I was Bob's chase for landing that day, so he came across the field, I joined up with him, with the F-104, and flew down with him and told him that the little nose-gear door was open and that we ought to be ready for some kind of anomaly on the nose gear extension.

So as he floated in to touch down, he pulled the landing gear handle and the main gear came down and the nose gear did not. It just hung there because there'd been enough heating damage inside and he was at a high enough angle of attack that it didn't fall down into the air stream; it just sat there and it kind of bobbed back and forth a little bit.

I was calling to him to "hold it off. Don't let the airplane touch down. Hold it off. Just keep holding it off. Hold it off." In fact, I think I said, "Hold it off. Hold it off. Get ready to bail." And I had just said, "Get ready to bail," and I saw the nose gear finally start to come down, and I said, "Don't. Don't bail. Hold it off. Hold it off."

He held it off as long as he possibly could, and it turned out that the nose gear finally latched and dropped down just before or about the same time the main gear touched and the nose slammed down. So he avoided some injury that day, but it was only a matter of precluding him touching down at the normal time, I think. If he'd touched down at the normal time, the nose would have come down before the gear was extended and then he would have had that problem of a very hard slapdown and either a very serious injury or get killed.

WRIGHT: On a completely different set of circumstances, Milt Thompson also tells of a special delivery that you made to a group of pilots stationed up in the High Sierras [Sierra Nevada Mountains] one time. Would you like to share that story with us?

ENGLE: Oh, you bet. Chuck Yeager and [Clarence] Bud Anderson, every year they would go on either a ten-day or two-week backpacking trip up in the High Sierras to fish; fish for golden trout. That was a delicacy and they were only found in the headwaters of the Kern River up there. So Chuck would pack up there with nothing but a backpack, and as I recall, it was a forty-four-pound backpack or fifty-four-pound backpack. I went with him a couple times, so I should remember. But you carried only your tent and enough dried food to last you for two days, because that's how long it took to hike to up to where the lakes were where the fish were, and then you ate fish for the rest of the time.

So at that time we would fly up in whatever airplane was on the ramp that we could get, just to check and make sure that everything was okay, and they had emergency signal mirrors that they could signal us and let us know exactly where they were on the ground. We'd fly down low and wave and everybody would know that they were okay.

Chuck had said that it gets pretty old eating fish for two weeks. Not that he was complaining, because he really liked to fish, but pretty much well along into their trek, their routing around up in the Sierras, I was going to go up and check on them one day, so I went over to the commissary and picked up some really nice thick steaks, and I was going to put them in a helmet bag and put the helmet bag in the speed brake of the 104, which opened up kind of like a clamshell in the back end, and close it, and then drop them to him, open the speed brakes and drop them to him. And I thought it would be kind of fun to give him something just as a joke, so I got some frozen fish sticks and put them in another helmet bag on the other side. The speed brakes opened up on either side of the 104. So on one side there were the steaks and on the other the frozen fish sticks.

I flew up and saw the flashing mirror and saw them, and went down low and wagged the wings, and they were waving. And I came back around real slow with the flaps down, and that normally means you're going to make a drop of some kind to them. When I got just about there to them or where I thought it was about right, I popped the speed brakes open and the bag of steaks came out just like they should, and fell and they hit very close to them on this high mesa where they were at. The other bag kind of hung up on the actuator, the hydraulic actuator that opened the speed brake, hung up for a while, flapped around until it tore the handle loose, and then it finally came out, but it fell down in a very steep canyon, down into the Kern River.

So Bud and Chuck ran over and picked the helmet bag up and saw these steaks and they were just beside themselves, Chuck said, that they knew the other bag had fallen down there and they were discussing whether or not it was worth going after those steaks or not, because it was a very steep climb down into the deep, deep Kern Valley, but they decided, yeah, for steaks it was. They spent the best part of a day going down, looking for that bag, because it was olive-drab-colored and didn't really stand out. But they found it, and then when they found out that they were frozen fish sticks, that was a good gotcha. That was one that Chuck hasn't equaled yet, but he's still trying.

ENGLE: And I couldn't have planned it any better, because they had the steaks. That was the hook. They had the steaks and they thought there were steaks in the other bag.

WRIGHT: Well, that's a nice relaxing time for them. Were there other trips that you guys took together to help relax and just get away from your tasks?

ENGLE: Yes. A lot of times we would find—there would be times when there was no particular flight testing that had to be done on a particular day and it was a nice day to fly, the airplanes were available, and they really encouraged us to fly as much as we could at Edwards, just to develop proficiency.

Chuck would call and say, “You want to go up north, make a run up north?” Well, that always meant a low-level run, because he had gone through gunnery school in World War II at Tonopah [Nevada], which is near Mud Lake, which is one of the prime dry lakebeds that we used for the X-15 emergency landings. He really got to know the area well, because they would fly low level and strafe at anything that they could with the [Bell] P-39s [Airacobras], when they were going through gunnery school.

So he loved it up there. He knew a lot of people, a lot of ranchers, and he knew a lot of fascinating things about areas, old mines, old cable cars that would go up over, haul ore up and over the mountains and down into Owens Valley, and he never ran out of new things to show me at low level. We’d fly up there, take a couple of 104s or a couple of whatever was on the ramp, and fly up and he’d point out these things to me. It was very fascinating, and the interesting thing was that we still fly together at Edwards. We get to fly the [Boeing] F-15s [Eagles] to open the [Edwards Air Force Base] Air Show every year, and one of Chuck’s favorite past times is to get a couple of airplanes and fly up there north, over Panament Springs and Tonopah and look at all the old places that we used to fly in World War II.

WRIGHT: You mentioned to us that you spent some time with the Confederate Air Force, but those were not high-speed airplanes. Tell us about the difference in flying the vintage planes.

ENGLE: Those were World War II airplanes and I, of course, grew up wanting to be a World War II fighter pilot, so for me, to get the opportunity to fly those airplanes was just a real thrill, a real nostalgic thrill, if there is such a thing. And actually, Chuck had been flying with them. He was the one who took me down and essentially introduced me to the Confederate Air Force and got me started flying down there, flying the airplanes down there. No, they're not fast, but they're our heritage. They were what won World War II and kept us from speaking German or Japanese today, I guess. [Laughter]

So I've always had a fascination with the aircraft that were used in World War II, both sides, as a matter of fact, and to fly those airplanes, it's a real thrill. It's a thrill for me, and I'm awed every time I think that people fought an entire world war in such basic equipment as those airplanes. It gives me a lot better appreciation of what they were up against when they flew their missions.

WRIGHT: Did you have one in particular that you liked to fly more than others on those vintage planes?

ENGLE: Oh, I think my favorite World War II fighter was the [Curtiss] P-40 [Warhawk], because that was what I initially wanted to be, was a P-40 Flying Tiger pilot, and that was the first airplane that I really got to know anything about. It was not the best flying airplane. It was not the highest performance by any means, nor was it the easiest to fly, although it was a very easy, straightforward airplane to fly.

The P-51, I think, was probably the most enjoyable World War II fighter that I have had the opportunity to fly. I did get to fly a lot of the airplanes; the P-40, the [Republic] P-47 [Thunderbolt], the [North American] P-51 [Mustang], the [Bell] P-63 [Kingcobra], P-39, and the [Lockheed] P-38 [Lightning], and all of them are very, very fun. They've all got their own unique personality, and I wouldn't trade any of them. I wouldn't trade the flights in them for anything else. But my favorite airplane was the P-40, and probably the nicest flying was the P-51.

WRIGHT: Were there some during your time at Edwards that you had to check out in and be responsible for taking up that you just didn't like?

ENGLE: No. I never met an airplane I didn't like. Some of them are less relaxing and less enjoyable and less fun to fly, and some of them are a lot more work to fly than others, but they've all got their own characteristics, they've all got their own personality, and I really, really enjoy any new airplane, any airplane.

WRIGHT: Just a few months after you took your final flight in the X-15, you became part of NASA in the astronaut corps. Tell us about how that transition occurred and how you made that move, and why you decided to take that path instead of staying with an Air Force assignment.

ENGLE: Well, as I mentioned, I knew that my flying at Edwards wouldn't be open-ended. I couldn't stay there as long as I wanted. I knew that I would probably be reassigned within a year, because I'd been there for quite some time and that's just the Air Force policy of rotating

you around to other assignments so that you have a good diversified career. So I knew that I was going to be reassigned.

I did apply and was accepted on that particular class of astronauts, and it was not without some reservations. I had some mixed feelings because I was leaving a very, very good flying job, the best flying job in the world at Edwards, for something that was unknown and something that was known it would not be as good airplane flying. But at that time the emphasis on selection of astronauts was on test pilots because of the type of the programs and missions that were being flown and the nature of the missions.

To me, it was somewhat an extension of the test pilot discipline, of the test pilot career. There was talk of controllable reentry vehicles, flying a vehicle back into the atmosphere, because we were working on the lifting bodies at Edwards at the time. So I kind of had that in my over-the-horizon view, I think, that I did want to go to the Moon, and that was the main purpose for the selection of our class. I did want to go to the Moon. I thought that would be a tremendous envelope expansion and wanted to do that, and then had hopes of being able to be part of whatever the vehicle was that came along that would be the reentry vehicle, which eventually was the Space Shuttle.

WRIGHT: You already had space experience, basically, because you had received your astronaut wings when you reached that threshold in the X-15. You were the only astronaut of your kind to come across to NASA. How were you and your class received by the astronauts that were already in place? What were some of your first assignments and tasks that you began working with them?

ENGLE: I sure didn't notice anything but a very warm welcome by all the people who were already selected. I think the feeling was that any new guy that came in—and our class was certainly the new guys—when the new guys came in, they went to the end of the line as far as getting a flight anyway, so there wasn't real concern on that. And I don't think at that time there was quite the feeling of flying and then turning around and flying again right away that there is now with the Space Shuttle, just because of the nature of the flights. You know, we fly much more often now and you're expected to fly a number of times now. So I don't think that feeling was there.

I know that we had a very large class, a class of nineteen, and after our class, the selection of astronauts continued to grow faster than the number of seats that we could see opening up downstream, and even [Donald K.] Deke Slayton at the time would tell new classes, he said, "I don't really need you, I didn't really want you, but you're here, so here's what I'm expecting of you," and that was pretty much your welcome speech. Of course, eventually just about everyone did fly.

But I didn't notice any resentment at all on the part of other astronauts in the office. In fact, much to the contrary; very warm reception, very much one of willingness to help get started, get your feet on the ground, and get running.

WRIGHT: Chuck Yeager was such a mentor to you in the Air Force. I'm curious, was there another figure of that type when you came into the astronaut program, someone that you worked closely with?

ENGLE: I think Deke Slayton was. Deke commanded the respect of everybody, the old guys, the new guys, and everybody, because he was very, very straightforward, very honest, very straightforward. I can't really remember for sure, but I know when we were selected, if you made it, if you were selected, Deke called you, and if you weren't selected, it seems to me like somebody else called and I can't remember who it was, to tell you that, you know, "Very impressive résumé," and all this, "but we'd like for you to try again next class."

But if Deke called you, you knew you were in, and it was not a real emotional high-grade sales pitch; it was, "This is Deke Slayton. Want to come down and work for me?" And that was about it. You said yes or no. [Laughs]

WRIGHT: How soon after you got the phone call did you report to Houston?

ENGLE: I don't really remember that. Probably a couple of months. I would think about two months, but I really don't recall. It wasn't an awfully long time, but long enough to get the transition made okay.

WRIGHT: And quite a difference in location from being out in the desert to the [Texas] Gulf Coast.

ENGLE: Well, it sure was. There were a lot of differences in reporting down here, positive and some not so positive things. I think the weather was not so positive. I was down here over the summer. While our home was being built, I was down by myself, and I just stayed out at the BOQ [bachelor officer's quarters] out at Ellington [Air Force Base, Houston, Texas], the old

BOQs, and they didn't have air conditioning out there. Got down here in the middle of March, so I was here in April, May, June, July, the hot, muggy part of the summer, and didn't know a whole lot different at that time, so although it was uncomfortable, I wasn't miserable. But it was sure a shock. The weather was a lot different than the dry heat of the high desert.

NASA was a much bigger organization than what I had ever been exposed to before. It was kind of a cultural shock for me. In the first place, it was a nonmilitary environment and I'd never worked in a nonmilitary, other than down at NASA Dryden, which, since it's located on an Air Force base, the culture is a little bit more military there.

But I remember my first feeling was that they're just paying way too much attention. The media and, in fact, the people in the residential areas, meaning well, but my impression was they just paid way too much attention to the new guys when they got here, before they'd done anything. The guys that had flown, that was okay, but when you just check in and you're getting ready to start training, and all that media attention, and all of the things that were done for you, I was very uncomfortable with that, I remember.

WRIGHT: How did your experience as a test pilot and X-15 pilot help you with the training as an astronaut?

ENGLE: It probably gave me a little confidence and self-assurance that I was going to be working in an environment that I had at least been exposed to; high altitude, high task demand, tasks that demanded a lot of attention and concentration. The environment of living in a spacesuit, a full-pressure suit, were all things that I really had no qualms, didn't have to think about, really, which was good. I think I was the only one in my class that did not have an advanced degree, didn't

have a master's degree or higher, I had only a bachelor's degree, and so probably it was a good thing. I would have been very, very concerned, I think, if I didn't feel that I at least had something to counter the academic levels of my counterparts.

I was very surprised, in fact, when I was selected, because of that, after looking at the list of guys who hadn't been selected, very surprised that—the trend had already been started toward focusing more on education, and there were more and more test pilots who did have advanced degrees. So I was a little pleasantly surprised when selected, because I didn't have an advanced degree. I perhaps had the opportunity for more flight test experience, but my academic background was not as strong as others'.

WRIGHT: It wasn't too long after you joined NASA that the [Apollo/Saturn, AS-] 204 fire occurred. Could you share with us your thoughts of that event, how it affected you, and how it impacted the astronaut corps? Then if you'll tell us how you were involved in the role of the investigation, if at all.

ENGLE: I wasn't involved in the investigation at all, because at that time, our class of nineteen was still in our training cycle, and our time was totally focused on the training program, the training curriculum.

It certainly was a shock. We certainly followed the tragedy and the investigation, and the causes for it. In fact, I think, as I recall, my first meaningful assignment after our astronaut training session year was to be assigned to the crew of—it was called 2TV-1, a thermal vacuum test. It was an eight-day test to put the newly designed vehicle in the big thermal vacuum chamber here at NASA and put a crew in so that all of the life-support systems were exercised

and tasked and all the electronics were tasked, and many of the things had to be done manually from inside the vehicle anyway.

So [Joseph P.] Joe Kerwin and Vance [D.] Brand and I were selected as the crew of 2TV-1, to go into the chamber for eight days or ten days? I think it was eight days. The chamber was pumped down to a vacuum and heat lamps were turned on, and we lived inside the Apollo Command Module for eight days. So that was really, as I say, that was my first meaningful what I considered contribution to the program.

WRIGHT: What was that like? Because that was quite an event at that point in the history of NASA, to spend that much time in that module as a testing.

ENGLE: We didn't think of it as being quite such a monumental thing. We were kind of bored in there, actually. [Laughter] I think I pulled on my hunting and camping skills to living in a confined area. Being confined in a tent while it's raining for several days, with a couple of guys, that was good training for 2TV-1. [Laughs]

We did learn. We did learn a lot about living in a confined area like that. We were really busy operating all of the systems, going through the checklist every day to operate the systems that needed to be exercised and checked out, so it wasn't a real bad experience.

WRIGHT: Just a memorable one.

ENGLE: A very memorable one.

WRIGHT: The progress did occur, though, through the Apollo Program, and Apollo 7 was launched and 8, 9. Describe what you were doing during the times of these missions and what you were doing as part of your training program and preparing for your turn.

ENGLE: I think even after our training period as a new class of astronauts, we were exposed to geology, because at that point in time everyone was a potential lunar surface crewman. The geology training I really thoroughly enjoyed. It was one of the most valuable pieces of new knowledge, and a discipline that I had not been exposed to before, and I really thoroughly enjoyed it. Plus, it meant traveling literally all over the world to different geologic sites, because at that time they weren't certain at all what kinds of geology would be found on the Moon, whether it would be sedimentary or volcanic or just what. So we were exposed an entire spectrum of geology and geology features, and by doing so, we did, in fact, go to Hawaii and Alaska, Mexico. We did go to Germany, but that was for specific training with regards to the Apollo 14 crew site. But the geology was one of the things that I really enjoyed the most.

In addition to the thermal vacuum testing on 2TV-1, I was given a task to monitor and evaluate different concepts for a lunar surface transporter, it was called at that time, crew vehicle. The rover we call it now, but at that time the concepts for how to get around on the lunar surface, beyond walking distance, really hadn't focused in at all on what type of vehicle it ought to be. And one of the more interesting ones was a rocket flyer that you strapped on your back, and I think you may have probably seen at football games or demonstrations, the rocket man. He's flying this rocket-powered vehicle. That was one of the concepts that was being considered at the time, and I think one of my more interesting flights was up at the Bell [Aerosystems

Company]—no, it was at [NASA] Langley [Research Center, Hampton, Virginia], I guess it was. Bell built the rocket pack.

But I convinced them that if I was going to give it a fair evaluation, I really needed to fly it. So they did let me strap it on, although I was tethered on a big rig and only got to fly up and around a very limited area, but I did get to fly that. That was a lot of fun.

I spent a lot of time at [NASA] Marshall [Space Flight Center, Huntsville, Alabama] in the development of what is the lunar rover now. That was interesting, fun and interesting, too. I like mechanical things, and that was very interesting to consider the requirements that were going to be needed on the Moon and the limitations, and factor those into the design of the rover vehicle. Not only the mobility of the vehicle itself and the type of suspension, the type of wheels that would be used, the type of tires that would be used, but the type of controllers that would be used, because in an inflated suit on the lunar surface, you had very restricted mobility and so all of the controlling functions had to be done with very limited movement, and with as few levers and things as possible so you didn't bump into them when getting in and out of the vehicle.

WRIGHT: So did you have an opportunity to take it out to the back forty and use it?

ENGLE: Oh yes. [Laughs] Oh yes. Yes, we did. We really worked it out and learned a lot while we were developing it, too.

[End of interview]