REMEMBERING APOLLO 8

By Christopher C. Kraft

Christopher C. Kraft *arrived at the Langley Aeronautical Laboratory just a few months after graduating from Virginia Polytechnic Institute. Those first steps through the gate in 1945 led him on a lifetime journey of looking beyond the boundaries of Earth. For the next thirty-seven years, Kraft used his engineering background and leadership skills to build and then strengthen America's human spaceflight program. Serving in management positions for more than two decades, Kraft guided operations in Mercury, Gemini, and Apollo missions, then led Johnson Space Center as its Director for more than ten years. After retiring in 1982, he provided his expertise to aerospace companies, began playing more golf, and wrote a book, titled* **Flight**, *reflecting on his experiences at NASA. Awarded numerous distinguished honors in his career, Chris Kraft continues to be recognized for his contributions in achieving the nation's greatest technological triumphs.*

Apollo 8 gave the world the first look at itself and set the nation on a nonstop path toward its goal of reaching the moon by the end of the decade. Some refer to the mission in December 1968 as the highlight in a year full of turbulence for the country; others still call it, even after forty years, the "most gutsy" decision NASA ever made. One of these people is Chris Kraft, famed pioneer flight director and former director of Johnson Space Center. He recently shared his thoughts during an interview with the JSC History Office and reflected on this historic journey that, for the first time, sent a manned spacecraft around the moon. He began by explaining how Apollo 8 cannot be appreciated unless "you know the situation we were facing in the summer of 1968."

As you recall, in January of '67 we had a fire; we killed three people. This was very traumatic for all of us, very tough on us. However, it was, without question, the turning point in the Apollo Program. Had we not had that event take place, it's a strong possibility we wouldn't have gotten to the moon in the '60s, and a strong possibility we wouldn't have gotten there at all.

At the time President John F. Kennedy said we're going to the moon, we had maybe 350 to 400 people working on the Apollo Program. There was a tremendous management challenge to build this monster program, and a tremendous number of unknowns—a tremendous difference between going from Alan Shepard's fifteen-minute flight (May 1961) to leaving Earth's gravity and landing on the moon. The magnitude of difference there was indescribable.

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President John F. Kennedy pins NASA's Distinguished Service Medal on Alan B. Shepard Jr. (left), honoring the astronaut for his flight in May 1961.

Not only was there not a large number of people in the Apollo Program Office, there was a whole group of new people—a lot of good, a lot of smart, a lot of very highly motivated people. But most of these people who came into the program were from unmanned programs; they were inexperienced in manned spaceflight and they were running too fast.

As a result, those of us working in Mercury and then Gemini, both in operations and engineering, had a darned hard time getting these people to recognize the implication of the human in the design of a space vehicle. Myself and a number of others were trying very, very hard to impress to the new people, particularly the upper management, that they were ignoring the lessons learned from previous programs. We could see the results of their labor and we could see the results of the contractors who, most of them, were also new to manned spaceflight.

In the late part of 1966, we were coming off of Gemini and able to put our best experienced people onto Apollo. The reports from Cape Canaveral, from the Thompson Committee which reviewed the Apollo 1 fire, described the quality of the hardware being delivered as a disaster waiting to happen. I could see it myself, because I'd been spending some time at the contractor's in California. John Bailey, who Bob Gilruth and I knew from the NACA (National Advisory Committee for Aeronautics) in the '40s and '50s, went to the Cape as our special representative down there in the '66 time period.

He kept writing these memorandums back to Gilruth, the Center Director, which were distributed among the top management, which said, "This hardware is not very good. The people are really not very good at checking this thing out. They're not very good at trying to maintain some semblance of the fact that a human being is going to be in this machine. I'm telling you, it's not good."

Now, on top of that, we had the management of the program bypassing the top management of the Manned Spacecraft Center (MSC), literally bypassing Gilruth. I spent a lot of time trying to convince the Apollo program manager, who was ignoring our inputs, that he needed to take advantage of the tremendous engineering experience and talent that we had at the Center.

That's the situation that we had in January of 1967. It was a tragedy, not only from the standpoint of loss of life, but from the standpoint of the program itself, because it was a situation that did not have to be that way. We were faced with a tough road technically, a tough road management wise, and a tough road politically because Congress, at that point, was not very happy with NASA. We had a lot to overcome.

Order out of Chaos

Fortunately, NASA had George Low. I can't emphasize how extremely important George Low was to the situation I just described, from every point of view: technical, management, and political—he had experience in all of those. George was the deputy director of the MSC; he had been in Washington from the beginning of manned spaceflight; he was very much involved in the decision-making process with John Kennedy to go to the moon. He was the ordained man to take the job. He knew what was wrong.

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Apollo 1 crew (left to right) Virgil I. Grissom, Edward H. White II, and Roger B. Chaffee died in a fire on the launch pad, January 1967.

NASA S70-27117

Chris Kraft (left) credits George Low (right) with advancing the space program.

The powerful 363-foot-tall Saturn V space vehicle launches early morning in November 1967 for the unmanned Apollo 4 mission.

NASA S67-50903

So, George Low becomes the Apollo program manager and brings order out of chaos. He immediately appointed a board, called a Configuration Control Board, and appointed all of the top managers at the MSC as board members. You could not send a representative to that meeting. You personally had to go. He had a meeting every Friday with that top management group. He had a meeting every day at noon to review the program.

Low then went to see the presidents of those companies building the Command/Service Module and Lunar Module, and had half of their top management removed. He began to get a hold of the program, solicited the advice of the top management of the Center, and brought the program to a place where it was obvious that it was healing.

Regarding the hardware, we had a meeting to list all of the things that everybody wanted done to fix the vehicles, to fix the management, to fix the rockets, to fix everything that had to be done. There were hundreds. There were 125 top ones. We listed their importance and then categorized them. We ended up, a year later, doing every one of them.

Operational Capabilities

The Marshall Space Flight Center under Wernher von Braun was building the Saturn V. They're rocket people. They know the rocket business. When we flew the first Saturn V, it looked like it was a great flight, but it wasn't. We had problems on the first, second, and third stage. They were not serious problems on that first flight because it made it. It did its job.

Well, the second flight was a disaster. I want to emphasize that. It was a disaster. The first stage had pogo (bounce). The second stage had pogo so badly that it shook a twelve-inch I-beam; it deflected a foot as it was flying in the second stage. The third stage ignited and then shut down, and it would not restart, which was a requirement to go to the moon. It also had some vibratory problems. Here's the Saturn rocket that everybody thinks is a wonderful piece of hardware but it almost busted itself into pieces in all three stages.

In July of 1968, the Command/Service Module had become a good-looking piece of hardware. That part of the program was really progressing well, and we all had a great deal of confidence that it would fly and fly well. But the Lunar Module was a mess. It was a mess because it had to be light and we were using these very delicate pieces of structure. Just everything was going wrong with it and it wasn't going to be ready for a while.

During those early Apollo planning meetings, we had set out various categories with objectives that we wanted to accomplish.

We wanted to prove to ourselves that the hardware was satisfactory and would accomplish the operational capabilities that we had set out in terms of rendezvous, docking, heat reentry capabilities, control, navigation and guidance, et cetera—all needed capabilities to reach the moon. We believed it probably would take more than one flight to accomplish the tasks we required; we thought to prove this, it would take us two or three flights.

Turned out, it took us one flight to do them all. That was a surprise to all of us.

A Change in Plans

In July of 1968, George Low could see that he was going to have trouble meeting the schedule. George was trying, in his mind, to come up with something that would advance the program but, at the same time, give him some time to get the Lunar Module corrected from both a structural and a management point of view and a checkout point of view.

So he called me into his office one day, and he said, "I'm thinking about trying to do something with the Command/Service Module (CSM) after the first manned Apollo flight, assuming that the first flight is very good if not perfect. I was thinking about a circumlunar flight."

I told him I would have to think about it a while. Asking us to go to the moon on the next flight after the first flight was quite a chore. Plus, that idea leapfrogged the program over these early orbital operations that we wanted. I thought we could probably hack that, if we worked our butts off. I didn't know about the Control Center, though, because we had a lot of problems in the Control Center with the magnitude of that hardware and the fact that we had a lot of new display systems.

Later, he called me into his office again and asked, "Well, what do you want to do?"

I said, "I think we ought to seriously consider it."

Then he said, "Let's go down to see Gilruth."

When we had some serious problems, we'd all have a bull session about it around Gilruth's table. We talked, just the three of us, for maybe a half an hour. We were talking about a circumlunar flight, just sending it up there, going around the moon. Gilruth liked the idea.

NASA S68-18733

Two pioneers of human spaceflight, Chris Kraft (left) and Robert R. Gilruth monitor the operations in the Mission Control Center, Building 30, during the Apollo 5 unmanned space mission launch (January 1968).

They both thought the achievement of this plan would give us a leg up on the Russians. I didn't know as much as they did about what the Russians were doing. Although I was asked to participate in all those secret briefings they were getting, I would not because I was with the press too much and was afraid of what I would say. Gilruth said, "We ought to call Deke in."

We got Deke Slayton, the director of flight crew operations, on the phone. He came in and we talked about it for another half an hour or so. We went out of that meeting with Deke going to see what he could do in terms of crew training and crew assignments, and how he'd have to shuffle crews because he had the astronauts all going in certain directions based on our originally laid out game plan.

Excited as Hell

I called in my top guys, and we sat around a table in my office, and God, they were excited as hell about it. I didn't expect that from them. I thought I'd hear all this doom and gloom, and I got nothing but, "God, that's a great idea."

We didn't want to let out as to what we were attempting to do here. In fact, we didn't know what we were attempting to do when I first got this group together. I was limited, as all of us were, in the people that we could talk to about it. We knew if this idea got out to the public, we'd be in deep serious trouble. It would spread like wildfire. We knew that it would mean a hell of a change to the press, it would be a hell of a change to the Russians, it would be a hell of a change to the politicians.

So, overnight, my guys went off and looked at this thing, and when I got to my office the next morning, they were there. They wanted to talk. They came in, excited, and they told me, "Yeah we think it's a great idea, we don't know whether we can do it or not, and we think we ought to do it." But then they said, "There's one thing we want to do which you haven't mentioned—we don't want to just *go* to the moon, we want to go in orbit *around* the moon."

Now frankly, that's an order of magnitude difference in risk right there. Of course my reaction to that was, "Why would you want to increase the risk?"

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Kraft (in jacket) stands with Apollo 8 Flight Director Glynn Lunney (left) during the historic mission that sent humans around the moon for the first time. Pictured also are Flight Directors Milton Windler (center) and Clifford Charlesworth (right).

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They said, "Well, we've been looking at the data from the tracking of the Ranger and the Lunar Orbiter around the moon, and we cannot do the orbital mechanics to determine the orbit in the first place, and then to predict where the spacecraft is going to be from the back side of the moon to the front side of the moon. Every time we do it with the gravitational models of the moon that we have, we miss by about two miles. We can't figure out why that's happening. But if we were to put the CSM in orbit *around* the moon, and measure it at the same orbit that we're going to fly to *land* on the moon, we could develop an empirical set of formulas which would allow us to do the right orbit prediction around the moon."

I don't remember exactly what my reaction to that was, as I didn't know whether that was a good idea or not. Frankly, I didn't know whether I could convince George Low to do that, because the service propulsion system engine had to work. You can go on a circumlunar flight without the engine. You can go at what we called a free-return trajectory. But you have to have that engine to put you into orbit *around* the moon, and you have to have the engine to get you *out* of orbit around the moon. So that really increased the risk probably an order of magnitude, if not two orders of magnitude, at that point in time.

Remember—we hadn't flown the Command/Service Module yet. We didn't know whether that hardware was good hardware or bad hardware. We thought it was good. All the engine tests were wonderful. But we didn't know. Anyway, I cogitated on that for about twelve hours or so, and then George called wanting to get together again to see what Deke and I had come up with.

Dead Silence in the Room

We met and started talking, then I threw this thing into the punch bowl and said, "Well look, if we're going to go, my people—and I think they're right—want to go in orbit around the moon."

There was dead silence in that room when I said that. They were shocked. But they listened. I did my best to convince them because I wasn't convinced totally 100 percent myself. I told them what we wanted to do, why we wanted to do it. George, just thinking about it a few minutes, said, "Well,"—and Deke, he didn't say much. He just reported what he would do.

As we discussed the possibility, we got pretty excited, and Gilruth said, "If we're going to do this, we got to get Wernher on board." He went right to his phone, picked up the phone, called the Marshall Space Flight Center and said he wanted to speak to Wernher.

The secretary said, "He's in a meeting. Can he call you back?"

Gilruth said, "No, I want to speak to him right now."

That shocked her on the other end. But after about five minutes, Wernher came to the phone. Gilruth told him that we'd been talking about a change in the program that would require his okay and his rocket. He didn't tell him what we were talking about, but said, "We'd like to come talk to you about it."

Wernher said, "I can probably see you tomorrow."

Gilruth said, "No, I want to see you right now. We'll fly over there right now and talk to you about it."

After we hung up the phone to von Braun, Low said, "I better call Sam Phillips (Low's boss). We can't go any further in this thing without getting Washington involved in this." It turned out Phillips was at a meeting at Cape Canaveral and said he'd join us.

We got on the airplane, flew to Huntsville (Alabama), and we all sat down in von Braun's office. Gilruth said we had a plan to fly to the moon on a flight after the Command/Service Module test in October. George explained the problems with the Lunar Module, what we thought about the CSM, what he thought the hardware could do, what he thought we could do. He said, "I haven't talked to Sam about it, but here's what we want to do." Then he looked at me and said, "You tell them what we want to do."

So I got up and described this mission. I could tell from the looks on the people's faces that they were surprised, but they began to become quite elated about it. Phillips responded immediately and thought it was a great idea. He recognized what a boost to the program it would be if we could pull it off.


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But he recognized the risks involved, the risks of getting ready to do it, the risks of being able to do it, the risks of having an almost perfect flight on the first flight of the CSM that would allow us to do it. Phillips said, "This is a pretty serious change, it's a serious risk, it's a serious thing in terms of convincing our own management and the politicians, so I don't want to talk about this outside of this room until we've thought about it, and see if there are any showstoppers, and we'll have a meeting two days from now."

Two days later we had a telephone conversation, and everybody reported, and everybody was going for it. Sam said okay, after we got through telling him what our problems were and what we thought we could do. He said, "I've got to expose this to Mueller and Webb."

NASA Administrator Jim Webb and George Mueller from the Office of Manned Spaceflight were in Austria attending an international space meeting. Sam talked to them and told us they were livid, saying how we were reshaping the whole program while they were out of the country for a few days. But Sam, a very competent human being, a great manager, and a great representative, said, "We're going to continue on because I think it's the right thing to do."

Then we brought Tom Paine, the Deputy Administrator, into the situation. Sam could tell that Paine liked it, but Paine wouldn't react. However, he did approve of going ahead with our plan, adding, "You've got to keep this secret."

Well, after a couple of days I went to see George, and I said, "We can't keep this thing a secret anymore. I've got to have at least seven or eight more guys to know the whole game plan here."

Deke had the same problem. "We've got to start laying this thing out if we're going to do it."

So they agreed that we could get a few more people involved. But they couldn't talk about it. We had to do it as if it were a general game plan.

When Mueller came back, we had meetings and meetings in Washington. He was still very cold to the program. He got recommendations from other people, and they were cold to it. He talked to Webb about it, and he was cold to it. But it turned out that Paine, who was Webb's deputy, thought very favorably about the idea. So we proceeded, convincing everybody that well, look, we're not saying we're going to do it. We've got to fly Apollo 7 first, that's number one, and it has to be practically perfect.

Webb said to continue to work on it and told us, "I'll have to announce that to the press, that we're doing this sort of thing, and I will couch it in the terms that it is a possibility being considered that we might do this for the various reasons that you guys have given me from the standpoint of the Lunar Module, et cetera." I don't know who else he talked to. I'm sure he must have talked to the heads of the committees in Congress. Probably talked to the White House. I'm not even sure he didn't talk to Lyndon Johnson about it, because he knew Johnson very well, as a personal friend.

George told us that all of that was going on, but I didn't pay too much attention. I had too many things to do.

High Risk

We had the flight of Apollo 7 (October 1968), and it was perfect. It was about as perfect as any spaceflight could be. As a matter of fact, for a first flight, it was uncanny. Nothing failed. Nothing. We've got the success we were looking for and now we've got to make a decision.

So we go to Washington. Gilruth, George, Deke, Bob and I—we're going back and forth to Washington like rubber balls to get this thing approved. Mueller tells us, "I'm going to talk with the presidents of all the companies and see what they have to say." I could tell he was getting a little warmer to the idea, but he had a lot of advisors telling him that there was too big a risk.

We had this meeting in Washington with the presidents of all the major companies—and I guess there were eleven or twelve of them—that were involved in Apollo. I was the major guy to make the presentations, along with George Low. He gave the management, the program management description, and I gave the description of what we wanted to do and why we wanted to do it from an operational point of view. George asked all these guys what they thought, and with one exception all of them thought it was a good idea.

They all admitted that it was a high risk. They thought, just like we did, that it was a tremendous step in the program, and that if we could pull it off it would really be a step function increase in both the morale and the confidence that we would have in doing the job.

and it has to be practically perfect."

Going to Change the World

Before we got too much further, Jim Webb left as NASA Administrator. Tom Paine was now the Acting Administrator and he was working through a checklist a mile long of people they had to consult with, because it was something that was going to change the world. Their checklist went all the way to President Lyndon Johnson.

Within twenty-four hours of NASA having made the decision that we were going, they said, "We've got to check with the outside world." So within forty-eight hours of having a go decision to do a lunar operation, we exposed the plan to the press. It was a headline in every technical paper and a headline in most newspapers that NASA is going to the moon on the next flight.

Once the news was out, we were met with total excitement and exhilaration from everybody at the Manned Spacecraft Center. They all recognized what a challenge that was, and what a shock to them, like the rest of us, that NASA was willing to do it. We were a very great organization, and able to do what we did technically, but we still were bureaucratic. The planning to do what we were doing had been in place for a couple of years. But now, we were suddenly faced with having to do it, and do it out of sequence from what we had planned to do.

From then on, it was: Get it done. Get the operation done, get the software done, get the people trained, define our goals, state our objectives, determine what tests we want to run to make sure while we're there we do this, that, and the other. Laid that out minute by minute. There were plenty of stopping points along the way, plenty of places along the operational mission where we could stop and regroup and reconsider.

For the First Time

We told the scientists, okay, for the first time, we're going to have six eyeballs able to look at the moon from sixty miles away. Never been to the moon with anybody's eyeballs. We got them involved in telling us what they wanted to see, what they would do if they were inside that spacecraft, what would they look at, what they want to know about the moon, what we want to get out of it, what you want them to report. They began to think about that and said: Tell us the color, tell us the shadows, tell us the shape of things, tell us the crater size, tell us how many craters you see, what you think it looks like compared to Earth.

We had to rendezvous with the moon, and we had never done that before. We wanted to replicate the proposed lunar landing mission in terms of altitude above the moon and trajectory across the moon's face. We wanted to look at the gravitational model from that altitude. We were told, "You don't know that you're that accurate. You don't know that you can hit the moon within 60 miles as you are aiming at it from 270,000 miles away. You don't know that your radar is that good. You don't know that your tracking is that good." All correct.

But we had previous missions that we put up there, Ranger and Lunar Orbiter, and we'd done that very, very well.

The Apollo 7 crew returns from a perfect spaceflight, clearing the way for Apollo 8. Pictured (left to right) are astronauts Walter M. Schirra Jr., Donn F. Eisele, Walter Cunningham, and Dr. Donald E. Stullken, Recovery Team Leader, MSC Landing and Recovery Division.

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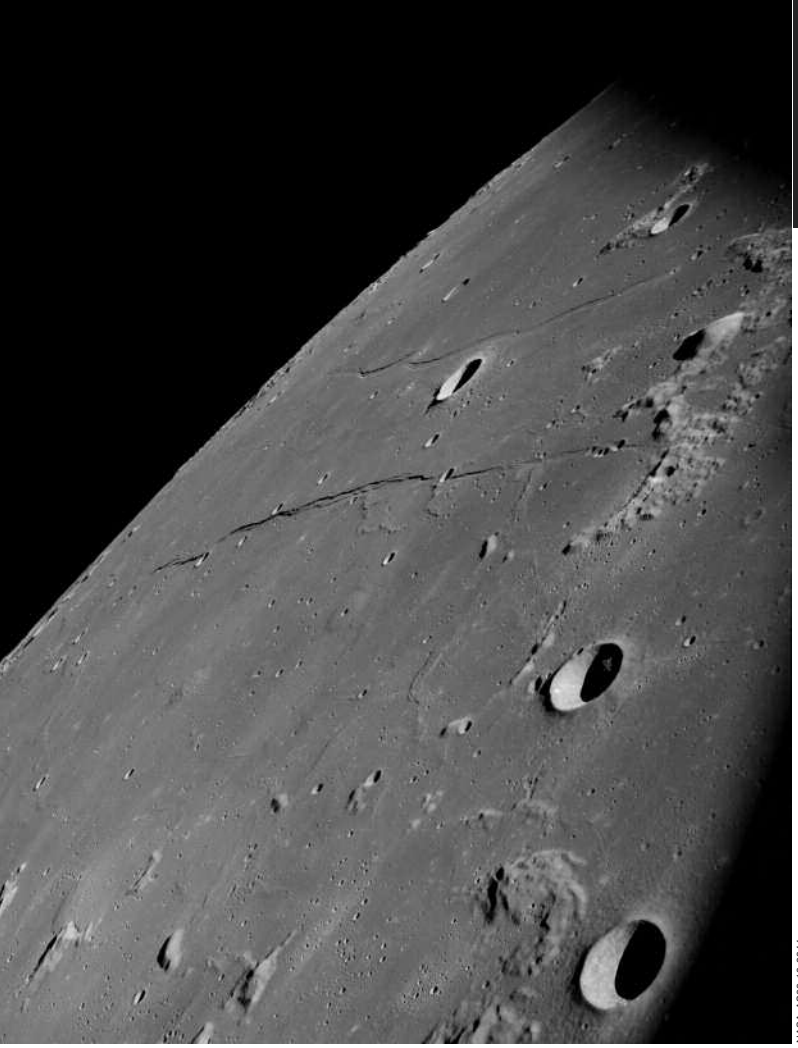


NASA AS08-13-2344

Apollo 8 captured this photograph looking into the Sea of Tranquility, the proposed landing site of the first lunar landing.

The tracking system, the deep space tracking network, had done that very well. They had told us what we were getting from Lunar Orbiter around the moon too. So we weren't dumb. The thing we were dumb about was that nobody had come up with mascons* yet. That's what screwed up the gravitational model. You may not believe that, but the things that had hit the moon and left these big core things of iron probably jammed into the face of the moon and had changed the gravitational effects, and that has a perturbation. Generally speaking, it doesn't change things, but when you're trying to get very accurate, it does perturbate the orbits.

We had to plan the whole recovery operation. It involves layers upon layers of people within the U.S. Navy and the Department of Defense; involves thousands. We would be recovering the crew in the Pacific for the first time, and we didn't have any people trained in the Pacific. They were all in the Atlantic. Got to train the frogmen, they need to know where the spacecraft might come down and what the dangers are, what they can do around the spacecraft. Teaching them that they can't touch this but if you do, you're going to get burned; this is how you open the hatch if you have to open the hatch, and here are the tools you can lift it up with, and then you got to crank this thing on board. The astronauts might be sick. This big bubble's on top, the balloons. All of that training has to be done.

Flight control team had to be ready. They're pretty resilient and they can do most anything. Their "what if" games during training are so broad you can't hardly ask them something they haven't thought about. We then laid out the flight plan and had the time planned down to the minute, to, from and while there. We had many groups, both operationally and in engineering, sitting down and saying, "These are all the things that we have to have ready, these are the things that we've got to make sure we have confidence will work, these are the tests we're going to run to prove it on the ground and then in flight."

That's where we realized that we couldn't leave this spacecraft sitting facing the sun. You can't just go to the moon and let one side face the sun and the other side face the moon. You're going to have to rotate it, and that affects the way you do guidance and navigation, as well as the stars you're going to look at and the rotational rates.

We had to know where the stars are at the time of day and the time of the season that we were going to fly, because we put thirty-five stars into the computer, and what you do is you look at this star and that star and that star, and you triangulate inside the computer, and you do it by hand, you do it on the ground, get these coordinates for what that says, and that'll tell you where you are. You have to be willing to say, "If the computer malfunctions, what is the crew manually going to be able to do?"

It was Dangerous. It was Risky.

It gets pretty broad as to what all we had to think about, and we had different groups that had that as a job anyway, except now we were going to have to do it for real.

I'm a guy who wants to know what's going on in everything. I want to make sure everybody's thinking right, that everybody is doing their planning, that they have their game plans made and could show me that they indeed did, both in the hardware and the software. But I didn't have to know the details of everything.

We had the best people in the world who were so extremely and highly motivated that, after you see them perform for a while, you know, well, they're going to do it and do it right and do it well. I never had the slightest doubt that any of the people that were in charge of that stuff couldn't do it. None.

* ***Mass concentration*** *can have different meanings in astronomy or chemistry. In astronomy or astrophysics* ***mass concentration*** *or* ***mascon*** *is a region of a planet or moon's crust that contains a large positive gravitational anomaly. In general, the word "mascon" can be used as a noun to describe an excess distribution of mass on or beneath the surface of a planet (with respect to some suitable average), such as Hawaii. However, this term is most often used as an adjective to describe a geologic structure that has a positive gravitational anomaly, such as the "mascon basins" on the moon.*

I had the same feeling about MIT. The MIT guys were a brilliant group of engineers.

Within the industry, we had people like that too. They had a bunch of great people involved and had put together a great team after the Apollo 1 fire with the help of George Low. By the time we got to Apollo 7, I don't remember having any doubts about anybody in terms of management or capability to penetrate the quality of what we were dealing with.

Now I don't mean to say that we didn't realize that we could get this thing pointed in the wrong direction off of the Saturn rocket, or that when we got to the moon we weren't at sixty miles altitude. Or that something could happen when we got on the back side of the moon, where we could not see what was happening from the Control Center and the crew was on its own.

It was dangerous. It was risky. Bill Tindall, as an example, gave me a presentation of all the things that could happen when you fire that engine on the back side of the moon. If the attitude control system did not work perfectly, when the engine stopped burning you could be going into the lunar surface. Or you could be going out into deep space and never see it again, if it cut off at the wrong time in the wrong attitude.

Tindall had it all figured out—what he was going to do about it in the computers, what the flight dynamics guys were going to do about it, when it showed up for first time and we saw it, or when it came back around the moon and it wasn't what we expected. We had thought about that in great detail and when we got to the moon, we had computed the exact second we would lose communications with the crew. It happened at exactly the right second and crew member Jim Lovell accused us of cutting the communications off saying, "You can't be that accurate." But we were.

The same thing is true about when it came back around the other side. We knew exactly the second. If the engine worked as it should, when the engine cut off and put it into orbit around the moon, we knew the exact second we should see that vehicle come out the other side of the moon on the deep space network.

Christmas Eve

While they were on the back of the moon, it was extremely tense for me. The worst time was after we'd been there for ten revolutions and were ready to come *out* of orbit. I was really tense about what might happen, what could happen, and waiting for it to happen. I wanted quiet inside the Mission Control Room for a while so I could pray or do whatever the heck I had to do to make sure that thing comes out the other end and the engine fires to put it back on a return trajectory to Earth. George Low and I were sitting there, looking at each other, next to each other waiting. That's when Lovell said, "There is a Santa Claus," and they were on the way home. But it sure was a relief in mental anguish when I knew they were on a return trajectory to the Earth and that engine had worked perfectly both times.

Until we decided we would be ready to go, and determined what the launch windows were, we had no idea that it was going to be on Christmas. We got accused of doing it purposely on Christmas, to be around the moon on Christmas Eve. That's untrue. It was happenstance. I didn't have any idea that it was going to be Christmas because we hadn't computed yet what the launch window was. We had only three hours to meet our criteria of getting to the moon at the right time and the right place with the sun at the right angle, and over the landing site that we had chosen for Apollo 11.

NASA S68-56533

Kraft and others in the Mission Operations Control Room heard the voice of crew member Jim Lovell say, "there is a Santa Claus," as the Apollo 8 spacecraft came around the moon for its last time and they were headed back to Earth.

William Anders:

"For all the people on Earth the crew of Apollo 8 has a message we would like to send you."

"In the beginning God created the heaven and the earth. And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters. And God said, Let there be light: and there was light. And God saw the light, that it was good: and God divided the light from the darkness."

Jim Lovell:

"And God called the light Day, and the darkness he called Night. And the evening and the morning were the first day. And God said, Let there be a firmament in the midst of the waters, and let it divide the waters from the waters. And God made the firmament, and divided the waters which were under the firmament from the waters which were above the firmament: and it was so. And God called the firmament Heaven. And the evening and the morning were the second day."

Frank Borman:

"And God said, Let the waters under the heavens be gathered together unto one place, and let the dry land appear: and it was so. And God called the dry land Earth; and the gathering together of the waters called he Seas: and God saw that it was good."

Borman then added, ***"And from the crew of Apollo 8, we close with good night, good luck, a Merry Christmas, and God bless all of you—all of you on the good Earth."***

The Apollo 8 crew entered lunar orbit on December 24, 1968, and via a live television broadcast shared with listeners the above message. That day the crew captured this Earthrise photo, giving humans their first look at their home planet. Traveling only sixty miles from the moon, the crew photographed numerous views of the lunar surface including the photo far right.

NASA AS08-14-2383

That Christmas Eve, they read from the Bible—that was very impressive that they chose to do that. Both Commander Frank Borman and I are lay readers in the Episcopal Church, so we had read that passage from the book of Genesis several times in our life. I got a little teary-eyed, I guess you would say.

Earthrise and Earthshine

The crew will tell you that when they saw the sight of a full-color Earth over the craters of the moon it was one of the most impressive sights they've ever seen. It was the first time we had seen the Earth. It had been unimaginable until that moment. The Earthrise picture taken (December 24, 1968) was probably the greatest picture ever obtained in space. That series of photos is really something.

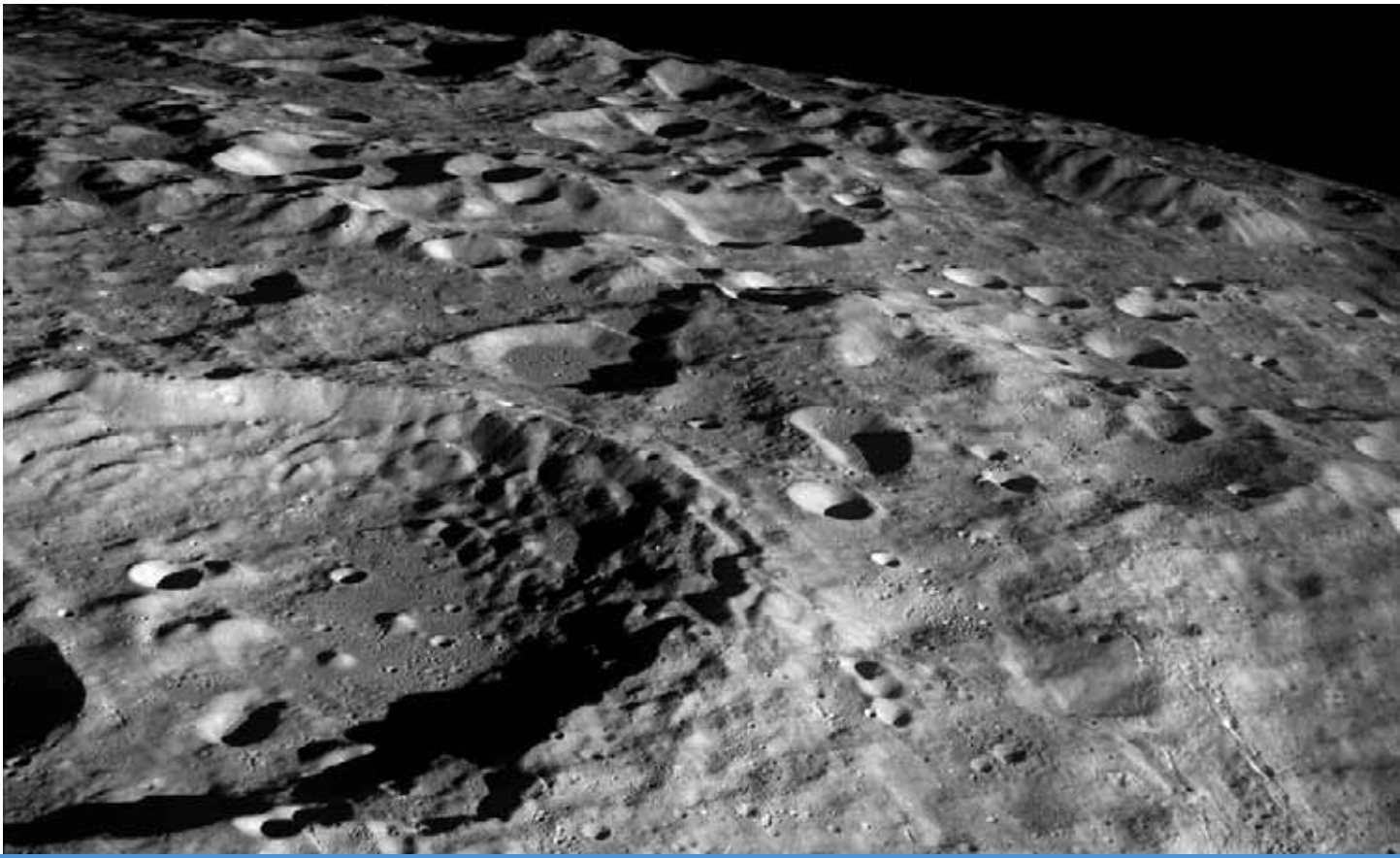
Before the photos were taken, crew member Bill Anders had been telling us that he found Earthshine was about as expected. Earthshine at the moon is about ten times as strong and you have no reference for what you see on the moon. Depending on what altitude you're at, you see craters, and that was particularly important in planning for the landing on the moon because, as you approach the moon, all you do see is more craters.

From some altitude, you see all these craters, but they are all big craters. When you get closer, you see more craters, but you don't know what their size is. Then you get down here, you see more craters and don't know whether you're seeing a big rock or a little rock because you have no reference. There aren't any automobiles, there aren't any trees, there aren't any buildings, there aren't any streams, the mountains you see, you don't know how tall they are, relatively speaking.

The one thing we do know is shadow length as you approach; from a crater, you can see the shadow. To give the pilots depth perception, we landed with the sun at their back at a seven to twelve degree angle. That's one of the major criteria in setting the launch time and the launch window in going to the moon. We wanted the sun at that angle at the point we were going to land. We wanted to land in the Pacific back on the Earth. When you put all that together, you had a three-hour launch window three days out of the month, and if you wanted to do it very well, one day out of the month.

Giving 110 Percent

George Low, myself, Bob Gilruth, Max Faget, and Deke Slayton—we were going to do everything within our power to do it and do it right. All felt that it was our duty. It was something that was required of us, and we were representing the country. I don't believe that it would have been anywhere



NASA AS08-13-2244

NASA S68-50265

Mankind had been looking at the moon ever since they could see, but these three men were the first to see it from only sixty miles away. Left to right are James A. Lovell Jr., William A. Anders, and Frank F. Borman II of Apollo 8.

near possible to do it, had we in the management lacked the commitment, because it was too damned hard.

The people who were working on the program—by the thousands—were giving us 110 percent of their capability every day. I don't think we could have done it without that kind of dedication to the program. We got *all* from the recesses of everybody's mind that worked on the program. If they had some talent buried back in those places, it came out.

Now that's what was so wonderful about working on it, that I think most of us—I guarantee you not all of us, but most of the people working on the space program felt that way. Maybe at least ninety percent. There would probably be ten percent that say we were nuts, and ask why are you doing this, or say I don't feel so good about it.

But, my God, the perfection we did it with, the tests run on the hardware, the success couldn't have been done without that kind of commitment right down to the working level of the guy on the machine in the machine shop, or the women that put the wires together in the spacecraft. They had that commitment.

The Apollo Program had 400,000 people involved. Somebody had to manage that effort, and managing 400,000 people in all walks of life was no simple task. That's not braggadocios. That's fact, because we couldn't have done it without that kind of commitment. I don't know whether we can ever do that again.

Most Significant Mission Ever

Although a lot has been accomplished, Apollo 8 probably remains the most significant mission ever flown. The first flight of the shuttle from a technical point of view was equivalent. But not from the total aspect, not from an emotional or the significant effect on the country and on the world that Apollo 8 had.

Mankind had been looking at the moon ever since they could see and wondering about it, thinking about it, looking at it from a religious point of view, from an astrological point of view, from a farmer's point of view, then later from a scientific point of view. Putting ourselves in the position of having a man leave the Earth for the first time, being able to look back at the Earth for the first time, realizing the environmental aspects of that—you can just go on and on.

The firsts involved in Apollo 8 almost were unlimited, if you stop to think about it, from an educational point of view, a theological point of view, an esthetic point of view, an art point of view, from culture, scientifically, philosophically, engineering wise, management wise, scope of capability wise. Outside of a war, we have never done anything like that in this country.

That event was a milestone in history, which in my mind, unless we land someplace else where there are human beings, I don't think anyone can match it.

It was an opportunity for those of us who were allowed to do it that doesn't present itself very often in any human being's life. We were extremely fortunate that all the conjunction of the stars and the politics and the money and the technology all came together in the '60s, in '68. That was a very extremely unique period in man's history from all those points of view.

In the '60s, even though people might not like you, even though they seemed to be hard to get along with, even though you thought they were going off in the wrong direction, you knew you all had the same thought in mind, you knew everybody was trying to get to land men on the moon. We were given an opportunity to do it, and we did it. But that's a characteristic of the American human being. That's what makes us great. ★

To read the entire transcript, log on to:
http://www.jsc.nasa.gov/history/oral_histories/KraftCC/kraftcc.pdf.