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JIM LOV

The famous astronaut recounts Apollo 13 — the mission that almost didn't make it home.

BY RICHARD TALCOTT

TO THE AVERAGE AMERICAN living in 1970, the space program had become rather humdrum. The previous year had witnessed Apollo 11's historic first Moon landing and Apollo 12's precision touchdown within walking distance of the unmanned Surveyor 3 spacecraft. But by early 1970, NASA's run of success had turned much of the nation complacent. Many wondered whether fixing problems on Earth demanded more attention than exploring the Moon.

It was in this climate that Apollo 13 set off on April 11 for the third lunar landing. The mission was to be the first devoted largely to science, and targeted an area near Fra Mauro Crater that scientists thought had been splattered by debris from the impact that formed Mare Imbrium.

Jim Lovell served as Apollo 13's commander. This was his fourth trip into space. He had previously teamed with Frank Borman on Gemini VII in December 1965, when they achieved the first rendezvous with another manned spacecraft; with Buzz Aldrin on Gemini XII in November 1966, that program's final mission; and with Borman and

The Saturn V rocket that sent Apollo 13 on its way to the Moon ignites its engines on the afternoon of April 11, 1970. ALL PHOTOS BY NASA UNLESS OTHERWISE NOTED

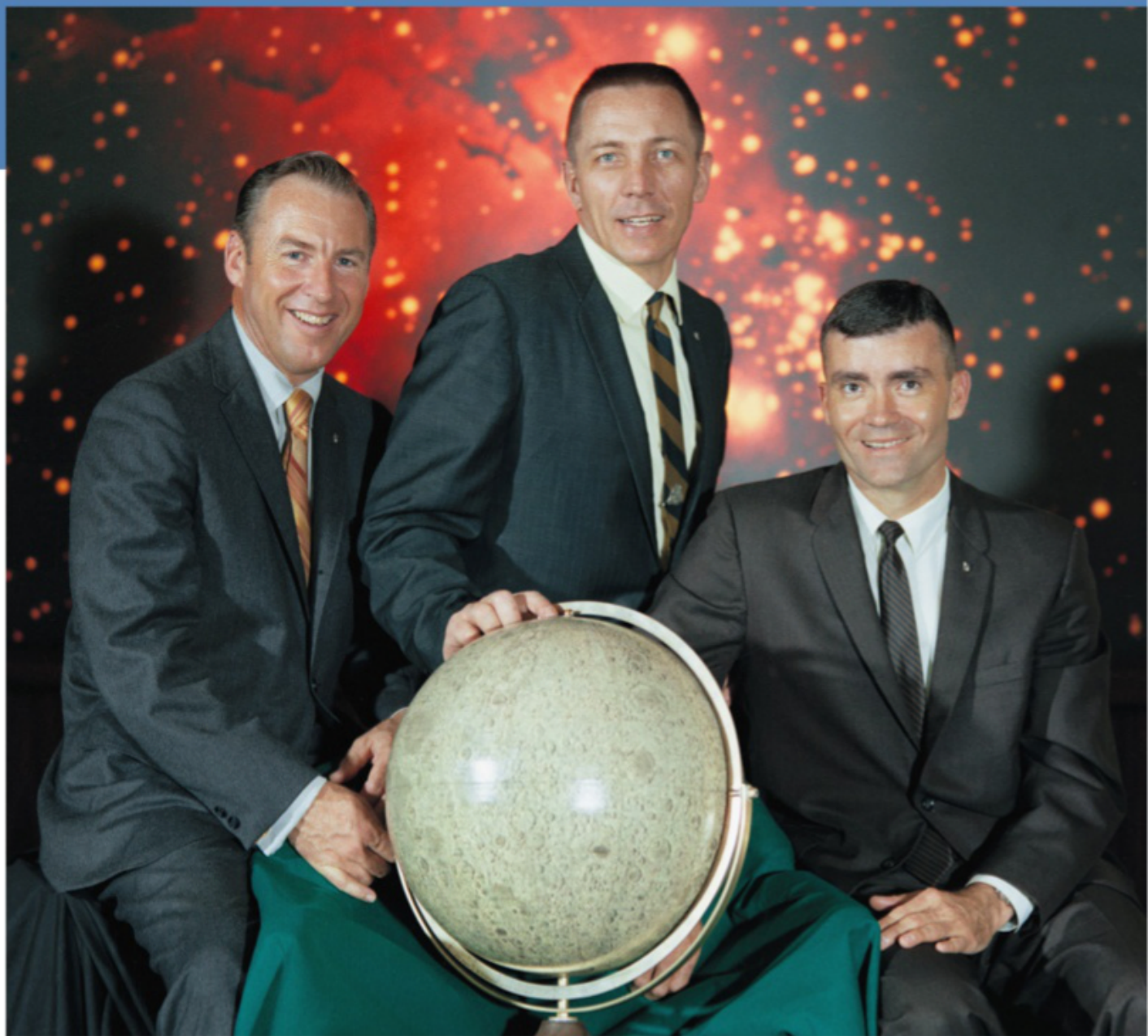
ELL REMEMBERS

Triumph over tragedy

Bill Anders on the historic Apollo 8 mission in December 1968 that first sent astronauts to the Moon. On Apollo 13, he was joined by a pair of rookies: Command Module Pilot Jack Swigert and Lunar Module Pilot Fred Haise. Swigert was a last-minute replacement for Ken Mattingly, who had been exposed to German measles a week before launch and was the only crew member who did not have immunity.

The first two days of the mission went largely according to plan, if little noticed by the broader public. None of the three major U.S. TV networks carried the crew's prime-time television broadcast the evening of April 13. But the world certainly took notice later that night when an oxygen tank in the service module exploded and put the mission — and the lives of the astronauts — in jeopardy. The harrowing return journey transfixed the nation and the world.

Recently, I had the honor to interview Captain Lovell about Apollo 13 at the Lake Forest, Illinois, public library. As you might expect, the events of the mission remain etched in his mind even after 50 years.



Astronomy: Thank you, Captain Lovell, for joining us today and reminiscing about Apollo 13, whose 50th anniversary is coming up quickly. We have several questions about the mission and your reactions to everything that transpired during Apollo 13. My first question is, Apollo 13 was going to be the third Moon landing. Could you talk a little bit about the objectives of your mission and how it differed from Apollo 11?

Lovell: Well, actually, this is the first time that we were really going for exploration or discovery. The first [two], Apollo 11 and Apollo 12, were merely machines to say, “Hey, we can do the job. Here it is.” ... But by the time 13 came around, [NASA] didn’t worry so much about the transition and the mechanics of getting to the Moon. What the scientists were now looking at was the Moon itself. We were going to a place called

The crew of Apollo 13 — Jim Lovell, Jack Swigert, and Fred Haise (left to right) — posed for their official portrait 11 days after they returned to Earth. An explosion on their way to the Moon prevented the astronauts from landing on the lunar surface.



FROM TOP: The staff at Mission Control looks on during a live TV broadcast from Apollo 13 the evening of April 13. (Haise appears on the giant screen.) Less than 10 minutes after the broadcast finished, an oxygen tank onboard exploded.

The Apollo 13 insignia included the Latin phrase *Ex Luna, Scientia* — “From the Moon, knowledge” — a reference to the mission being the first scheduled lunar landing in which the return of science would play the most significant role.

The day before the flight, they put liquid oxygen back into [the oxygen tank], and from then on it was a bomb waiting to go off.

Fra Mauro. Fra Mauro was supposed to be a very informative place with different kinds of materials than 11 or 12 picked up. That was our whole objective, and so that’s what we trained for. Unfortunately, we didn’t make it.

Astronomy: *I understand your crew was originally scheduled to fly on Apollo 14 and not 13, but NASA rejected [Director of Flight Crew Operations] Deke Slayton’s recommendation for the Apollo 13 crew, and thus bumped you up. I was wondering, how did you feel about that at the time and how do you feel looking back on that in retrospect now?*

Lovell: Well, it’s kind of interesting. After Apollo 8, ... I was the backup to Neil on Apollo 11. Then I was assigned Apollo 14, so we started training for that, but the NASA management determined that Al Shepard didn’t have enough training. He was grounded for some time.

So one day Deke came in and said, “Look, we want to put you on 13 rather than 14.” I thought that would be fine. I mean, we’d be coming up six months or some time earlier. It’d

be an earlier flight.

I went home and I told my wife, “We’re gonna go on 13, not 14,” and she said, “13?” I said, “Well, it comes after 12.” [Laughs.] Then they put that in the movie. [Laughs.]

Astronomy: *How do you feel about that, looking back now?*

Lovell: Well, being in the government at NASA, we don’t believe in myths like the number 13, but it did have — as you look at the flight and you analyze the mission from its inception to the finality of it, you’ll see that it was plagued by bad omens and bad luck from the very beginning. One by one, now that I look back on it, I can see the things that occurred that told me that, hey, something’s gonna happen here.

Astronomy: *Can you mention a few of those things?*

Lovell: Yeah. First of all, we were getting all squared away to check things out. During the



countdown demonstration test, which was two weeks before the flight, we had the spacecraft loaded with fuel and things of this nature. The test was completed — everything worked fine for launching the vehicle.

We left and the ground crew went in to secure the spacecraft. One of their jobs was to remove the liquid oxygen from the two liquid oxygen tanks that were in the spacecraft. And the way they did it, they put gaseous oxygen, or gas, in the fill line and forced it out the vent line through a system in the tank itself; the plumbing allowed you to do that.

But years before the flight, this tank had been dropped in the factory. Now they tested it out for everything it had to do to supply oxygen to the spacecraft, but they

failed to look at the mechanisms and the tubing to remove the oxygen after a routine test. So when the flight crew, after the last test, just two weeks before the flight, tried to remove the oxygen, they couldn’t do it.

So they looked at the schematics of the tank. They looked and they said, “Well, wait a second. This tank has a heater on it. And we should just apply ground power because we have ground power at the launch site” — 65-volt ground power, while the spacecraft flew at 28-volt power.

They applied the 65-volt power to the oxygen tank’s heater system and, as they predicted, it worked out. They boiled the oxygen out of the tank and made everything all squared away, all set to go. But what they didn’t know, as the temperature in the tank got up close to 80 degrees, which is kind of unusual for liquid oxygen, the little thermostat



was gonna open up to shut off the power and keep the heat down. But when it came up, the higher voltage welded those contacts shut, and from then on, we had no safety.

As it turned out, the temperature got up to 300 or 400 degrees. The ground crew never knew it. The oxygen was all removed. The tank didn't explode for some strange reason. All the oxygen got out. But the day before the flight, they put liquid oxygen back into it, and from then on it was a bomb waiting to go off.

But the anomaly of this whole thing was, back in 1965 I think it was, the manufacturer of the spacecraft told the manufacturer of the liquid oxygen tank to change the circuit breakers or the thermostats from being compatible for 28-volt to 65-volt. They did not do it. They did not do it.

Then, what made things worse is that the manufacturer didn't double-check his directive to do it and, consequently, they damaged the tank, and then 200,000 miles out — on April 13 — the tank exploded.

Of course, other omens were we had [exposure to German] measles just before the takeoff and Jack Swigert had replaced Ken Mattingly. So these are the things that led up to Apollo 13 [being] unusual.

Astronomy: Yeah. In retrospect, it sounds quite interesting. [Along] that same line of thought, the Apollo 13 liftoff started flawlessly, but the center engine on the Saturn V, the second stage, shut down about two minutes early. Did you have concerns at that point, whether you'd be able to reach the Moon?

Lovell: Yes, we did. Suddenly, the center engine shut down I think one minute or two minutes early, and we had that big light blinking at us and we said, "Boy, what's the story?"

Well, it turned out that on the third stage we had enough fuel to get into Earth orbit and then go around, and with enough fuel left on the third stage to give us the velocity to go to the Moon. But that was another little bad omen.

The funny thing is on one of the unmanned Saturn Vs — there were two unmanned Saturn V launches — that same thing had occurred, and they felt they had everything all squared away by [the time of our launch]. Of course, on 8 and 10 and 11, everything worked fine.

Astronomy: Can you describe your reaction when you heard the loud bang that resulted from the oxygen tank exploding?

Lovell: Well, first of all, we didn't know. I heard a loud bang. The funny thing is during our test phases, while we were in the spacecraft, Fred Haise made things kind of funny. He would pull on a — I think it was an oxygen valve or something — it sort of gave a bang, too.

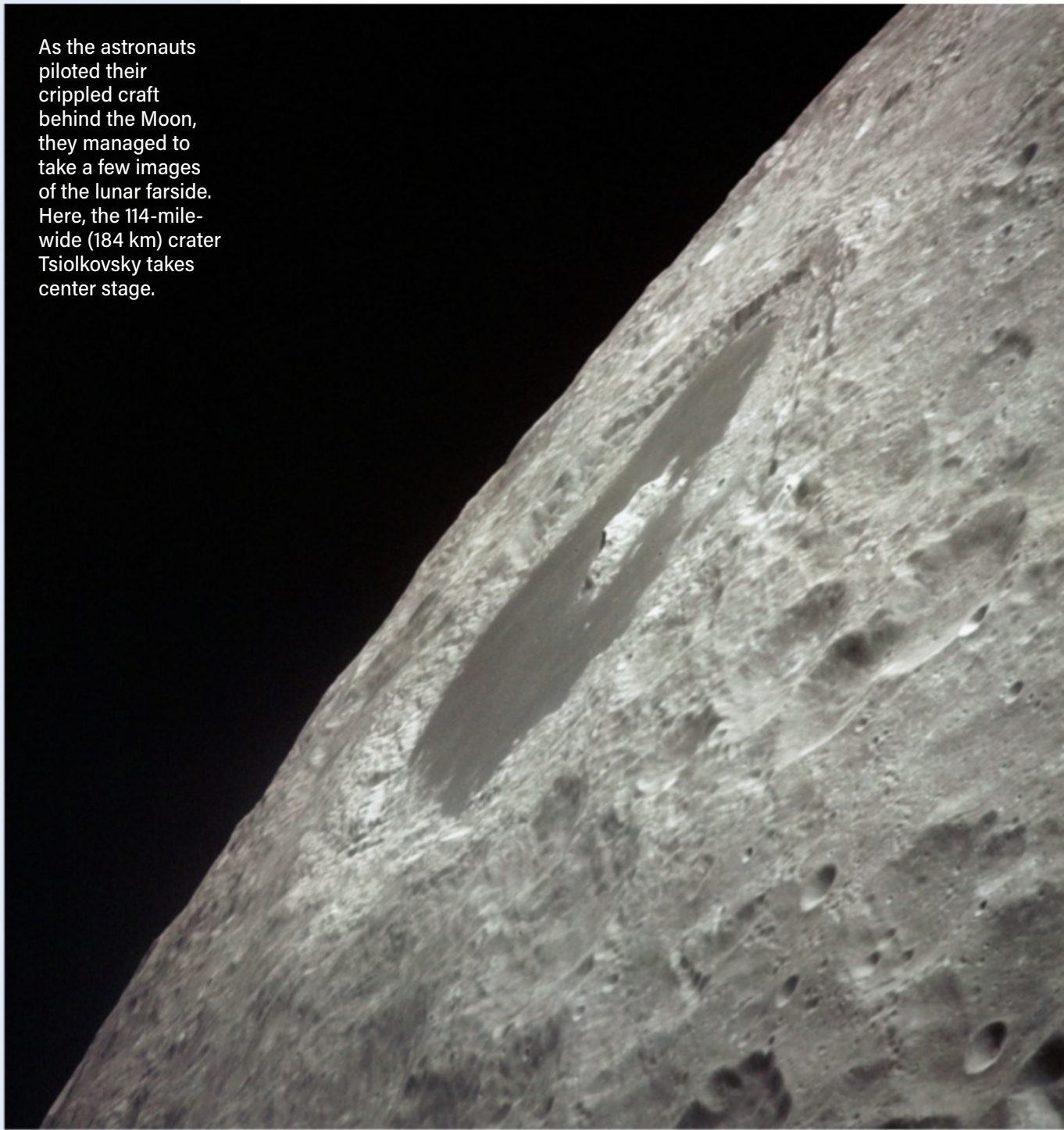
And I thought at first that it was Fred. "Why is he doing that again?" Then I looked up at him. I had been down in the command module. I looked up at him and his eyes were as wide as saucers. I could tell. He said, "It's not me."

CLOCKWISE FROM TOP LEFT: Swigert, Lovell, and Haise (left to right) enjoy a brief moment of relaxation April 9, 1970, two days before taking off for the Moon.

As Apollo 13 pulls away from Earth, the astronauts catch this view of home and a cold front crossing the Pacific Ocean.

Lovell stands for his formal portrait four months before the April 1970 mission. The crew's destination — Fra Mauro Crater — lies near the center of the Moon globe.

As the astronauts piloted their crippled craft behind the Moon, they managed to take a few images of the lunar farside. Here, the 114-mile-wide (184 km) crater Tsiolkovsky takes center stage.



We knew quite quickly that we were in a dying vehicle and that we were gonna have to go into the lunar module.

The rugged farside of the Moon holds few of the large maria seen on the nearside. One of the backside's largest is Mare Moscoviense, seen at the center of this image.



Then, of course, things started to happen.

Astronomy: *When you saw the gas venting from the command module, how quickly did you realize that this was something major?*

Lovell: Well, before I saw that, I saw that we lost two out of three fuel cells. I knew that one fuel cell would give us enough electrical power to just get us around the Moon and back home again. But then I looked up at the instrument panel and I saw the quantity gauges of the two fuel cells in the service module, and one fuel was zero, and the other fuel cell started to go down ever so slightly, but something you would never see in the normal uses of oxygen on a flight to the Moon.

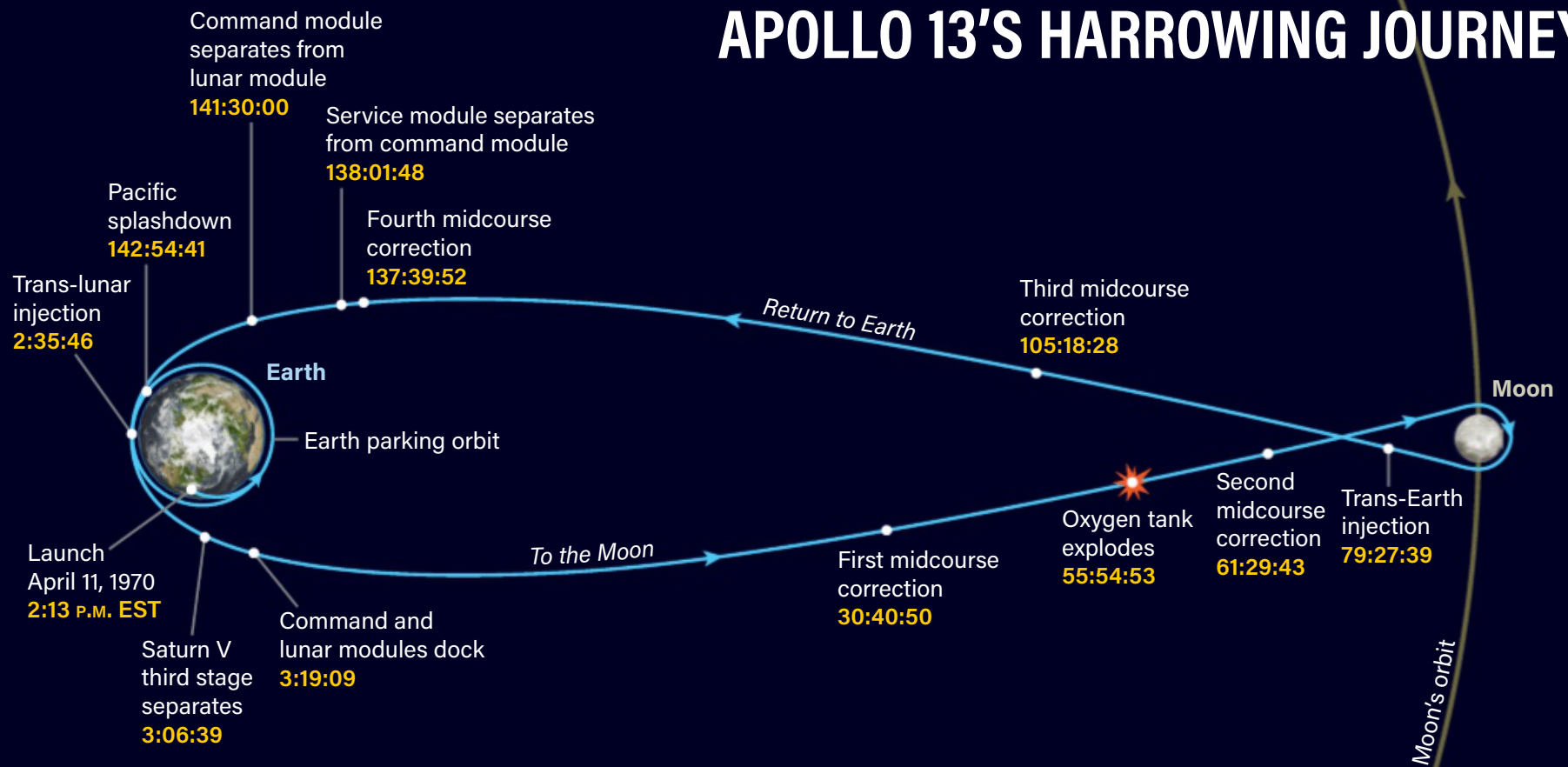
Then I went out to the side window. I can't tell you today why I did it, but when I looked out the window, I saw escaping at the rear of my spacecraft in sort of a flame or flume type of thing, a gaseous substance, and I realized quickly that that gas I saw coming out was the oxygen, and that I had lost ... both oxygen tanks. So the explosion ruptured part of the second tank, too, which was not damaged by the factory crew when they pumped it.

Astronomy: *How did you hold your composure in such an extraordinary and unprecedented moment of crisis?*

Lovell: Well, when you're in a situation like this, I could have bounced off the walls for 10 minutes trying to figure out what to do, and then nothing would have changed. And remember, the crew was former test pilots. So I had been used to an engine quitting occasionally when testing airplanes and things like that.

So I finally had to decide what to do. We knew quite quickly that we were in a dying vehicle and that we were gonna have to go

APOLLO 13'S HARROWING JOURNEY



Everything was proceeding according to plan until an oxygen tank in the service module exploded a little more than two days into the flight. The times listed denote the hours, minutes, and seconds elapsed since launch.

ASTRONOMY: ROEN KELLY

into the lunar module, because it was the only thing that still had oxygen tanks. Because of the loss of electrical power, we lose our rocket engine on the command module. So it was gonna be dead, which is exactly what happened.

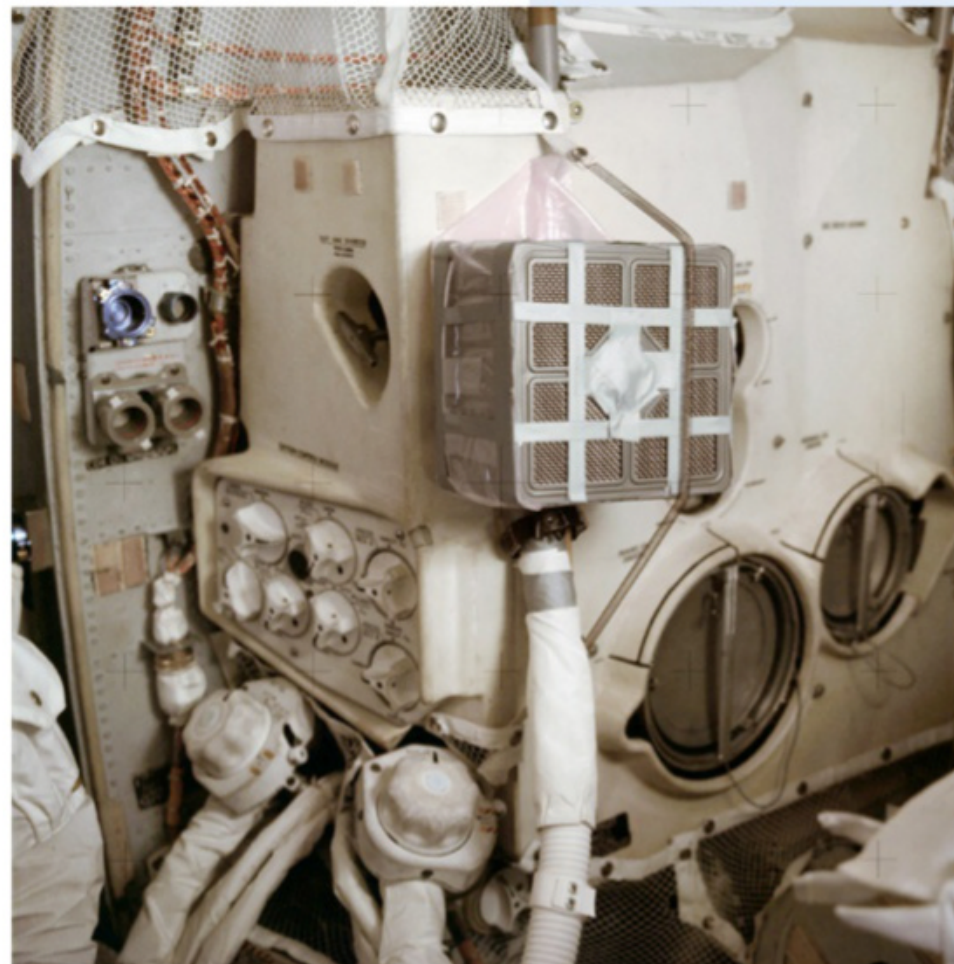
We discussed it. Finally, I forget exactly when, we got to talk to the ground. The ground at first thought that this was a communications problem, that somehow we were interrupted by the radio waves or the rays coming from the Sun or something of this nature, and giving all these false indications on the consoles down there. But we knew what the story was right from the beginning.

So they finally agreed that that was the case, let's go in the lunar module. The first thing we did, which was very, very fortunate, we took the guidance parameters out of the guidance system and put them into the guidance system in the lunar module. So the guidance system in the command module knew our attitude with respect to the celestial sphere. So we got that information back into the lunar module's guidance system — which was dead, we

had to fire it up — and put it in. So we knew then in the lunar module what our attitude was, so we could use the lunar module later on with [its] engine to maneuver to different attitudes.

Astronomy: *At this stage, you'd already performed a midcourse correction to get off the free-return trajectory, onto a better path for landing near Fra Mauro. How quickly did Mission Control figure out how to get you back onto that free-return trajectory and to speed the spacecraft up to get you home early?*

Lovell: It took a little while, but that was the first thing they thought of. It's kind of interesting. We started out to the Moon on a free-return course, which essentially meant that if our engine quit in the service module, that we were on a course that would take us all the way to the Moon and ... with the help of the Moon's gravity, we'd switch around and come back on a course to the Earth at such an attitude that we could cut into the Earth's atmosphere.



But then about, I don't know, 20 hours after we were taking off, going from the Earth to the Moon, they called up and said, "Look, we've looked at your situation. When you get around to starting to go down to land on Fra Mauro, we've kind of figured out that the Sun is gonna be just above you. So it's gonna wipe out

The Apollo 13 astronauts would never have made it home safely if they hadn't figured out a way to remove carbon dioxide from the air. With the help of engineers on the ground, they jury-rigged a square canister from the command module to fit into the round holes of the lunar module's environmental system.

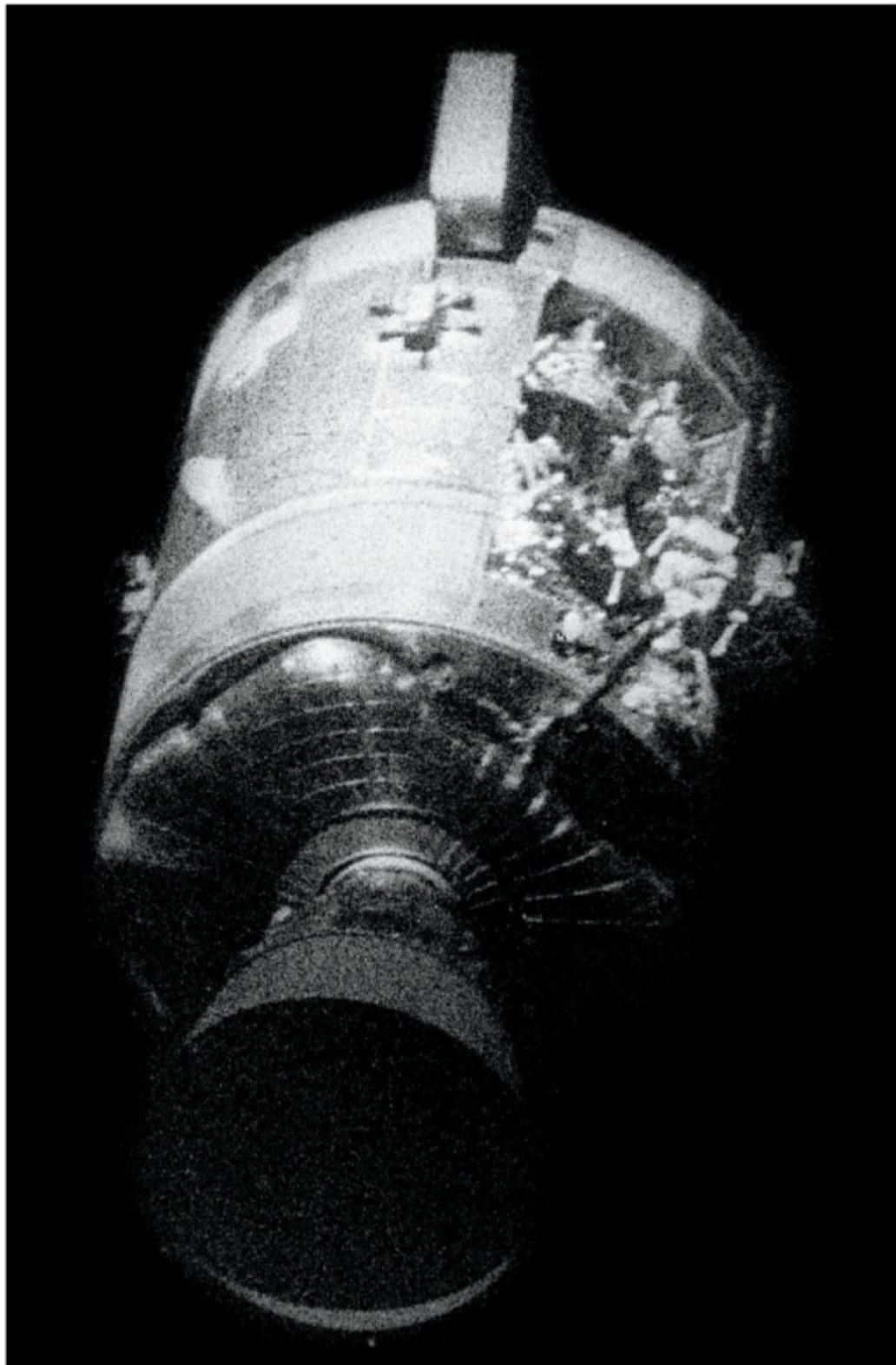


CLOCKWISE FROM TOP LEFT: Swigert (at right) and Lovell (off camera, to the left) fiddle with some of the temporary hoses and other gear they needed to convert the lunar module into a lifeboat for the trip home.

Lovell catches some shut-eye during the long, nerve-wracking journey back to Earth.

An oxygen tank explosion on the way to the Moon crippled the Apollo 13 spacecraft. The blast blew away a panel on the service module, seen here after the astronauts jettisoned the module shortly before reentering Earth's atmosphere.

Fortunately, when you're in deep trouble, you learn pretty fast.



everything down below. You're gonna be like landing in a saucer of milk. So we're gonna get you off that free-return and put you on a course that when you get around and start landing, you'll start to see the craters and the shadows and things like that." So that's fine.

Then, of course, when the accident occurred, we were in a position that, had we not gotten off that course, [we would have gone] around the Moon [and come] back to the Earth, [but] we would miss the Earth completely and we'd end up in a long elliptical orbit, going back out to where the Moon was, back to where the Earth was, back to the Moon; I don't know, for years, I guess.

Astronomy: *That's a little scary. One consequence of the free-return trajectory was that you set a record for the farthest humans have ever been from Earth. Did you realize that at the time or were you too preoccupied with the tasks at hand?*

Lovell: No, we didn't. Although when we came around at the apogee, this time we didn't slow down, of course. We let the apogee take us back. I looked back at

the Moon and I could see that it's not the one I saw on Apollo 8. It's a lot smaller.

[But] that's fine with me because I know we're not gonna slow down, either. So I've got the velocity to not get captured by the Moon, to get back home again.

Astronomy: *That's good. The lunar module obviously was never designed to operate as a lifeboat and using it was truly unprecedented. How difficult was it to operate and maneuver the lunar module, running the engines and using that to navigate back home?*

Lovell: Well, normally a lunar module is like any other vehicle. I mean, when you do things, when you do the controls, they'll go the way they were designed to go and you learned it that way. But when the explosion occurred and we had to use the lunar module, [we still] needed the command module and its heat shield to get back into the atmosphere.

[This is] what happened when I first tried to maneuver the vehicle, before we got to the Moon, to get back on that free-return course [after] the ground gave us the particular attitudes to do it. [When] I started to maneuver in the normal way — it didn't work.

The center of gravity, instead of being in the center of the lunar module like it is normally, was way out in left field someplace, and if I wanted to go right, it went someplace else. If I wanted to go left, it [went someplace else].

So I literally had to learn by the [way it handled] how to maneuver, or how to place my controller to get to the proper position. It took a little while for me to do that. But, fortunately, when you're in deep trouble, you learn pretty fast.

Astronomy: *That's always good. I was curious how the communications between you and Mission Control worked out. You were obviously working on the*

immediate crisis, while they were planning ahead on how to get you safely home. What was the dynamic like, talking to them and working things out?

Lovell: It was pretty good. In the beginning, though ... they knew we had to get back on the free-return. ... We had a procedure in the computer to slow down and come back again, but we didn't think the lunar module's fuel system would handle all that. So they were debating what to do ... as we were going towards the Moon. But we talked back and forth. Without Mission Control, I think we wouldn't be talking today.

Astronomy: *Is it true that Jack and Fred were captivated with taking photos of the lunar farside?*

Lovell: [Laughs.] Well, after we got back on the free-return course, the ground came up again and said, "Look it, we have analyzed your situation and the amount of electrical power you have on the lunar module, and it's fairly touch and go. We think you'll run out before you get back, and you're gonna have to have electrical power to get your final position for landing. And so we're gonna speed you up."

This was on the way to the Moon. So we have a crew down in the simulators now working out the directions. Then, as we got closer and closer to the Moon, they said, "By the way, when you get behind the Moon now, you'll lose communication with us, so be sure you're ready to copy [our instructions]." And I said, "Well, I have my two companions, and if I miss something to copy on this next procedure, I'm sure they'll pick it up."

So as we got very close to the Moon, they call up and say, "Are you ready to copy?" and I said, "I am," and I started to copy. And I looked at my companions. They weren't paying any attention.



To the relief of nearly everyone on Earth, the Apollo 13 command module splashed down safely in the South Pacific Ocean on April 17.

They had cameras in their hands. Can you imagine, with cameras in their hands?

I said, "Gentlemen, what are your plans here?" They said, "As we go around the farside of the Moon, we're gonna take some pictures." And I said, "If we don't get home, you won't get them developed." [Laughs.] But I got the procedures, they got their photographs, and so we came home.

Astronomy: *How ill did Fred get on the trip back home? Was that a major concern for you?*

Lovell: Yeah. He got an infection, a bladder infection. He got the chills and things like that. I tried to keep him warm. Every once in a while I'd give him a bear hug and try to heat him with my body. But he hung in there, fortunately.

The temperature kept dropping slowly. At first, we didn't notice it. We were turning off all the electronic equipment that provided the heat, to balance the temperature inside the spacecraft. Finally, when all that stuff was down, it got kind of cold in there. But he hung in.

They figured out a way of taking a canister from the dead command module, which was square, and trying to fit it into a round hole, which we finally did with duct tape.



FROM TOP: The Apollo 13 crew of Haise, Lovell, and Swigert (left to right) finally breathe a sigh of relief as they step on the deck of their recovery ship, the USS *Iwo Jima*.

On board the USS *Iwo Jima*, Lovell reads a newspaper story that gives a detailed account of Apollo 13's successful conclusion.

Astronomy: *What were your thoughts as you splashed down in the Pacific and you knew that you had made it home safely?*

Lovell: Of course, it was one of pure delight. We were coming back in, and we got through that one other big problem that we had, that we were being poisoned by our own exhalations. The environmental system in the lunar module had just one canister to remove carbon dioxide, and it was designed only for two guys for two days, and we were three guys for four days.

So we had to figure out a way of getting rid of the carbon dioxide, which Mission Control did.

They figured out a way of taking a canister from the dead command module, which was square, and trying to fit it into a round hole, which we finally did with duct tape and everything of that nature. And it worked. This was a miraculous thing, because if that didn't happen, that carbon dioxide was building up and I don't know what would have happened then.

Astronomy: *On a somewhat lighter note: What was the experience like working on the Apollo 13 film and appearing in it, as well as your association with making the film?*

Lovell: It was kind of interesting. As a matter of fact, just after we finally landed and we got on the [recovery ship] *Iwo Jima* and we're dusting ourselves off and Fred got into sick bay, we went down to see him and we're sitting around talking. We said, "You know something. This is an unusual flight. I mean, look what happened. ... We ought to write a book about it."

So we decided, well, maybe that's a good idea. I talked to Jack Swigert at that time and Fred Haise, and then nothing happened for a while. Days went by, or years went by, actually.

Then a fellow by the name of

Jeff Kluger called up and he was a writer for *Discover* magazine. He said, "I've always wanted to write a story on NASA and the space program, and I thought 13 was the way to go." I said, "That's what we've been thinking about."

But by that time, Fred had a job with Grumman and so he wasn't interested, and Jack had died. ... And I said, "Well, let's do it. We'll split. We'll go fifty-fifty. I'll be the guy that gives some of the information." I liked his writing, and so that's what we did.

That's what started out to be *Lost Moon*. ... It's kind of funny how [the movie] got started. ... We hadn't finished the book yet, when our [agent] said, "Look, there's some interest in the movies for it." So I got a call from Ron Howard: "Could you come out and talk to me about this particular story?"

It turned out that the son of a flight controller also worked for Ron Howard, and his job was to go through all the books and the scripts and everything that people handed him, to see if they're worthwhile making a movie. He saw this manuscript, which was not completed, and he went to Ron Howard and he said, "Look at this. I think this would be kind of interesting." So [Jeff] and I went up and talked to him, and that's how it all got started.

Astronomy: *From the Apollo 13 film as well as from your getting safely back home, I think in most people's minds, Apollo 13 is right up there with, or maybe just a little bit below, Apollo 11 in terms of what people remember about the Apollo program. How does it feel to be part of something that didn't work, but, in the end, ended up becoming even more famous?*

Lovell: Well, it did become more famous in the beginning, at least in the eyes of NASA. I have to tell you an interesting story. We came back. It's a failure. ... So the

spacecraft, the command module, which was the only thing left of Apollo 13, really, was in a warehouse down in Florida for about six months. Then, they tried to forget about it. They wanted to go on to Apollo 14 and everything like that.

Then France called up, Paris called up, [the] museum at Le Bourget, which was where Lindbergh landed. They asked the Smithsonian, “Do you have any space artifacts that we could have in this museum?” Then the lights came on in the Smithsonian and also NASA, “Well, we can get rid of this spacecraft.” So they exiled Apollo 13 to Le Bourget, and it stayed there for 20 years.

About 18 years ... after that, I had a classmate that went out there and he saw it and he wrote me a letter. He said, “Do you know where your spacecraft is?” I didn’t at that time. No one told me it was in Le Bourget.

Then, later on, a year or so later, my wife [Marilyn] and I were in Paris and we went out to this museum, which was at the airfield there, and there we saw it. We walked up to it. It was still on the cradle that they had rolled it in on. It was all by itself, just about, nothing else around it. The hatch was missing. The instrument panel was missing. The seats were missing. The only thing I saw was ... a piece of paper that was stuck on the side that said, “Apollo 13,” and gave the names of the three crew members. ... And then Ron Howard made the movie. Of course they made the movie that was shown in France, and all those French people said, “Oh, it’s out there in Le Bourget. Let’s go see it.”

Meanwhile, NASA was so embarrassed and the Smithsonian, that a museum out of Hutchinson, Kansas, called the Cosmosphere, offered to go get [it] and bring it back and pay for it — and they did. And all those Frenchmen now were mad because they had



kept it for 20 years, and now it came back here. *[Laughs.]*

Astronomy: *Do you recall what the first thing you and Marilyn talked about once you returned after Apollo 13? What did that conversation go like? Did [she] encourage you to find a different career path maybe?*

Lovell: Well, I have to tell you another interesting story along those lines. About a week or two weeks after we got picked up in Hawaii and then we came back, we had a big press conference of course. All the NASA people came in and all the reporters came in, and TV people and stuff like that, and a lot of the families came in to listen to the whole thing. We were in the auditorium down in the Johnson Space Center. So we started talking about that.

At the beginning of the conference, a reporter asked, “Jim, are you gonna ask for another flight? Obviously, this was not successful.” Before that, on Apollo 11 [and] 12, management said, “Look, if there’s a problem with this flight, we’ll get you back and we’ll give you the very next one.”

So when that question came up from the reporter, I thought to myself, because management was



right behind us, here was the perfect opportunity to put them on the wall and say yes, because they had not talked to us, the 13, just 11 and 12. I was about ready to say something like that when, out in the audience, I saw a hand go up. Then I saw it go down like this. *[Jim gives a thumbs down gesture.]* It was my wife. *[Laughs.]* I could tell. I said, “No. I think this is the last flight I’m gonna make.” *[Laughs.]*

Senior Editor **Richard Talcott** remembers the anxious moments and ultimate elation of Apollo 13’s journey as if it happened yesterday. His latest book is *Space Junk* (Ziga Media, 2019).

FROM TOP: Jim Lovell reminisces about the Apollo 13 mission with Senior Editor Rich Talcott. *ASTRONOMY*: DAVID J. EICHER

Commander Jim Lovell chatted with *Astronomy* magazine in August 2019 about the Apollo 13 mission. *ASTRONOMY*: DAVID J. EICHER

“If we don’t get home, you won’t get [the pictures] developed.”