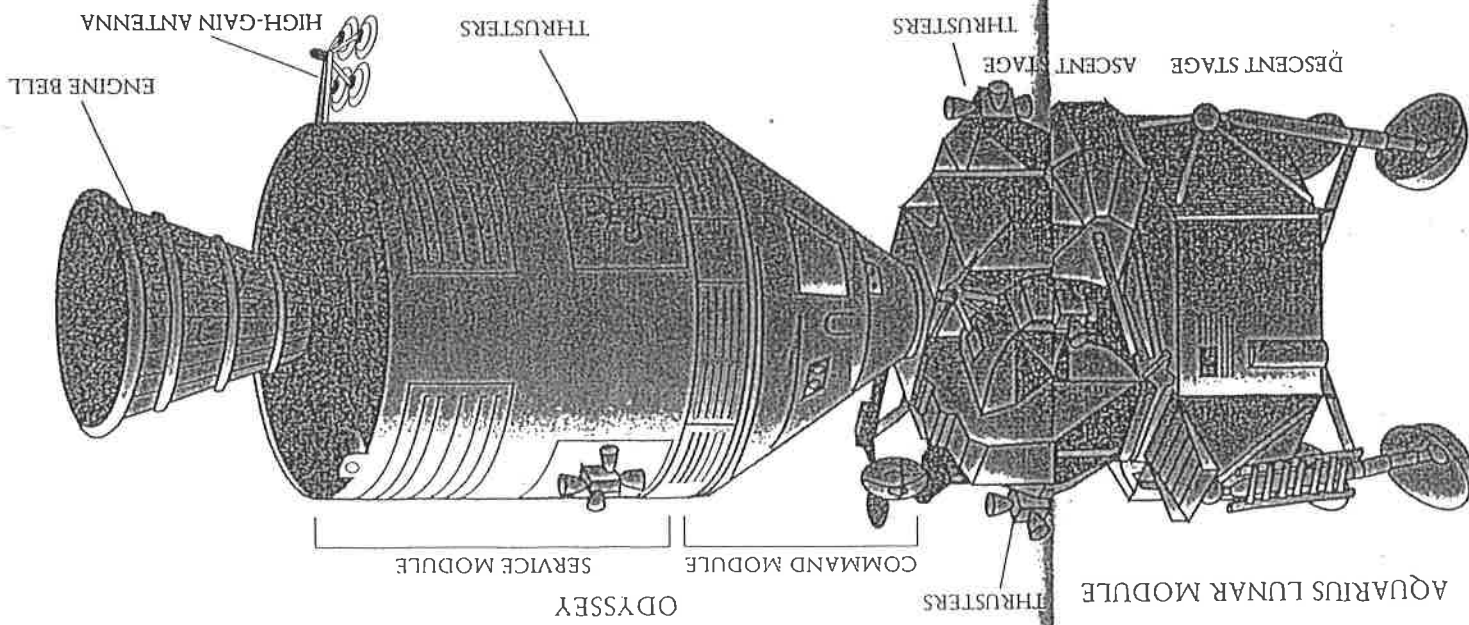


Jim Lovell & Jeffrey Kluger

APOLLO 13



HOUGHTON MIFFLIN COMPANY
BOSTON • NEW YORK



Appendix A APOLLO 13 MISSION TIMELINE

GET (ground-elapsed time)	Houston Time and Date	Mission Event
00:00:00	Sat. April 11 1:13 P.M.	Liftoff
2:35:46	Sat. April 11 3:48 P.M.	Translunar injection
30:40:50	Sun. April 12 7:53 P.M.	Mid-course correction burn to leave free-return trajectory
55:11:00	Mon. April 13, 8:24 P.M.	Beginning of last TV transmission
55:54:53	Mon. April 13, 9:07 P.M.	Oxygen tank two explodes
57:37:00	Mon. April 13 10:50 P.M.	Crew abandons Odyssey
61:29:43	Tues. April 14 2:43 A.M.	Aquarius's engine fired for return to free-return trajectory
77:02:39	Tues. April 14 6:15 p.m.	Spacecraft disappears around far side of moon

<i>(ground elapsed time)</i>	<i>Houston Time and Date</i>	<i>Mission Event</i>
79:27:39	Tues. April 14 8:40 P.M.	Aquarius's engine fired for PC+2 speed-up burn
86:24:00	Wed. April 15 3:38 A.M.	Crew begins constructing lithium hydroxide adapters
97:10:05	Wed. April 15 2:23 P.M.	Battery two in Aquarius explodes
105:18:28	Wed. April 15 10:31 P.M.	Aquarius's engine fired to correct trajectory
108:46:00	Thurs. April 16 1:59 A.M.	Aquarius's helium disk bursts
137:39:52	Fri. April 17 6:52 A.M.	Aquarius's attitude jets fired to correct trajectory
138:01:48	Fri. April 17 7:14 A.M.	Service module jettisoned
141:30:00	Fri. April 17 10:43 A.M.	Aquarius jettisoned
142:40:46	Fri. April 17 11:53 A.M.	Reentry begins
142:54:41	Fri. April 17 12:07 P.M.	Splashdown

Appendix B

APOLLO 13 DRAMATIS PERSONAE

John Aaron	Electrical and environmental command officer (EECOM), Maroon Team
Arnie Aldrich	Systems chief, Flight Operations Directorate
Don Arabian	Director, Mission Evaluation Room
Stephen Bales	Guidance officer (GUIDO), Maroon Team
Jules Bergman	Science correspondent, ABC News
George Bliss	EECOM backroom engineer, White Team
Bill Boone	Flight dynamics officer (FIDO), Black Team
Jerry Bostick	FIDO, Maroon Team
Vance Brand	Capsule communicator (Capcom) and astronaut, Gold Team
Dick Brown	EECOM backroom engineer, White Team
Clint Burton	EECOM, Black Team
Gary Coen	Guidance, navigation and control officer (GNC), Maroon Team
Edgar Cortright	Director, NASA's Langley Research Center
Chuck Deiterich	Retrofire officer (RETRO), Gold Team
Brian Duff	Director of Public Affairs, Manned Spacecraft Center, Houston

Charlie Duke	Apollo 13 backup LEM pilot; Apollo 16 prime LEM pilot
Charlie Dumis	EECOM, White Team
Max Faget	Director, engineering and development branch, Manned Spacecraft Center
Bill Fenner	GUIDO, White Team
Bob Gilruth	Director, Manned Spacecraft Center
Alan Glines	Instrumentation and communications officer (INCO), White Team
Jay Greene	FIDO, Maroon Team
Gerald Griffin	Flight director, Gold Team
Fred Haise	Apollo 13 lunar module pilot
Jerry Hammack	Chief of spacecraft recovery team
Willard Hawkins	Flight surgeon, White Team
Bob Heselmeyer	Telemetry, electrical, EVA mobility unit officer (TELMU) for the lunar module, White Team
Tom Kelly	Lunar module engineering manager, Grumman Aerospace
Joe Kerwin	Capcom and astronaut, Maroon Team
Jack Knight	TELMU, Maroon Team
Chris Kraft	Deputy director, Manned Spacecraft Center
Gene Kranz	Lead flight director, White Team
Sy Liebergot	EECOM, White Team
Hal Loden	Lunar module flight control officer (CONTROL), Black Team
Jack Lousma	Capcom and astronaut, White Team
Jim Lovell	Apollo 13 commander
George Low	Director of Spacecraft and Flight Missions
Glynn Lunney	Flight director, Black Team
Ken Mattingly	Apollo 13 prime command module pilot; Apollo 16 backup command module pilot

Jim McDivitt	Gemini 4 and Apollo 9 commander; head of Apollo Program office
Bob McMurrey	NASA protocol officer
Merlin Merritt	TELMU, Black Team
Thomas Paine	NASA administrator
Bill Peters	TELMU, Gold Team
Dave Reed	FIDO, Gold Team
Gary Renick	GUIDO, Black Team
Mel Richmond	Recovery officer
Ken Russell	GUIDO, Gold Team
Phil Schaffer	FIDO, Gold Team
Larry Sheaks	EECOM backroom engineer, White Team
Sig Sjoberg	Director of Flight Operations
Deke Slayton	Director of Flight Crew Operations; astronaut
Ed Smylie	Chief of Crew Systems Division; inventor of lithium hydroxide adapter
Bobby Spencer	RETRO, White Team
Bill Stoval	FIDO, White Team
Bill Strable	GNC, White Team
Larry Strimple	CONTROL, White Team
Jack Swigert	Apollo 13 command module pilot
Ray Teague	GUIDO, White Team
Dick Thorson	CONTROL, Gold Team
Glenn Watkins	Propulsion officer, TELMU backroom
John Wegener	CONTROL, Maroon Team
Tom Weichel	RETRO, Black Team
Terry White	NASA Public Affairs officer
Buck Willoughby	GNC, Gold Team
Milt Windler	Flight director, Maroon Team
John Young	Apollo 13 backup commander; Apollo 16 prime commander

In Houston, Marilyn Lovell smiled. Her husband looked fine, if a little scraggly with a three-day growth of stubble, and his voice sounded level and serene. Though he certainly wouldn't have let on during a TV show if anything about the mission had been causing him concern, he would not have been able to keep at least a small edge out of his voice either. But Marilyn heard no edge tonight. Her husband was evidently happy with this flight so far and, she assumed, was looking forward to its lunar climax. She herself was glad it was almost halfway over, and was looking forward to the Pacific splashdown. Marilyn glanced at her watch, said a quick goodbye to the NASA Public Affairs officer who had been watching the broadcast with her, and she and Mary Haise left for their homes to make sure their children got to bed on time.

Down on the floor of Mission Control, Lousma looked over the list of maneuvers the crew would have to carry out before getting their own chance to turn in for the night. As Capcom, he had at least some control over when the astronauts would be told to perform each task, and he figured he'd give them a few minutes to get their camera stowed and return to their couches before radioing up the instructions for the cryo stir, the thruster maneuvers, and the antenna readings.

Before Lovell could get out of the tunnel or Haise could get out of the LEM, however, the controllers and crew had to return immediately to business. On the command module pilot's console a yellow warning light flashed on, indicating that there might — *might* — be a problem with the pressure in the cryogenic system. At the same time, a corresponding signal appeared on Liebergot's console. Scanning the data on his screen, Liebergot saw that the alarm was caused by a low-pressure reading in one of the hydrogen tanks, a tank that had been presenting intermittent problems for the past two days. If the cryo tanks or their quantity sensors were getting even a little balky, it was as good an indication as any that all four needed a good stir. As Lovell floated back to his left-side couch and Swigert shimmied over to his rightful position in the center, Houston radioed up its instructions.

"We'd like you to roll right to 060 and null your rates."

"O.K., we'll do it," Lovell responded.

"And we'd like you to check your C4 thrusters."

"O.K., Jack."

"And we've got one more item for you when you get a chance. We'd like you to stir up your cryo tanks."

"O.K.," Lovell said. "Stand by."

As Lovell prepared for the thruster adjustments and Haise finished closing down the LEM and drifted through the tunnel back toward

We Have A
Problem

Odyssey, Swigert threw the switch to stir all four cryogenic tanks. Back on the ground, Liebergot and his backroom monitored their screens, waiting for the stabilization in hydrogen pressure that would follow the stir.

Of all the possible disaster scenarios that astronauts and controllers consider in planning a mission, few are more ghastly — or more capricious, or more sudden, or more total, or more feared — than a surprise hit by a rogue meteor. At speeds encountered in Earth orbit, a cosmic sand grain no more than a tenth of an inch across would strike a spacecraft with an energetic wallop equivalent to a bowling ball traveling at 60 miles per hour. The punch that was landed would be an invisible one, but it could be enough to rip a yawning hole in the spacecraft's skin, releasing in a single sigh the tiny pressure pocket needed to sustain life. Outside Earth orbit, where speeds could be faster, the danger was even greater. When Apollo astronauts first began traveling to the moon, one thing they dreaded most but spoke of least was the sudden jolt, the sudden tremor, the sudden boot in the bulkhead that indicated their highest of high-tech projectiles and some meandering low-tech projectile had, in a statistically absurd convergence, found each other like the pairs of fused bullets that once littered the battlefields of Gettysburg and Antietam, and had, like the bullets, done each other some serious damage.

In the sixteen seconds following the beginning of the cryo stir, the astronauts of Apollo 13 were executing their next maneuvers and awaiting additional commands when a bang-whump-shudder shook the ship. Swigert, strapped in his seat, felt the spacecraft quake beneath him; Lovell, moving about the command module, felt a thunderclap rumble through him; Haise, still in the tunnel, actually saw its walls shift around him. It was nothing that Haise and Swigert had ever experienced before; nor was it anything that Lovell, with his three prior flights and weeks spent in the cosmic 'deep, had come across either.

Lovell's first impulse was to be pissed off. Haise! This had to be Haise and his bloody repress valve! Once, maybe, the joke was funny. But twice? Three times? Even allowing for a rookie's misplaced exuberance, this was pushing things too far. The commander turned toward the tunnel, to find the eyes of his crewman and scold them with an angry glare. But when the two men's glances locked, it was Lovell who was brought up short. Haise's eyes were huge, unexpect-

edly huge, saucer-wide and white on all sides. These weren't the crinkly, merry eyes of someone who had just gotten off another good one at the expense of the boss and was awaiting a smiley rebuke. Rather, they were the eyes of someone who was frightened — truly, wholly, profoundly frightened.

"It wasn't me," Haise croaked out in answer to the commander's unasked question.

Lovell turned to his left to look at Swigert, but he got nothing. He saw the same confusion here, the same answer here, the same eyes here. Over Swigert's head, high up in the center section of the command module's console, an amber warning light flashed on. Simultaneously, an alarm sounded in Haise's headphones and another warning light, on the right-hand side of the instrument panel where the electrical systems were monitored, began to glow too. Swigert checked the panels and saw that there appeared to be an abrupt and inexplicable loss of power in what the crew called main bus B — one of two main power distribution panels that together provided juice to all of the hardware in the command module. If one bus lost power, it meant that half the systems in the spacecraft could suddenly go dead.

"Hey," Swigert shouted down to Houston, "we've got a problem here."

"This is Houston, say again please," Lousma responded.

"Houston, we've had a problem," Lovell repeated for Swigert. "We've had a main B bus undervolt."

Next Steps

Lovell, Swigert, and Haise could not hear Kranz's speech, but at the moment they didn't need to be told to keep cool. The moon landing was definitely off, but beyond that, they were probably in no imminent danger. As Kranz had pointed out, fuel cell two was fine. As the crew and controllers knew, oxygen tank one was healthy as well. Not for nothing did NASA design its ships with backup system after backup system. A spacecraft with one cell and one tank of air might not be fit to take you to Fra Mauro, but it was surely fit to take you back to Earth.

Lovell drifted over to the center of the command module to get a read on his remaining oxygen tank and see how much of a margin of error it would provide them. If the engineers had planned it right, the crew would arrive back home with a substantial load of O_2 to spare. The commander glanced at the meter and froze: the quantity needle for tank one was well below full and visibly falling. As Lovell watched, almost entranced, he could see it easing downward in an eerie, slow-motion slide. Lovell was put in mind of the needle on a car's gas gauge. Funny how you can never actually see the thing budge; funny how it always seems frozen in place, but nevertheless makes its way down to empty. This needle, though, was decidedly on the move.

This discovery, horrifying as it was, explained a lot. Whatever it was that had happened to tank two, that event was over. The tank had gone off line or blown its top or cracked a seam or something, but beyond the very fact of its absence, it had ceased to be a factor in the functioning of the ship. Tank one, however, was still in a slow leak. Its contents were obviously streaming into space, and the force of the leak was no doubt what was responsible for the out-of-control motion

of the ship. It was nice to know that when the needle finally reached zero, Odyssey's oscillations would at last disappear. The downside, of course, was that so would its ability to sustain the life of the crew.

Lovell knew Houston would have to be alerted. The change in pressure was subtle enough that perhaps the controllers hadn't noticed it yet. The best way — the pilot's instinctive way — was to play it down; keep it casual. Hey you guys, notice anything about that other tank? Lovell nudged Swigert, pointed to the tank one meter, then pointed to his microphone. Swigert nodded.

"Jack," the command module pilot asked quietly, "are you copying O₂ tank one cryo pressure?"

There was a pause. Maybe Lousma looked at Liebergot's monitor, maybe Liebergot told him off the loop. Maybe he even knew already. "That's affirmative," the Capcom said.

As near as Lovell could tell, it would be a while before the ship's endgame would play out. He had no way of calculating the leak rate in the tank, but if the moving needle was any indication, he had a couple hours at least before the 320 pounds of oxygen were gone. When the tank gasped its last, the only air and electricity left on board would come from a trio of compact batteries and a single, small oxygen tank. These were intended to be used at the very end of the flight, when the command module would be separated from the service module and would still need a few bursts of power and a few puffs of air to see it through reentry. The little tank and the batteries could run for just a couple of hours. Combining this with what was left in the hissing oxygen tank, Odyssey alone could keep the crew alive until sometime between midnight and 3 A.M. Houston time. It was now a little after 10 P.M.

But Odyssey wasn't alone. Attached to its nose was the hale and hearty, fat and fueled Aquarius, an Aquarius with no leaks, no gas clouds. An Aquarius that could hold and sustain two men comfortably, and in a pinch, three men with some jostling. No matter what happened to Odyssey, Aquarius could protect the crew. For a little while, anyway. From this point in space, Lovell knew, a return to Earth would take about one hundred hours. The LEM had enough air and power only for the forty-five or so hours it would have taken to descend to the surface of the moon, stay there for a day and a half, and fly back up for a rendezvous with Odyssey. And that air and power would last forty-five hours only if there were two men aboard;

put another passenger inside and you cut that time down considerably. Water on the lander was similarly limited.

But Lovell realized that for the moment Aquarius might offer the only option. He looked across the cabin at Fred Haise, his lunar module pilot. Of the three of them, it was Haise who knew the LEM best, who had trained in it the longest, who would be able to coax the most out of its limited resources.

"If we're going to get home," Lovell said to his crewman, "we're going to have to use Aquarius."

Back on the ground, Liebergot had discovered the falling pressure in tank one at about the same time Lovell did. Unlike the commander of the mission, the EECOM, sitting at the safe remove of a control room in Houston, was not yet prepared to give up on his spacecraft, but he did not hold out great hopes for it either. Liebergot turned to his right, where Bob Heselmeyer, the environmental control officer for the LEM, sat. At this moment, the EECOM and his lunar module counterpart could not have been in more different worlds. They were both working the same mission, both struggling with the same crisis, yet Liebergot was looking out from the abyss of a console full of blinking lights and sickly data, while Heselmeyer was monitoring a slumbering Aquarius beaming home not a single worrisome reading.

Liebergot glanced almost enviously at Heselmeyer's perfect little screen with all its perfect little numbers and then looked grimly back at his own console. On either side of the monitor were handles that maintenance technicians used to pull the screen out for repairs and adjustments. Liebergot all at once discovered that for several minutes he had been clutching the handles in a near death grip. He released the handles and shook his arms to restore their circulation — but not before noticing that the backs of both his hands had turned a cold, bloodless white.

Jim Lovell's Wife Finds Out

"Marilyn?" the voice on the line said tentatively. "It's Jerry Hammack. I'm calling from over at the Center." Jerry Hammack and his wife, Adeline, lived across the street and were close friends of the Lovells. Hammack himself was head of the NASA recovery team that was responsible for plucking the Apollo command modules out of the ocean when they splashed down at the end of a mission.

"Jerry," Marilyn said, surprised, "what are you doing working so late?"

"I just wanted to let you know that you don't have anything to worry about. The Russians, the Japanese, and a lot of other countries have already offered to help in the recovery. We can bring them down in just about any ocean and have them on a carrier in no time."

"Jerry, *what* are you talking about? Have you been out drinking?"

"Hasn't anyone told you?"

"Told me what?"

"About the problem . . ."

In any small company town, news of a problem at the factory or the plant travels fast. In the suburbs of Houston, where the business was space, the factory was Mission Control, and the likelihood of a problem occurring was always unsettlingly high, it travels even faster. Nearby, in the Borman home, the phone rang at about the same time Marilyn Lovell's did. The former Apollo 8 commander listened to the news from the Space Center, hung up the receiver, and turned to Susan.

"Lovell's in trouble," Borman said. "It does *not* look good. I'm going over to NASA. You go over to the house."

Susan picked up the receiver Borman had just dropped and phoned the nearby McCullough home, where Marilyn's friend Carmie lived.

"Frank says there's a problem with the moon flight," she said. "Meet me at Marilyn's in five minutes."

At the house next to the Lovells', the Benwares got their own call from the Space Center.

"You'd better go next door," Bob said to his wife, Betty, after listening to the news. "I'd better go to work."

In the Lovell home itself, Marilyn, fresh off her breezy twelve-minute ride from the Space Center, was aware of none of this.

"What problem?" she now said to Hammack, her voice noticeably rising. "Jerry, I just saw Jim on TV. Everything was fine!" In the kitchen, Elsa and Jane turned.

"Uh, well, everything isn't fine. A few things have gone wrong."

"What things?"

"Well . . . mostly it's a power problem," Hammack began to hedge.

"A fuel cell problem, actually. They're running out of electricity and, well, it looks like they're not going to be able to go through with the landing." In the background, Marilyn heard the second phone line ringing in the study and saw McMurrey run to answer it.

"Oh, Jerry, that's terrible," she said. "Jim's worked so hard for this. He's going to be so disappointed." She caught Jane's eye and Jane mouthed, "What happened?" Marilyn held up her hand in a wait-a-second gesture.

"Yeah, I'm sure he will be," Hammack said. "But in any case, I didn't want you to worry. We're doing everything we can over here."

Marilyn hung up and turned to Jane. "This is terrible," she said. "Something went wrong with a fuel cell and they're canceling the landing. That was the only reason Jim went back out there, and now he's just going to have to turn around and come home."

"Marilyn, I'm so sorry," Jane said. The two friends exchanged a sisterly hug, and over Jane's shoulder, Marilyn saw Conrad and McMurrey standing by the study, deep in whispered conversation. Conrad looked pale and distracted; his eyes were wide.

"Marilyn," Conrad said hoarsely, "where's the squawk box?"

"Why do you need the squawk box?" Marilyn asked.

"No one's talked to you yet?"

"Yes, I just talked to Jerry Hammack. He told me about the fuel cell problem."

"Marilyn," Conrad said quietly, "this is more than a fuel cell problem."

Conrad steered Marilyn to a chair, sat her down, and explained everything the protocol man had just told him: the disappearance of the oxygen in tank two, the problem with tank one, the venting, the gyration, the plummeting power, the thinning air, and, worst, the mysterious bang that had started it all. Marilyn listened and felt suddenly sick. This wasn't what was supposed to happen. Before Jim went back out there, this was precisely what he had promised would *never* happen.

Marilyn pulled away from Conrad, ran to the television, and flipped it on. Instinctively, she switched it not to CBS, where family friend Wally Schirra would be working, but to ABC, where Jules Bergman, the giant of science correspondents, could be found. Almost immediately, she was sorry she had. Bergman, she discovered, was talking about the same oxygen tanks Conrad had just mentioned, the same spacecraft gyrations, the same mysterious bang. But unlike Conrad, Bergman was talking about one other thing too: the odds. As Marilyn listened, Bergman told his audience that while nobody could predict these things precisely, there appeared to be no better than a 10 percent chance that the crew of Apollo 13 would make it home alive.

Dealing With It

Jim Lovell was surprised by what had become of his LEM in the time he was asleep. It had been a little after ten o'clock Wednesday morning when he floated up the tunnel to Odyssey to begin his sleep cycle, and it wasn't until close to three in the afternoon that he prepared to swim back down. The four and a half hours of sack time was far and away the most rest he'd had since the accident, and with splashdown now less than forty-eight hours away, the sleep couldn't have come at a better time.

As always on this trip, Lovell stirred himself from slumber well before his scheduled wake-up call from the ground. Rising from his couch in the frosty command module, he looked around bleary-eyed and drifted through the lower equipment bay toward the tunnel.

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Before swimming down to the LEM, however, he stopped and considered something. Off and on, Lovell had been entertaining the idea of breaking what was ordinarily an ironclad rule on any space mission, and now, almost impulsively, he decided to do it. Opening the top two or three buttons of his flight suit, he reached beneath his thermal undershirt, felt around for the biomedical sensors that had been glued to his chest since before liftoff Saturday, and began painfully removing them.

There were a lot of reasons, Lovell decided, that the electrodes had to go. First of all, they itched. The adhesive used to hold the sensors in place was supposedly hypoallergenic, but after four days, even the most skin-friendly glue was going to become annoying, and this glue most assuredly had. More important, pulling off the sensors would save power. The biomedical monitoring system that beamed the astronauts' vital signs to Earth drew its juice from the same four batteries that powered everything else aboard the LEM, and although the electrodes were hardly power gobblers, they still consumed their share of amps. Finally, there was also the question of privacy. Like any test pilot, Jim Lovell had long prided himself on his ability to keep his emotions out of his voice — whether he was flying over the Sea of Japan in a blacked-out Banshee or flying over the far side of the moon in a blacked-out LEM. But while the voluntary nervous system responds to such exertions of will, the involuntary one doesn't, and nobody could control the accelerated respiration and triphammer heartbeat that even the most imperturbable pilot could experience in an emergency. Lovell did not know how high his cardiac rate climbed after the explosion that aborted his mission on Monday night, but it rankled him to know that everyone from the flight surgeon to the FIDOS to the pool reporters did. In the event of another crisis in the next two days, he saw no reason that his heart rate should be broadcast to the world. Peeling off the electrodes, he balled them up, stuffed them into a pocket, and pushed off toward the LEM.

"Morning," Haise said as Lovell's head poked through the tunnel. "Looks like you finally got some rest."

Lovell glanced at his watch. "Wow," he said, "looks like I did."

"Jack coming down?" Haise asked.

"Nope." Lovell floated all the way into the cockpit. "Still sawing wood. What's the status of things down here?"

"Well," Haise said, "they've definitely decided on a mid-course

burn sometime tonight, probably around 105 hours. We're shallowing pretty bad now."

"Mm-hmm," Lovell said.

"And they're pretty sure we'll try to get it in before the helium bursts."

"Makes sense."

"Also," Haise said. "Looks like we had a bit of an event in the descent stage."

"An . . . event?"

"A bang. And some venting."

The commander looked at his LEM pilot for a long moment, reached for his headset, and pressed his push-to-talk switch.

"Houston, Aquarius," Lovell called.

"Roger, Jim," Vance Brand said from Houston. "Good morning."

"Say, Vance, what is our status on descent-stage venting? Was it venting? Is it still venting?"

Brand, who had not yet gotten a report from Arabian and McDivitt in Building 45, hedged. "Fred reported it. Does he still see it?"

Lovell turned to Haise with an inquiring expression. Haise shook his head.

"No," Lovell said. "Fred hasn't seen anything else."

"O.K.," Brand said, without elaboration.

Lovell waited to see if his Capcom had anything to add, but Brand said nothing. In the clipped code of the air-to-ground loop, Lovell knew, this silence said a lot. Brand didn't *know* what the bang was yet, and he would almost certainly prefer it if the commander didn't pursue it. It was one thing for the omnipresent press to hear the Capcom explain a problem to the crew, quite another for them to hear the commander ask for an explanation of something and the Capcom come up empty. Lovell let another instant go by and moved on to other things.

"Also," he said to Brand, "I understand we can expect the supercritical helium to relieve itself at about 105 hours."

"Closer to 106 or 107," Brand said.

"And we'll be doing a mid-course a little before that?"

"Roger," Brand said. "Not only will that guarantee you fuel pressure, but it means you'll still have your thrusters powered up from the burn when the helium blows. That way, if the venting tosses you around a little, you can regain control."

"Roger," Lovell repeated skeptically. "I can regain control."

He clicked off the air, pursed his lips, and decided that he didn't like what he was hearing one bit. These newest problems might have surfaced on Haise's watch, but they would have to be resolved on Lovell's. He felt his jaw clench once with an unexpected flutter of tension. Suddenly Brand's voice reappeared in his ear.

"And there's only one more item for now, Jim. Could you switch your biomedical switch to the position opposite wherever it is now? We're getting a signal but no data."

Lovell paused. Brand paused. Three seconds went by, and the man on the ground, sitting impassively at his console, outwaited the man in the spacecraft.

"Now you know, Houston," the commander said at last, "I don't have the biomed on."

Lovell listened on the air-to-ground channel and braced for what he assumed would be a reprimand from Houston. Instead, he heard another few seconds of silence. Finally Brand, an astronaut himself who, like Lovell, had learned his craft test-flying jets and who, like Lovell, might one day find himself in a busted spacecraft far from home, clicked back on the air.

"O.K." was the only thing the Capcom said.

Lovell smiled to himself. When this flight was over, he'd have to remember to buy Brand a beer.

Return Home

From the center seat, Jim Lovell turned to look at the men on either side of him and smiled. "Gentlemen," he said, "we're about to reenter. I suggest you get ready for a ride."

Unconsciously, the commander touched his shoulder belts and lap belts, tightening them slightly. Unconsciously, Swigert and Haise copied him.

"Joe, how far out do you show us now?" Swigert asked his Captain.

"You're moving at 25,000 miles per hour, and on our plot map board, the ship is so close to Earth we can't hardly tell you're out there at all."

"I know all of us here want to thank all you guys for the very fine job you did," Swigert said.

"That's affirm, Joe," Lovell agreed.

"I'll tell you," Kerwin said, "we all had a good time doing it."

In the spacecraft, the crew fell silent, and on the ground in Houston, a similar stillness fell over the control room. In four minutes, the leading edge of the command module would bite into the upper layer of the atmosphere, and as the accelerating ship encountered the thickening air, friction would begin to build, generating temperatures of 5,000 degrees or more across the face of the heat shield. If the energy generated by this infernal descent were converted to electricity, it would equal 86,000 kilowatt-hours, enough to light up Los Angeles for a minute and a half. If it were converted to kinetic energy, it could lift every man, woman, and child in the United States ten inches off the ground. Aboard the spacecraft, however, the heat would have just one effect: as temperatures rose, a dense ionization cloud would surround the ship, reducing communications to a hash of static lasting about four minutes. If radio contact was restored at the end of this time, the controllers on the ground would know that the heat shield was intact and the spacecraft had survived; if it wasn't, they would know that the crew had been consumed by the flames. At the flight director's station, Gene Kranz stood, lit a cigarette, and clicked on to his controllers' loop.

"Let's go around the horn once more before reentry," he announced.

"EECOM, you go?"

"Go, Flight," Aaron answered.

"RETRO?"

"Go."

"Guidance?"

"Go."

"GNC?"

"Go, Flight."

"Capcom?"

"Go."

"INCO?"

"Go."

"FAO?"

"We're go, Flight."

"Capcom, you can tell the crew they're go for entry."

"Roger, Flight," Kerwin said. "Odyssey, Houston. We just had one last time around the room, and everyone says you're looking great. We'll have loss of signal in about a minute. Welcome home."

"Thank you," Swigert said.

In the sixty seconds that followed, Jack Swigert fixed his eyes out the left-hand window of the spacecraft, Fred Haise fixed his out the right, and Jim Lovell peered through the center. Outside, a faint, faint shimmer of pink became visible, and as it did, Lovell could feel an equally faint ghost of gravity beginning to appear. The pink outside gave way to an orange, and the suggestion of gravity gave way to a full g. Slowly the orange turned to red — a red filled with tiny, fiery flakes from the heat shield — and the g forces climbed to two, three, five, and peaked briefly at a suffocating six. In Lovell's headset, there was only static.

In Mission Control, the same steady electronic hiss also streamed into the ears of the men at the consoles. When it did, all conversation on the flight controllers' loop, the backroom loops, and in the auditorium itself stopped. At the front of the room, the digital mission clock read 142 hours, 38 minutes. When it reached 142 hours, 42 minutes, Joe Kerwin would hail the ship. As the first two minutes went by, there was almost no motion in either the main room or the viewing gallery. As the third minute elapsed, several of the controllers shifted uneasily in their seats. When the fourth minute ticked away, a number of men in the control room craned their necks, casting glances toward Kranz.

"All right, Capcom," the flight director said, grinding out the cigarette he had lit four minutes ago. "Advise the crew we're standing by."

"Odyssey, Houston standing by, over," Kerwin called.

Nothing but static came back from the spacecraft. Fifteen seconds elapsed.

"Try again," Kranz instructed.

"Odyssey, Houston standing by, over." Fifteen more seconds.

"Odyssey, Houston standing by, over." Thirty more seconds.

The men at the consoles stared fixedly at their screens. The guests in the VIP gallery looked at one another. Three more seconds ticked

slowly by with nothing but noise on the communications loop, and then, in the controllers' headsets, there was a change in the frequency of the static from the ship. Nothing more than a flutter, really, but a definitely noticeable one. Immediately afterward, an unmistakable voice appeared.

"O.K., Joe," Jack Swigert called.

Joe Kerwin closed his eyes and drew a long breath, Gene Kranz pumped a fist in the air, the people in the VIP gallery embraced and applauded.

"O.K.," Kerwin answered without ceremony, "we read you, Jack."

Up in the no longer incommunicado spacecraft, the astronauts were enjoying a smooth ride. As the ion storm surrounding their ship subsided, the steadily thickening layers of atmosphere had slowed their 25,000-mile-per-hour plunge to a comparatively gentle 300-mile-per-hour free fall. Outside the windows, the angry red had given way to a paler orange, then a pastel pink, and finally a familiar blue. During the long minutes of the blackout, the ship had crossed beyond the nighttime side of the Earth and back into the day. Lovell looked at his g meter: it read 1.0. He looked at his altimeter: it read 35,000 feet.

"Stand by for drogue chutes," Lovell said to his crewmates, "and let's hope our pyros are good." The altimeter ticked from 28,000 feet to 26,000. At the stroke of 24,000, the astronauts heard a pop. Looking through their windows, they saw two bright streams of fabric. Then the streams billowed open.

"We got two good drogues," Swigert shouted to the ground.

"Roger that," Kerwin said.

Lovell's instrument panel could no longer measure the snail-like speed of his ship or its all but insignificant altitude, but the commander knew, from the flight plan profile, that at the moment he should be barely 20,000 feet above the water and falling at just 175 miles per hour. Less than a minute later, the two drogues jettisoned themselves and three others appeared, followed by the three main chutes. These tents of fabric streamed for an instant and then, with a jolt that rocked the astronauts in their couches, flew open. Lovell instinctively looked at his dashboard, but the velocity indicator registered nothing. He knew, however, that he was now moving at just over 20 miles per hour.

On the deck of the USS Iwo Jima, Mel Richmond squinted into the

blue-white sky and saw nothing *but* blue and white. The man to his left scanned silently too, and then muttered a soft imprecation, suggesting that he saw nothing either; the man to his right did the same. The sailors arrayed on the decks and catwalks behind them looked in all directions.

Suddenly, from over Richmond's shoulder, someone shouted, "There it is!"

Richmond turned. A tiny black pod suspended under three mammoth clouds of fabric was dropping toward the water just a few hundred yards away. He whooped. The men on either side of him did the same, as did the sailors on the rails and decks. Nearby, the network cameramen followed where the spectators were looking, and trained their lenses in the same direction. Back in Mission Control, the giant main viewing screen in the front of the room flashed on, and a picture of the descending spacecraft appeared. The men in that room cheered as well.

"Odyssey, Houston. We show you on the mains," Joe Kerwin shouted, covering his free ear with his hand. "It really looks great." Kerwin listened for a response but could hear nothing above the noise around him. He repeated the essence of the message: "Got you on television, babe!"

Inside the spacecraft that the men in Mission Control and the men on the Iwo Jima were applauding, Jack Swigert radioed back a "roger," but his attention was focused not on the man in his headset but on the man to his right. In the center seat, Jim Lovell, the only person in the falling pod who had been through this experience before, took a final look at his altimeter and then, unconsciously, took hold of the edges of his couch. Swigert and Haise unconsciously copied him.

"Hang on," the commander said. "If this is anything like Apollo 8, it could be rough."

Thirty seconds later, the astronauts felt a sudden but surprisingly painless deceleration, as their ship — behaving nothing like Apollo 8 — sliced smoothly into the water. Instantly, the crewmates looked up toward their portholes. There was water running down the outside of all five panes.

"Fellows," Lovell said, "we're home."

Marilyn Lovell laughed out loud as Jeffrey cried out once and started to squirm. Through a film of tears and a swarm of people, she watched

the television screen in her family room as Odyssey struck water and the three parachutes that had carried it down flattened themselves on the surface of the ocean. Throughout the slow descent, she had been holding her son in her lap, and as the spacecraft fell, Marilyn had unknowingly clutched him tighter and tighter. At the moment of splashdown, Jeffrey shouted in protest.

"I'm sorry," Marilyn said, laughing and crying and kissing him on top of his head. "I'm sorry." She hugged him once more and set him down on the floor. When she did, Betty Benware appeared from nowhere and embraced her tightly. Then Adeline Hammack materialized, then Susan Borman. At the edge of the room, Pete Conrad opened the first bottle of champagne, followed by Buzz Aldrin and Neil Armstrong, followed by who knew who else. Marilyn got up, found her other children, and, ducking the spray from the popping bottles, hugged them as well. Somebody put a drink in her hand. She took a long, fizzy swallow, and more tears — this time from the bubbles — came to her eyes. In the distance, Marilyn faintly heard the phone ring in the master bedroom. It rang a second time and Betty disappeared to answer it. A moment later she reappeared.

"Marilyn, it's the White House again."

Marilyn handed her drink to someone nearby, ran to the bedroom, and picked up the dangling receiver.

"Mrs. Lovell?" a woman's voice said. "Hold for the president."

Several seconds went by, and then Marilyn once again heard the deep, familiar voice.

"Marilyn, this is the president. I wanted to know if you'd care to accompany me to Hawaii to pick up your husband."

Marilyn Lovell paused absently and smiled into the middle distance, picturing the spacecraft she had just seen bobbing on the waters of the South Pacific. The line from Washington crackled slightly.

"Mr. President," she said at last, "I'd love to."