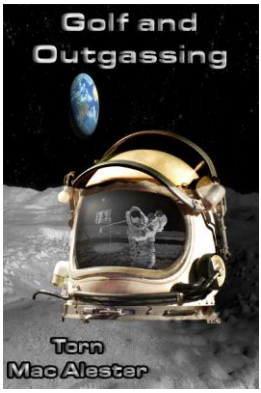
Golf and Outgassing



i

"What's my time?" I asked, wondering how much time we had left for the first moonwalk.

"Okay CDR," Capcom's voice, my husband Cy MacInturner, crackled in my headset. "Annie Mac, you're looking good. I show you with five seven minutes remaining. You just passed hour number five."

"Confirmed." I said, wanting to add an 'I told you so' since I warned them about this many times. *If we hadn't waisted so much surface time celebrating me being the first woman on the moon, we might be finished already.*

I glanced at the space-suited figure of my crew-mate Milt Johnson moving toward me across the lunar surface. I noticed him move with ease, which contrasted to his difficulty during training on Earth. I figured he would get his moon legs, and it pleased me to see it come true.

“Looks good. Once we get these garbage cans set, we’ll call it a day.” I said, referring to the fifty-gallon-drum-sized experiments they needed to unload from the six-wheeled crawler. We had intended to set up the experimental packages during the first EVA, and throughout training, we had done the work in three or four hours. *Damn, this takes far too long. We need the margin for EVA 3.*

“You’re the boss, Annie,” answered Milt in his relaxed style. I had known him for two years, since he joined the space agency. He had a reputation for resourcefulness. He always had the most information about anything, including rumors. He also had a know-it-all personality that grated against many in the astronaut office, including myself. Many times, he was right, making it far worse.

“Okay, let’s get after it.” As I grabbed the garbage can containing a soil mineralogy experiment, it knocked me off balance. “What the–?”

“Problem boss?” Milt asked in a tone suggesting a joke.

“Damn thing is off balance.” I realized that even though the weights of the experiments were much less, moving their mass was difficult. It had been affecting me most of the day. I figured it contributed to us being behind schedule. The last experiment proved worse than the others.

“Want me to take it?”

“No,” I answered. “I’ve got it.”

I struggled a moment, finding the experiment package top-heavy. I didn’t recall the same being true on the simulator. The simulation team had forgotten something when they made the training item. On the moon, it only weighed thirty pounds, though having

some mass off-center meant it carried significant inertia. Plus, it out-massed me.

"Have the experiment design team make a note," I stated while moving the trash-can experiment into position. "Even though we practiced with one-sixth weight, we didn't practice large masses."

"Understood, Mac," said my astronaut husband. "Should we also shine 'em up for you as well?"

"Ha, ha," I laughed. *Smart ass!* I shoved the trashcan into an upright position. I pulled out the antenna and solar array and set up the experiment for surface activity.

We would leave the experiments much like Shepard and Mitchell did sixty years prior. The only difference was that our experiments had improved electronics, wireless data feeds, and solar power. Here, the experiment pulled lunar soil into a reaction chamber use sunlight to break oxygen from the rocks. The experiment acted as a prototype. It would prove that such a unit could make a two-week supply of oxygen during a single week of operation.

After turning on the power, I glanced south and saw a glint of gold atop a small rise. I didn't recognize what it was at first, but then realized it was the lower half of the old Apollo 14 lunar lander, *Antares*, left on the lunar surface over fifty years prior. Our own lander, *Steamboat*, sat some thirteen hundred meters distant from *Antares*.

I turned on the unit. After a few minutes a green light turned on, showing the experiment started. "I've got Tango-Charlie-Six operational. Do you have telemetry?" I asked. I waited for the answer, hoping the electronics could communicate over the radio, showing normal operation. Far too many of them needed reboots this afternoon.

"Stand by," Cy answered after the two-second speed of light delay.

I glanced at the TC1 trashcan sitting a dozen meters away, noting the unfurled antenna pointed toward the Earth and the series of green lights on its side. I wondered about the wireless link between TC6 and TC1. If the wireless connection failed, I would have to reboot TC6—an easy but time-consuming procedure.

After a few more moments, Cy continued, "Looks like Tango-Charlie-Six is a go. Good work, Mac."

About time!

ii

What the hell?

Without invitation Milton Johnson stormed into my office and took a seat. He didn't knock. Even though we had an appointment, I felt common courtesy meant that he would knock first. If he'd been military, I'd kick him out forget about his interview.

"Mister Johnson," I said with the steadiest tone I could muster.

"Yes," he said taking a seat. "I'm ready for my interview."

Damnit! He didn't call me Colonel.

I ignored him and buried my attention to his file, staring at my computer screen allowing my temper to subside. Military or not, he needed to know who was in charge. Cy had pointed out that I could not expect that kind of protocol from Space Agency civilians. They'd do their job, and I could expect nothing more. *Bull–*

Besides taking the first woman to the Moon, the key goal of this mission was to test the lunar space system, requiring a crew of two. My crew would leave the space station using a two-man capsule to rendezvous with the lander and a big rocket motor to launch the stack to the moon, perform the landing, and return - simple.

Could Mister Johnson handle simple? My first question was silence. I planned it carefully. An impatient man would break it. An uncomfortable man would fill it. *Can he handle the pressure? What kind of man is Milton Johnson?*

He sat quiet. After his initial breach of protocol there were no further statements. I wondered if he sensed my initial irritation and corrected his behavior or if he made his entrance and was waiting for my response. I let the test go on for nearly a minute as I glanced at the time, while looking at the file I had already memorized.

"So." I smiled, closing my laptop screen. "Mister Johnson–" I looked at him—the piercing stare every Marine learns that is meant to make someone uncomfortable.

"Milt, please. Mister Johnson is my father." Milt grinned. I guessed he had little use for titles.

"Very well," I answered. "Milt. First off, you're a rookie. Don't you think it's taking on a lot to fly this as your first mission?"

"I don't think so," Milt answered. "The mission to the Moon is ten days, but we spend almost twice that amount acclimating ourselves on the space station prior to TLI. I doubt an extended stay on the station would provide me with much more experience. Also, you and I will both be rookies for deep space. There aren't any veterans available since the last mission was nearly sixty years ago."

Good answer, I thought, *he's very aware of the mission parameters.* Lack of flight experience was never one of my criteria. I

wanted someone who could make the mission a success for more than carrying the first woman to the moon. *Someone had to be first. I drew the short straw.*

"From your qualifications, you aren't just a smiling face."

He stared back at me unflinching.

I noted the lack of humor and smiled. "Milt, why do you want to be on my crew?"

"A better question would be," Milt offered, "why you would want me on your crew."

"Fine," I felt myself bite my lip. Not much bearing, but little did it matter. *Of all the arrogance!*

He lacked the wide-eyed awe of many younger astronauts and looked as though the experience of preparing for spaceflight lacked excitement for him. I hated his attitude, though I continued the interview out of fairness. I gave each of the other candidates an hour, and I vowed it would not change. I would give him his hour. He needed to make good.

"A fair question. Convince me," I said.

"First," Milt smiled, brushing an errant hair from his forehead, "I am resourceful. For example, I already know that the committee took the Tranquility site off the table. It makes sense, and I'm sure the committee wants something else besides the retrace of the first landing site."

"They consider that site as a historical monument," I answered, unimpressed with his restatement of known facts.

"It's a good idea to stay away from Tranquility. This mission should not be a 'look, we can land on the moon' journey," he said.

I smiled, thankful that he didn't add the 'First woman on the Moon' to his mission description. I would be the first, but it meant that I was next in the flight rotation—nothing more.

"I'd also take the south pole off of the list," he continued.

"Why?"

"Too much additional risk for a first mission."

"That's one of the main goals for the program," I said. "What risk are you talking about?"

"The margin for the system is very tight to get to the south pole. We give ourselves considerable margin for an equatorial landing."

"I think the engineering team has already put the south pole as the goal for mission two."

"I concur."

"Were you part of those meetings?" I asked.

"No. I worked independently."

"What site would you pick?" I wondered about what he might think and how well it matched my own. I wanted to get Tycho, Aristarchus, or some other scientifically interesting site.

"Fra Mauro." Milt smiled. "Of course."

What the hell is he thinking about? I thought, *there has already been an expedition to Fra Mauro. What explanation justifies going back to that site?*

“Why?” I asked.

“First, it’s close to the equator, so we won’t have to stress the rocket systems on our first mission by allowing plenty of margin.”

“Interesting,” I answered, pleased by his awareness of the rocket booster’s capabilities. Landing in lunar equatorial regions added fuel margin to the mission. It showed that he had considered and understood engineering limits. “Go on.”

“The second reason is that the old NASA seemed very interested in the location.” Milt smiled. “Did you know that it was the landing-site for both Apollo 13 and 14?”

“I didn’t realize that,” she answered, knowing about Apollo 14 from the history surrounding the flight.

“At least it was for Apollo 13. After the accident, planners chose the same location for Apollo 14. That was the policy at the time: use the previous flight plan to meet the missed mission objectives.”

“Oh, yes, the Apollo 13 accident. The re-flight seems like a reasonable conclusion. I think we’ve used that same paradigm ever since Yellowstone.”

I looked in Milt’s eyes to see how he reacted to the mention of the super-volcano’s eruption over a decade prior. *No reaction! Could he have been that lucky to lose no one? Either that, or he was numb from it.*

“I agree,” Milton nodded. “But some interesting information that I have found has made me reconsider.”

“And that would be?”

"The Apollo 14 surface experiment package detected water vapor about a month after the landing."

"What?" I sat up. *No way!*

"Yes, you heard correctly." Milt smiled.

"I had never heard that before."

"They had decided at the time that the water vapor came from the *Antares*' descent module or something else left by Shepard and Mitchell on the surface," Milton explained.

"I wonder." I felt unconvinced.

"The paradigm at the time was a dry moon," Milton said. "Most of the science had water boiling off the surface and into deep space because the moon's gravity is too weak to hold any atmosphere. It seems reasonable that they ignored the discovery."

"So not a detection."

"Well…" Milton paused.

"And?"

"It happened again in a few weeks."

"Really?" I exclaimed. "Again."

"Yes."

"They didn't ignore it. Did they?"

"It convinced them that the water had come from something left behind by the crew. There was a model of seismic activity causing outgassing of ground water. It's in some reports from the time."

I considered a moment, then figured it made sense that something left behind could have caused the signature. *I guess they could have been right. It makes sense.*

“But that brings up my fourth reason for going to Fra Mauro.”

“Which is?”

“Let me revise that. It's still part of my third reason.”

“Fine.”

“I cannot find a reference for any such detection in the data associated with any of the other experiment systems left at the other landing sites.”

“So?”

“Fra Mauro is different. It’s something that the Apollo 14 crew left behind, or it’s part of the region.” Milt lowered his voice. “The answer to that question is at Fra Mauro.”

“What else?” I asked, sensing there was more.

“One of the earliest moonquakes detected by surface seismographs–”

“Let me guess.” I grinned. “Fra Mauro.”

“Yes.”

“You know I’ll have to verify everything you just told me.”

“Of course,” he set a thumb-drive on the desk. “All of my report is cross referenced.”

Send me out to the Stumps! This guy is for real.

I mistook Milton’s confidence as arrogance. He presented a good case for the mission. It was better than any of the proposals I listened to from the mission science team. Milton earned a job in my eyes, and he determined the mission I wanted—a return to Fra Mauro.

iii

"This reminds me of the Stumps," I said, driving the crawler up to the Apollo Lunar Science Experiments Package, ALSEP, location along its northern side. I glanced to Milton, occupying the right seat in the pressurized crawler. We wore our suits but stored our helmets in the airlock at the rear. We use the crawler to move between locations.

"Stumps?" Milton asked as I stopped the crawler short to avoid the footprints left behind by the Apollo 14 crew.

"An affectionate name given to the base called 29 Palms. We called it 29 Stumps because the palm trees had been cut down or blown up. The entire base could be used for a live fire exercise."

"I take it was a cratered landscape."

"Yep." I answered. *Just like here.* "Driving the crawler here reminds me of the off roading on that base. Shame we can't go hot dogging it today."

I drove carefully, promising everyone that we would not disturb the Apollo 14 landing site apart from one device, the suprathermal ion detector experiment or SIDE. That instrument made the water detection. The science team wanted it. From the vantage point, I saw the SIDE about twenty meters beyond the central station. To our left, two hundred meters distant, I saw the *Antares* descent stage. A mass of footprints linked the *Antares* and the ALSEP central station. Though over fifty years old, the footprints looked as fresh as if we made them yesterday.

"Central station." Milton said, pointing to a set of boxes of various sizes. One sported an antenna pointed toward Earth, and another looked like a power supply because of the radiator fins.

“Yes,” I answered, looking over the boxes. A third looked like a box tilted on an angle by two fragile legs. The last simple box was covered in gold foil.

“Arrival at ALSEP,” I stated. We planned to collect most samples using robotic arms controllable from inside the crawler. Should the need arise, we could put on our helmets and go outside to collect samples.

“Looks like our estimate of foot traffic from the old photos is correct—walked this area a lot,” Milton observed.

“–copy–” interrupted ground control.

“I guess right is the way, I can see the retroreflector mirrors – Control, say again – over.”

“Roger Mac,” I heard Cy’s voice on CAPCOM. “We copy your arrival at ALSEP. Can you switch to *omni bravo?* Your signal has been breaking up.”

“Copy *omni bravo,*” Milton answered. “Mission one, radio check.”

“Roger five-by-five.” Cy said.

“Control this is CDR,” I said. “Radio check.”

“Mac I’ve got you weak and staticky.”

Piece of shit, headset. I tried to reinsert the plug into the console. “One more time, Control – CDR – Radio check.”

“Better Mac, we thought you had fallen into a well.”

“Ha ha, Cy.” I said.

"Signing off here," Cy said. "We're at shift change. Have a good EVA Annie, we'll talk later tonight."

I turned the crawler toward the east. The crawler paralleled the tracks. I drove toward the easternmost experiment in the ALSEP configuration, the Laser Ranging Retroreflector. It was only about three dozen meters distant, making the journey quick in the crawler.

"Yes," Milton answered. "We need to go around the LRR and then south, past the end of the geophones."

"Roger that." I drove the crawler, seeing the LRR about twenty-five meters distant, near a small crater to its south. The scale shift from seeing a small experiment sitting next to a crater made both seem farther away than they were. As I drove, I saw the footprints end past the location of the LRR. "It looks like they didn't go much farther than the location they chose for the LRR."

"Yeah," Milton answered. "Looks like they put it down and went back to their work."

"I didn't see a sign of the geophones as I drove by. Did you see 'em?" *Damnit, where did they go?*

"I caught a glimpse." Milt said. "There was a set of tracks heading off that direction. I may have seen glints from the metal." The geophones stretched about a hundred meters toward the south. Sheppard and Mitchell's Apollo 14 tracks would have been along its length.

I rounded the LRR and turned the crawler south, avoiding the small crater as she drove. There were no footprints, so I continued until we had traveled about a hundred meters. I glanced to the left, looking for the geophones and the telltale tracks in the moon dust. From my vantage, I saw the *Antares* descent stage from another

perspective that revealed the rungs of the descent ladder. “Control, I don’t see the geophones.”

“Copy,” cracked over the headset.

“Where in the hell are they?” I asked no one in particular.

“I’m thinking we are south and west of them. That five-meter crater over there,” Milt said, pointing ahead of us to the right.

“Yes?”

“It appears to be fairly shallow. I’m guessing that it’s this crater here,” Milt said, pointing to the map display on the dashboard. If he was right, the crawler was about thirty meters south and west of the end of the geophones.

I turned the crawler toward the west, then north. “It will be nice once we get the NAV system extended to the moon,” I said while driving. “I’d like to drive a little more accurately with all these footprints around.”

I slammed on the breaks, seeing what I feared. The set of boot prints crossed our intended path.

I saw Milt touch the VOX switch, ensuring ground control could not hear them. “These shouldn’t be here.”

“What do you mean?” I felt confused, not sure why Milton saw fit to disconnect them from discussions with ground control.

“It looks like a circumnavigation of the landing site.” Milton showed a pensive look on his face, as though he were about to say something.

“What?” I snapped.

“Oh, it’s nothing.”

I felt irritated. Milt withheld information, even when being helpful. “Spit it out, Milt.”

“If this is true, we cannot approach the SIDE without crossing this set of tracks.”

“Obviously,” I barked.

“I have two alternatives.” Milton smirked.

“They are?”

“Drive over the path like we did not see it.”

I considered a moment. “I don’t like that option. The other?”

“Let’s walk over there and get it.”

“You’re kidding.”

“No.” Milton stated. She noticed no hint of humor in his features.

I assembled my thoughts but covered my thinking by asking questions. I learned to do so while in the Academy. It allowed me to think while having someone answer my questions. “What do we gain by using your first option?”

“It will allow us to continue with our existing plan,” Milton started. “We roll through and use the robot arm and snag the SIDE. Afterward, we back out the way we came.”

“Anything else?”

“This is your decision,” he stated.

“What do you mean?” *Of course it is my decision!*

“Exactly what I said,” Milton continued. “You have the ultimate authority for the mission.”

“So, you want me to assert my authority?”

“I’m not advocating any position. I am stating that you have the authority.” Milton looked out of the crawler upon the lunar surface. After a moment, I saw him grin for a moment and turn back to me. “It’s a long way. We should get what we came for.”

I thought, *He is right. It’s my choice.* But it wasn’t a choice between action or inaction. It was a choice between two different actions. Others would likely find either action undesirable. Some might question my authority in the situation. I wished Cy were available to talk about it. Yet I knew his answer. “We’ll drive on,” I said.

“Are you sure?” he asked.

“Yes. It’s obvious we need to get what we came for. The way we do that is by getting robotics to the SIDE location. Without the crawler, we’d destroy more boot prints. If our goal is to keep this site as pristine as possible, then this is the way to do it.” I started driving. “Turn the VOX back on.”

I saw him move at the corner of my eye as I drove. “Roger.”

“Control, we’re moving on,” I said.

“Copy,” answered ground control. “Moving on.”

iv

I heard Milt emerge from the airlock and shut the door, preparing to store the retrieved SIDE on the crawler. The crawler lurched a bit from him, stepping from the back.

We had easily picked up the experiment from the surface and cut its cables using the robotic arm. The last effort would be to grapple the experiment and haul it over to the crawler.

“Boss,” said Milton over the radio. “I found something.”

I looked at the viewscreen, trying to discern the object that Milton found. She thought it appeared to be a rock. Attempting to adjust the contrast, she asked, “What is it?”

“I’ve found one of the golf balls.”

“What?”

“One of Al Shepard’s golf balls is lying right here. It’s deformed, it’s discolored, and it looks like a rock. But it’s one of the golf balls. I recognize the dimples. We must have dislodged it from the dust as we rolled over it.”

“I didn’t expect to have found one.”

“Neither did I,” Milton answered. “We should ask Smithsonian if we should retrieve it.”

“Copy,” I answered. “Let me know when you are ready for me to move the SIDE over to you.”

“Give me a second to get the crate unhitched from the side.”

From the monitor, I could see Milton fighting with something. In the high contrast, I guessed that he could not see since the crate was in a deep shadow. It was difficult. Without the benefit of atmospheric refraction, the shadows became impossibly deep. I knew he would need some time to work out a solution. “Roger.”

“Okay, boss,” Milton finally answered after a bunch of grunting and heavy breathing. “I’ve got the crate ready.”

I adjusted the robotics controls, lifting the SIDE from the lunar surface. At first, I thought I might lose it as it slid in the robot's grip, but it slowed and stopped. Carefully, I swung the arm away from the cut wires and over toward the crawler and the waiting Milton. The arc progressed frustratingly slowly, making my palms sweat as she worked the controls. Another defacement of the Fra Mauro landing site would not be explained away. I crossed the line of tracks. Any more damage would amplify that choice. Every second, I thought it would slip out of the grasp of the robot arm.

Feeling it might last forever, I watched as Milt reached up and collected the SIDE into his hands.

“SIDE recovered,” I sighed, relieved.

A long delay finally produced an answer from ground control: “Copy. SIDE retrieved.”

v

I looked on as Milt and his backup, Nils Carmike, studied the image of Cone Crater on the pad sitting between them on the table. The lunar science team stepped out, giving us a chance to pour over the data.

I had insisted that the team choose its own scientific goals, since they would carry them out on the moon. I made the case to the science board when I chose Fra Mauro as our mission. I compromised on a solution allowing them recommendations as long as the crew kept the final choice. My case was helped because I insisted on doing some surface science on the moon, something mission managers had

placed in a low priority. To their thinking, proving the lunar transport system was the only goal of the mission. I disagreed based on Milt's recommendations about Fra Mauro, plus I wanted more of a legacy than being the first woman on the Moon.

In the original mission to Fra Mauro, getting a sample from the interior of Cone Crater had been one objective for Apollo 14. Cone Crater was a deep crater, revealing the composition of the bedrock beneath the landing site. Shepard and Mitchell intended to get a sample from inside Cone's rim. The difficulty ascending the Cone Crater hillside had left Shepard and Mitchell exhausted. Their final position was shy of the rim when time constraints forced them to return to *Antares*. Nils suggested that we should make a trip to Cone Crater a top priority, even if they had taken similar samples on later Apollo missions. I agreed, it seemed like a reasonable sample that we'd collect that would complete the story of the Fra Mauro geology.

Milton lifted the pad and stated, "Nils, there is no way that smudge is anything significant."

Nils had looked to me and to my husband, Cy, my backup for the expedition. Nils looked gaunt, betraying his lack of sleep during the past weeks. I asked the flight surgeon to ensure Nils could fly, should Milton be unable. I recommended additional sleep, but Nils seemed unconcerned about it, attributing it to habits of study in college.

Nils turned back to Milt and almost shouted, "I've checked with the image analysis folks on this. There's a good chance there is a skylight cave there."

"A skylight," Cy said thoughtfully.

I glanced at Cy, knowing that he really was not paying attention. I spotted him using the technique shortly after we met. He

was watching football, and I remembered asking him a question. After each question I uttered, Cy had repeated a few words from the question in a thoughtful tone but never answered. After a while, I figured it out. Cy was preoccupied, but tried his best to sound engaged in what I had been saying. Now Cy seemed concerned about something else. I focused on the conversation, knowing that I might have to brief Cy at another time.

"Yes," Nils answered. "It's possible."

"Maybe," Milton said in an unconvinced tone.

"Nils," I interjected, feeling that they avoided key information. "It would be useful if you presented the evidence."

"Oh, yes." A nervous smile played over Nils's face. "If you look at the series of photographs from the Apollo era, we can see that there seems to be a shadow that persists regardless of sun angle."

"It's a rock," said Milt.

"A rock," said Cy, seeming to agree.

"But our laser altimeter readings show a flat or dimpled region where you think there is a rock," Nils added.

"So, a depression is in near-permanent shadow?" I questioned.

"Yes." Nils rubbed his head. "I believe so."

"How deep?" I asked, glancing at Milt, who looked on with interest.

"At least three meters below the crater floor," Nils answered. "If it is a skylight, it's a significant find. A cave under Cone Crater could be a location for potential lunar water to collect. It would be permanently out of the sunlight making it frigid."

“Cone Crater is a recent impact,” Milton offered, glancing toward me.

“Millions of years old, if you mean recent,” offered Nils.

As opposed to the several-billion-year age that described most of the lunar craters, I thought.

“Sounds like you are becoming convinced.” Cy turned to Milt, raising an eyebrow and reconnecting to the conversation.

“Yes,” Milt answered.

“Then it would be a good addition to the mission plan,” Cy stated. “It will take up an EVA by itself.”

“What do we have now?” I asked, looking at Milt.

“EVA one—deploy experiment packages and preliminary geology traverse. EVA two—recover SIDE from ALSEP and primary geology traverse.” Milton answered.

“There is always a contingency EVA,” Nils added.

“Command contingency,” Cy corrected. “It's for us to complete tasks from previous EVAs.”

“I understand.” Nils nodded. “I’m thinking you could put that as a contingency option, if we have all tasks completed.”

“The front office ain’t going to like that,” Cy said, “even though it’s a great idea.”

“Let me worry about the front office,” I stated, hoping the tone convinced him that I considered the issue closed.

“Still, we already have an aggressive mission,” Cy said. “The point was to make sure all the system works for the future missions.”

“Yes,” Nils agreed. “But we need to get along with phase two, fast.”

“We have a lot of engineering to do before phase two,” Milt replied.

“This will prove the system,” Nils countered.

“Listen,” I interrupted. “I don’t care about all that. I need a case for the science.”

“Agreed,” Cy added.

“If I have a good reason to climb down to the bottom of that crater, I’ll add it to the mission. Make it good,” I said.

“There is one,” Nils stated.

“You must prove it,” I replied. “I’m thinking the mission scientist will want to weigh in.”

“You can’t mean that!” Cy exclaimed.

“Why not?” I countered. “I must answer to the flight director. It’s the same difference.”

“Fair enough,” answered Cy.

“Nils,” I looked at him. “What do you think is the reason for taking that risk?”

“I think there is ice in that skylight cave.”

“What?” Milt spat.

“You’re kidding,” Cy said.

“Hold on, you two.” I held up my hand. “Let Nils finish speaking.”

"Thank you. The clues are all there. There was a detection that happened twice on the SIDE instrument that some thought was water. We have evidence of seismic activity. And we have a skylight. The ice could be in the cave, and sunlight warms it enough to have a slight outgassing of water vapor. The SIDE detected it."

"Wow," I said.

"The only thing we need is samples from within that crater," Nils continued. "Shepard and Mitchell were exhausted by the time they reached the rim. If they had continued…"

"And we won't be exhausted," added Milt. "We can drive up there with the crawler and let a rover go down. They had to do it on foot while carrying a survey cart."

"Impressive," I had remarked, realizing that the team had come through. I would make a case for Cone Crater.

vi

I watched from the seat in the crawler, watching the robotic rover descend into Cone Crater. The slope from the western side seemed easy to navigate. The robot descended, spooling behind it a cable connecting it to the crawler. I glanced at Milt, working the controls from his seat in the crawler. From our vantage, I could see our tracks that approached from the south along the rim. Once in position, we deployed the robotic rover using the crawler's robot arm. It gave us an advantage to set down to the bottom of the first cliff instead of driving around it. From that spot, Milt guided the robotic rover toward the suspected skylight.

"It looks like we are making progress," Milt said.

The crawler had traversed to the Cone Crater along the northwestern side of the Fra Mauro landing site. Shepard and Mitchell had only explored the southern edge. It kept us clear of any more potential damage to the Apollo 14 landing site.

“Yes,” I answered, seeing the shadow growing larger in the monitor.

“Only a few more feet.” Milt concentrated as the monitor showed the vehicle had come to a halt.

“That’s it.” I smiled in triumph. It vindicated my arguments for the command contingency. We now had a close view of the skylight at the bottom of Cone Crater.

The mission scientist held the meetings with the mission manager and the flight director. Those discussions continued for weeks prior to launch. After six frustrating meetings, I got the approval to use the command contingency for another moonwalk.

“Let's get those lights on and look.”

Through the monitor, it became clear the darkness seen in images resolved to a skylight at this close range. It was hard to guess how deep. Except for an outline of the hole, the lights ended in darkness.

“It looks like what we came for,” Milt said.

After descending about a quarter of the way down the inner slopes of Cone Crater, “Mac, this is Control,” crackled over my headset.

I knew Cy’s voice sounded extremely urgent. I knew something was wrong before I answered, “This is Mac. Go, Control.”

"Babe, we have a critical situation. You must shut down all power and evac Fra Mauro landing site. Radio silence from acknowledge until three zero seconds after liftoff. Acknowledge."

"Copy. Out." I shut down my radio. *He called me Babe, this is serious.*

I moved over to Milt. I could see by the external panel that he had shut down his suit radio. I moved in close and touched him, helmet to helmet. "Can you hear me, Milt?"

"Yeah, I hear you. What the hell is going on?"

"I don't know. Something has scared the hell out of them, and they want us the hell out of here, now."

"Yeah, but what?"

"Something is unsafe here," I said. "We need to go. I know the tone in Cy's voice. We are in real danger."

"Okay."

Steamboat was almost two kilometers west of our current position on the west side of Cone Crater. We needed to traverse the distance on foot. Luckily, it's well within our walk-back circle of oxygen. I considered a moment that it would be faster to use the crawler to head back. But Cy said to shut down all power. He said Babe, meaning that I needed to heed the warning. It meant that the power of the equipment had something to do with the evacuation. I realized that we traded time versus danger. Though we needed to leave fast, I opted against using any power.

They climbed out of the crater, using the cables strung down from the crawler on the western limb. Upon reaching the top, she turned to see Milton had followed her out of the crater. As soon as he reached the top, she moved to touch helmets again.

“I’ve thought about it on the way up,” she said. “Shut down the power to the crawler. Then we walk back out.”

“Agreed,” answered Milt. “I’ll know in a second.”

“Let’s be as quick as we can. Is there anything we cannot afford to leave?” I looked to the rim of the crater.

“I’ll look around just in case. But I don’t think so.”

I looked around outside.

“Milt,” I said, making helmet contact again.

“Yeah?”

“How much of *Steamboat* needs to be shut down?”

“Some,” he answered. “It acts as our comms relay.”

“Shut it down,” she said.

“That will mean–”

“–yes, it will mean that they cannot communicate with us.”

“They wanted it that way,” Milt confirmed.

“Let’s get it shut down, then.” I looked at my watch. “We should be able to make *Steamboat* within forty-five minutes.”

“Three clicks,” Milt agreed. “Easy.”

“Okay.” I looked through the samples and the supplies, looking for anything that we needed to take. The rocks weren’t from inside of Cone Crater, so they likely represented the scatter for the site. I realized that, while Milt shut down power for the lander, I could collect a sample from inside the crater rim.

I ran to the rim and stepped into the crater. I bent down and grabbed a rock, likely a basalt, threw it into the sample bag. I hoped it would be enough, but took another smaller rock, a breccia, and a handful of soil and put it all in the same bag.

I hoped I made a good choice of rocks and soil. The bag would be the only sample from inside Cone Crater—complementing the sample from the near the opposite rim taken in 1971. I hoped that it wouldn't be another half-century before someone got a look inside.

I turned and ran back to the crawler as Milt exited. I moved up the slope and touched helmets. "I collected a contingency from the crater."

"*Steamboat* and the crawler are shut down."

"Okay, let's go," I said. "I'll lead."

"I'll be right behind you."

I turned and started moving across the lunar surface, moving at a deliberate pace along the crawler tracks, back toward the lander. Before the mission, the plan had prevented I and Milt from disturbing the Apollo 14 landing site.

I kept moving, knowing that I could not see the lander after descending the slope away from Cone Crater. I saw a small rise obscure it. The lander disappeared as we descended from Cone Crater's rim. I guessed to the lander's location and used the terrain to maximize my speed.

Most of the distance required me to move around smaller craters, though some I ran right through. I also needed to avoid rocks, forcing me to change directions often. *I think I'm making the right path toward Steamboat. Is that cluster of rocks in the right direction?*

I breathed heavily, fogging my helmet. Luckily, the sun was not directly in my line of sight, or the combination would have made it even more difficult to navigate. On my own and using my feet seemed an odd way for a pilot to make a journey. At that moment, I wished I could have quickly flown the distance, since my muscles hurt enough.

I pushed onward, hoping I had not drifted toward either the north or the south. Neither were bad for getting lost. The path to the north included the tracks of the crawler. To the south, I would reach the path of the crawler used to retrieve the SIDE. Either way, the path would enable me to navigate to *Steamboat*. I hoped the middle path I chose would be the fastest.

There's Steamboat. I saw its upper structure, the ascent module, glinting in the sunlight. The exhaustion I felt forced me to stop and gave me a moment to look back to keep track of Milton's progress.

I turned and did not see him.

Realizing that I had not set eyes on him for about ten minutes, I began walking back toward Cone Crater. He could have fallen and broken his visor. Such a disaster would be impossible to fix, but I needed to know his fate before leaving the Moon. I upped my pace a bit, keeping a close eye on the rocks, hoping one of them was not spacesuit shaped. I quickened my pace, resolved to find out what had happened to him.

As I rounded a boulder, I saw him on the other side, leaning against it. I ran up to him, touching helmets.

"What's wrong?" I asked.

"I turned an ankle," answered Milt. "I took a bad step about a half kilometer back."

"Sorry," I apologized. "I made a dumb mistake. We should have stayed together."

"No worries," Milt commented. "I had no visions of you leaving without me."

"Still," I answered, pulling Milt's arm over my shoulder and acting as a crutch to keep him moving.

It slowed our pace, but not as bad as I feared. Milt was not as heavy as I first expected, using his Earth weight as a measure. It was far easier to support him and keep moving. I needed to be cautious about his mass. He was bigger and required more force to maneuver, but we were going slowly enough that I dealt with it.

After another twenty minutes, we arrived at the lunar lander *Steamboat*. I watched as Milt ascended the ladder without difficulty. As he ascended, I did a last look for anything useful. I saw an unusual rock and grabbed it in my hand. *Who knows if this is worth it*? I thought. I ascended the ladder and shut the door and began the power-up. I hoped that whatever had been responsible for them having to power down would not affect the power-up. If the power-down had something to do with radio communications, I ensured that all radio and radar transmissions were off.

Firing the engines, I guided the module toward lunar orbit manually. After a hundred kilometers of distance, "Okay, that's a hundred. Get the radar and the S-band back online."

"I've got it," said Milt.

"Let's see what control has to say about this fiasco." She touched the VOX switch and spoke. "Control, this is *Steamboat*, over."

"*Steamboat*, loud and clear." Cy sighed as he answered. "We had the telemetry feeds lock in a second ago. You look good, Mac, right down the contingency course."

"Why the power shutdown and sudden departure?"

"We discovered that the mortars for the active seismograph experiment were never fired on the ALSEP. You had live rounds pointing toward your landing site. We had no way of telling if they were explosive rounds or not."

"Good catch," Milt answered.

"Yes," I added.

"I'm glad we got you out of there," Cy replied.

"One question," I stated.

"Yes?" asked Cy.

"Who's buying?"

Epilogue

I looked from the window of her habitat toward the northwest and Fra Mauro, thinking to herself. It had been decades since I and Milton Johnson had evacuated the landing site. Cy and my home sat about forty kilometers from Mitchell Town.

"Thinking about the mission again?" Cy asked as he handed me a coffee.

"How could you tell?"

"There aren't many times you stare out that window without the subject coming up."

"What the hell happened?" I asked, still trying to figure out the chain of events that led to the evacuation of Fra Mauro. No one had ever said anything directly, but I always felt I had the stigma of a failed mission.

"The best I can figure is that Nils and Milt didn't do their homework about the active seismography experiment," Cy said.

"That's the official line," I grumbled. "They overlooked a mortar, god-damn-it!"

"Mac," Cy soothed, "take it easy."

"And it was pointing at our ride home."

"What do you expect, Colonel? They left the agency shortly thereafter."

"True." I stared at my coffee. "It still makes me wonder, especially after what we discovered."

"Oh, you mean our unofficial expedition to Fra Mauro." Cy made quotes with his coffee-free hand.

"Yeah," I looked to him. "Do you suppose?"

"If you were still on speaking terms with Milton, you could ask him." Cy took another sip of coffee. "I need some help with the harvest. Can you give me a hand?"

"Sure," I answered. "I'll be right there."

End

Bonus Scene II

Nils Carmike looked up from his desk after looking at the flight rosters to see Moses Crane standing in the doorway.

“Care to take a walk over to building 5?” Mose asked.

“Me?” Nils asked with a start. Crane was as close as a legend than anyone in the astronaut office. “I uh –”

“Who else, Carmike?” Mose laughed. “Did you think I asked your invisible friend over there?” Mose asked, pointing to the empty desk.

“Well, sure.” Nils rose and followed the senior astronaut.

“Come on,” Mose walked relaxed, letting the other man keep up. “– wondering what this is all about?”

“Yeah,” Nils answered.

“Why do you think Cy dropped you from his crew?”

“I'm not sure.”

“I do.” Mose said. “He doesn't trust you.”

“You talked?”

Mose shook his head. “I didn't need to. That is the number one reason why anyone is dropped from a crew.”

“What am I supposed to do about it?”

“There ain't nothing you can do.”

“So why are we–?” Nils asked.

“Let's set a standard of trust between us.” Mose suggested.

“Sure... How?”

“I will promise to always be truthful with you.”

Nils thought for a moment. “Okay...”

“I'd like for you to do the same.”

“All right—that is fair enough.”

“Good.” Mose nodded thoughtfully. “I have one question as we begin.”

“Go ahead. Ask me anything.”

“Was the idea about the skylight at the bottom of Cone crater yours?”

Nils looked at his feet, then at Mose, then back to his feet. “No. It was Milt's.”