The Power of Apollo (16)

Marianne J. Dyson

After the high-speed ballistic "hop" from near Tycho Crater to the old Apollo 16 site, Ashley waited for her heart rate to slow back to normal. She watched nervously as the lunar dust kicked up by the retros slowly painted her landing area with whitish ejecta. Had she landed far enough away to avoid disturbing Young and Duke's footprints? She promised to minimize the damage to the historic site while doing what she must to save herself and Sarah.

"Raider 1, Spaceport Houston," her radio blared.

"Ah!" she squeaked, quickly adjusting the volume on her radio, something Sarah normally handled. But Sarah was busy driving their rover toward the South Pole to maximize sunlight exposure on its solar panels. Hopefully she'd make it before nightfall. By then, Ashley will have retrieved Apollo 16's radioactive thermonuclear generator and used it to warm the greenhouse at NASA's mothballed Paul Spudis Station. At least that was the plan.

"Everything okay, Ashley?" Capcom Matt Bailey asked.

"Um, yes sir. I mean, roger, Spaceport Houston," Ashley replied. Why did she always get so nervous speaking to Matt? "Raider 1 has landed safely." The name Raider 1 had been Matt's idea, though critics of the private space science program said it proved she was making light of the desecration of Apollo. Those critics seemed to be more interested in being proved right about their safety concerns with the automated crew return vehicle than saving her life. Unless the team back home found a way to correct their CRV's trajectory soon, Ashley's reputation as a "grave robber" would be the least of her worries.

She rambled on, "Give me a minute to get things configured and double-check all the systems."

"Roger, Raider 1. Spaceport Houston standing by with a map update when you're ready," Matt said.

She scanned the displays of the lunar excursion vehicle. She was a well-trained pilot, but she recognized that she was under a lot of stress. Now was especially not the time to accidentally leave something running and use up the battery. Thankfully the folks at NASA were working with the Spaceport team to reactivate the demo water extraction factory at NASA's Spudis Station. Hopefully it would produce enough to top off the hopper's tanks, assuming they survived nightfall and had a CRV to rendezvous with. "All systems safed. Ready for map update," Ashley reported.

While the map program processed the shortest, least obstructed paths to the generator, Ashley eyed the empty passenger seat. Had she been wise to fly here and leave Sarah alone to drive to the pole? Sarah Savage was the most competent astrogeologist Ashley had ever met. And she was an experienced driver. But the terrain near the pole was the most dangerous on the Moon. The trail she was following was littered with abandoned "educational research" bots that couldn't handle the steep slopes that were as slippery as any snow-covered mountain. Ashley's biggest fear was that Sarah would drive into a shadow-shrouded crater with sides too steep to climb out of. Sarah would then have to walk out to a place flat enough for Ashley to land and pick her up before her suit ran out of power. But hopefully Sarah could get the rover within EVA distance of Spudis so they could transfer there if/when the batteries at Spudis failed. The RTG would give them a little more margin against that contingency.

The map finished processing and appeared on her heads-up display. Ashley popped the canopy and stood up facing west. She panned the horizon, which was about two and a half kilometers away, though it seemed closer because of the lack of air and objects to provide scale. Large rocks and boulders littered the surface. Overall, it seemed smoother here than near Tycho. "Spaceport Houston, looks like the path heading straight south to Station 2 on the Apollo 16 EVA map offers the best approach," Ashley said. She scanned north to south and spotted a glint of gold. "I see the Lunar Module!" she said. "It's much shorter than I imagined."

"That's probably because in all the Apollo photos, the black and white ascent stage the crew flew to orbit is still on top," Matt responded.

"Yeah, I think you're right. Do we know where that one came down after they jettisoned it?"

"No. If I remember right, it had some kind of navigation problem," Matt said. "Could have come down anywhere along the orbital track."

"I'll keep an eye out for it," Ashley said. She climbed down the ladder and hopped to the surface.

"Sarah asked me to pass along a request to take your UV laser along to check for organic biosignatures."

"It's already strapped to my leg," Ashley said. While she'd been in transit, she'd reviewed some of the science reports from Apollo 16. Several breccia collected from the Cayley Plains included zircon-bearing clasts formed during large impacts. The zircon crystals revealed the dates of their formation, and hence the impacts, were between 4.15 and 3.4 billion years ago. It was unlikely she'd find any younger zircons like they'd found near Tycho, but she owed it to Sarah to at least look.

"Okay, good," Matt said. "Hey, I read that Apollo scientists discovered that some bacteria that rode to the Moon on the Apollo 16 spacecraft survived exposure to vacuum and radiation. So maybe you'll find some bacteria from the 1970s?"

"I'll let the laser run in the background while I work," Ashley said. "Maybe we'll find some evolved Moon bugs in their garbage."

"That would be groovy," Matt quipped, emphasizing the last word. "But speaking of garbage, if you come across any Apollo food pouches, you should grab them. They might taste better than your ration bars, even half a century later." He chuckled. "But seriously, the backpacks might have some components you can use or recycle via the 3D printer at Spudis."

"Yeah, well, let me know," Ashley said. She was glad Matt was such a creative thinker. Finding ways to stretch their resources and survive an extended period of darkness at the pole station was not going to be easy. Supposedly, there were seeds available there for them to grow a crop of radishes in the little greenhouse. She planned to use the RTG to thaw the water tank and warm the seeds enough to germinate during the nightspan. She hoped Sarah had a green thumb because Ashley couldn't even keep a houseplant alive.

The map on her heads-up display showed the three Apollo 16 EVA tracks, extending west, south, and north of the Lunar Module. The generator had been deployed during EVA I, about ninety meters, the length of a football field, east of the LM. Her hopper was about two kilometers northwest of the LM, between the tracks for EVA's I and III. She'd navigate between them as much as possible. But with her target so close to the LM, she'd literally be walking in the footsteps

of the two Apollo astronauts before long.

She pulled a handle on the leg of the hopper, releasing a drop-down side panel that unfolded into a ramp like attic stairs. She then used a crank to lower what they called the Little Red Wagon down the ramp to the surface. It reminded her of the fabric wagon her sister used to take her two boys to the zoo. Her tools were in a bag attached to the back. A metal ring around the wagon lifted up and then forward to become an open handle, like a rectangular hula-hoop. She stepped into the rectangle and attached it to the front of her suit. The empty wagon weighed so little that Ashley could barely feel it bouncing along behind her as she set off toward the LM.

Even though she'd been on the Moon for a full week now, she had never needed to lope across its surface quickly. Her search for unique rock samples and her desire not to spray them by kicking up plumes, had trained her to take small steps. But the downhill slope here plus the press of time had her skidding and spraying dust like a skier doing S turns. Because of the low gravity, she spent much longer off the surface with each kangaroo hop and had a hard time judging where exactly her boots would land. Consequently, her left boot caught on a boulder she thought she'd clear. "Umph!" she blurted as she fell sideways and sent moondust every which way. "Darn it anyway," she added as the red wagon unceremoniously bounded down on top of her.

"You okay?" Matt asked.

Embarrassed, Ashley stood, brushed off her faceplate with a gloved hand so the engineer could see her path again through her helmet cam. "Yes, I'm fine," she said. "Just need to follow Grandma's advice about more haste, less speed."

"Understand and agree with your grandma. Especially with you being out there solo, you need to be more careful than quick," he said. "No need to rush. You still have a good five hours of air and battery before you need to recharge."

"Right." Ashley would have felt better with a full eight-hour supply, but she had left the hopper unpressurized for her flight here to save fuel in case she needed to rescue Sarah from a stuck rover.

She checked that her tools were still in the wagon and then resumed her trek, albeit, more slowly. "Speaking of time," she said, "have you decided if you want me to retrieve anything other than the RTG?"

"We're still looking at the data—most of what I can find is short on details. Did you know two of the Apollo 16 crew are still alive? NASA is trying to contact Charlie Duke and T.K. Mattingly for any insights they might provide."

"Wasn't Mattingly the guy who got pulled from Apollo 13 because they thought he had the measles?" Ashley asked.

"Yes, that's right, and how many people remember him," Matt said. "But he was also the Apollo 16 Command Module pilot and the commander of the fourth Space Shuttle flight. He was the youngest Apollo astronaut, and Duke was the youngest to walk on the Moon."

Ashley thought they both must be close to one hundred years old by now! "I feel like I should have known that—but now that I do, I'm going to make a point of visiting them when I return to apologize in person for pirating their mission!"

"Well, I don't think you need to apologize. It was our idea to send you after the RTG," Matt said. "Anyway, what I know so far about the backpacks is that they are as big as extra-large suitcases. It might be best to open them up and remove the most useful parts, such as the refillable oxygen canisters. If we're short on time, I'm thinking you might just grab some of the discarded batteries. They stashed used ones under the LM."

"What use are dead batteries?" Ashley asked.

"They are silver zinc rechargeable batteries," he said.

"Oh, I didn't know they had rechargeable batteries back then," Ashley said. "Sounds promising."

"Yeah, we think so, too," Matt said. "But still not as useful as the reactor which is still producing power. And Apollo 16's is the 'youngest' of those except for 17 which is farther away and closer to nightfall."

"Right. We need every watt we can get," Ashley said. She loped down into a light-colored depression complete with bright rays extending from it. "This is a *very* fresh crater!" she noted.

"Hopefully my laser can capture some data on it for us." Wishing she had time to stay and study it further, she reluctantly climbed up the side and saw the Apollo experiments seeming to glow with white light in the distance. The LM appeared super close now, but her map said she was still almost a kilometer away.

She scanned the historic scene where John Young and Charlie Duke had gathered samples and deployed experiments in 1972, long before she'd been born. "Are you seeing what I'm seeing?" Ashley asked. She turned her helmet slowly with the camera in high-res mode for Matt.

"Yes. That white box in the distance is the experiment's central station. The reactor is the dark cylinder to its right from where you are."

"No—I mean, yes, I see the station and reactor." She laughed at herself for forgetting she was talking with an engineer, not a fellow planetary scientist! "But I meant the two fresh craters between me and the experiments: like the one I just traversed. They're all lined up. That can't be a coincidence. I bet they're part of some experiment."

"Could be. We'll pulse our local Apollo historian about that," Matt said.

"Okay," Ashley replied.

A few seconds later, Matt said, "Ah-ha, you're right. There was something called the active seismic experiment that involved launching grenades and using the impacts to calibrate the seismometers. The experiment was controlled from the ground after the astronauts left—so there were no photos from ground level showing the craters."

"Oh wow," Ashley said. "They fired grenades up here during Apollo?! That's very cool. Now I just *have* to grab some regolith samples for Sarah!" She carefully took high-res scans of first one and then the farther of the two craters and scooped surface samples into self-sealing bags. Knowing the exact location, timing, and strength of these impacts could help them date other recent impacts.

Though she doubted anything she did here would satisfy those who wanted the Apollo sites kept pristine, at least Sarah would appreciate the data. Dr. Savage was one of the few people in the department who shared Ashley's passion for understanding the origin and distribution of lunar resources, especially organics. If humans were ever going to sustain themselves in space, they had to know where all the resources were located. She was indebted to her predecessors like "Mr. Moon" Paul Spudis who had led the search for sources of water and found it in surprising abundance at the South Pole.

She slowed her pace as she neared her destination. Reluctant to step into Young and Duke's boot prints. She stopped and carefully stepped out of the wagon's hoop harness. "Well, here's our little generator," Ashley said. The nuclear thermal reactor didn't look like much. The dark gray cylinder surrounded by fins was only about half a meter tall and a little less in diameter. The cylinder stood upright on a white square base strewn with gray regolith.

"Be careful how you handle the reactor," Matt said. "The vanes are like six hundred degrees!"

"Celsius or Fahrenheit?" Ashley asked.

"Oh, sorry, all the Apollo data is in English units. That's 315 Celsius: hot enough to melt the wagon's fabric."

Ashley looked around. "Maybe I can kick it over onto the platform and carry it to the wagon like a turkey on a platter—but I need some way to hold onto it and keep it from sliding off."

"Is the cable long and flexible enough to use for a strap?" Matt asked.

Ashley eyed the cable running from the reactor to the white box of the central station. "Yeah, it's as long as a garden hose!" she said. "But I'm afraid the hot vanes might melt it. Maybe I could use a platform from one of the other experiments and make it into a turkey sandwich?"

"I take it from the turkey talk that someone's getting hungry," Matt remarked.

"Yeah, it has been a long time since breakfast at Tycho!" Ashley agreed. "But I've got water and a snack in my suit, so I'll be fine until I get this thing loaded. Anyway, what can I use that would cause the least damage to history?"

"I'm more concerned about your future than history right now, but there's something on the map near you labeled magnetometer."

Ashley spied the magnetometer's white balls on golden arms looking like an expensive sculpture in the distance. "No, I think it's too big, and besides, I'd hate to break something so beautiful, you know?"

"Yes, it is a beautiful piece of engineering!" Matt said.

She smiled, glad that someone else shared her aesthetic sense. She spotted a small white platform with some sort of little tripod mounted on it. "I see something that might work, and it's close, too." She made her way over to the experiment. "It has a little tube pointing up at the sky—is it some sort of telescope?" she asked.

"I don't know," Matt admitted. "It's not labeled in any of the photos or diagrams."

"Well, if it didn't even rate a label, then no one is going to miss it, are they?" Ashley said. Talking with Matt was definitely improving her mood.

Matt laughed. "Now you're thinking like a real space pirate!"

She laughed. She bent down and disconnected the device from the platform that reminded her of a white board. Then she slid the platform out from under the device, whatever it was. "Got it!" she said. She carefully stepped in her own footprints back to the reactor.

"Oh, just FYI," Matt said. "I set up packet streaming of your laser fluorescence data to Sarah. She said checking it over will help her stay sane during your extended stay."

Ashley chuckled. "I'm sure she prefers that to my country music collection!"

"What? Now what am I going to use for wakeup music?"

Ashley heard "Take Me Home, Country Roads" playing in the background and smiled. "When I asked her music preference, she said she'll listen to anything, but she prefers rocks that roll."

"Argh!" Matt groaned.

"Seriously, she will appreciate the data. Thanks for setting that up."

Ashley kicked the reactor over and laid the white board on top. "Turkey sandwich, ready for pickup!"

"Looks yummy," Matt said. "Time to disconnect it from the central station."

"Yeah." Ashley followed the power cable to the central station.

Ashley yanked on the cable but couldn't get it free. She whipped out her electric drill, glad that it had a full charge. Careful not to cut the live wire, she held it in her left hand while she drilled with her right. She felt it pull free, and then suddenly it was as if someone had shoved her from behind! She was thrown forward with great force, crashing into the station and tumbling with it to the surface, dust flying everywhere.

She quickly rolled onto her back and lay there panting while regolith pelted her faceplate. Stunned, she lay staring up at the Earth, half of a blue and white marble in a black sky. "Hello? Matt?" Her suit display blinked red "LOS" for loss of signal.

All those billions of people up there, and without her radio, none of them could help her. She was on her own even more than before, and time was precious.

She sat up, brushing regolith off her torso—and discovered that the drill had slammed into the control panel on the front of her suit. No wonder her comm was out. The control unit had a hole drilled through it! Fortunately, the fan assembly that circulated her air was on her back and continued working. She didn't hear any hissing sounds. Nothing hurt. She'd miss the map on her display, and especially Matt's commentary, but she could easily follow her tracks back to the hopper. But first she needed to get what she came for. She took a deep breath. She'd landed a plane safely after an engine failure. She could do this.

She stood up, stomped her feet, and flapped her arms to get the dust off and reveal any other suit damage. Thankfully, she didn't find any more holes. Seeing the size of the crater, she was lucky she hadn't been killed.

What had caused this crater? Meteors struck the Moon all the time, but the odds of one striking right here as she unplugged the generator were astronomical. Also, the crater was shallow for an impact event. The RTG ran off radioactive decay. There was nothing in it to explode. Well, whatever had struck or exploded, she was lucky she hadn't been closer to the center!

She didn't see the reactor and realized it must have been buried by regolith. She could follow the cable to it. She knelt next to the broken central station. She retrieved the drill by habit—never

leave a tool behind. Before the auto shut off had kicked in, it had not only drilled her suit but cracked a big rock in half. She rolled it over in her hand, seeing colorful inclusions in the sunlight, mysterious little stars begging her to examine them. And that one inclusion sure looked like a zircon!

She stuck the rock in her leg pouch. Fearing something sharp that could tear her suit might be buried in the wreck of the station, she stood back up and used her boot to locate the cable. Mindful of one end being a live wire, she grabbed it some feet from the end, and tied a clumsy knot in the stiff cord. Then she gathered up the cable like winding a stiff garden hose, lifting it up and out of the loose regolith and wrapping it in loops around her arm.

She clambered out of the new "Ashley" crater and saw the squarish lump that must be the reactor. She was reminded of the time she explained to her nephew that the Moon had no jagged mountains. Impacts had dumped regolith over everything like sand over pointy conch shells on the beach.

Another smaller lump nearby was her wagon. She turned it sideways and dumped out her tool kit. She opened it up and got her geologist's brush. She needed to dust off the reactor "sandwich."

The blast had knocked the top off her "sandwich" and left regolith stuck between the cooling vanes. Lunar regolith was a heavy-duty insulator. Would it make the reactor overheat? She knew it couldn't explode, but could the excess heat damage the seals? Plutonium was only dangerous if inhaled or ingested. She hoped Matt would figure out a way to do a leak check on it before she put it into the greenhouse.

Ashley brushed off the platform and then kicked the reactor to shake some of the regolith off. Unfortunately, the dust stuck electrostatically to the vanes like hair to a balloon rubbed on someone's head. She put the smaller platform "bread" back on top and wrapped the cable over it. She unfolded the handle of her geologist's spade and used it to lift first one side and then the other of the lower platform to get the cable underneath. Unlike on Earth, no bugs rushed out from under it. She wondered if her laser would pick up any of the bacterial hitchhikers that Matt mentioned? Not likely. However, it would be interesting to know how much radiation the platform had blocked during its decades on the surface. She shoveled some regolith from under the platform into a sample bag and used another to get a sample from a sunlit spot nearby.

She was surprisingly tired after she completed tying the cable around the package. And hungry. She paused to bite off a section of the somewhat stale snack bar in her suit. She sucked some water and took a few more bites, wishing the reactor really were a giant turkey sandwich! Was Matt taking a break, too? She imagined him desperately trying to reach her and wondering why her comm had gone offline. Was there any satellite that he could use to check on her? See her moving around like the stranded Mark Watney in that old Mars movie?

She swallowed the last bit of her snack bar and chased it down with some lukewarm water. How long had it been since the accident? She kept looking at her display expecting to find the time and saw only the red LOS alarm flashing. She couldn't even use the movement of the sun or shadows to judge the passage of time like she could on Earth because the Moon rotated too slowly for her uncalibrated eyeballs to notice changes in mere hours. But she could use Earth!

Theoretically, she could tell time by which oceans and continents were visible as Earth rotated from its fixed spot in her sky at this latitude. She looked up at the waxing crescent Earth, nearly first quarter already. The daylit side of Earth was about 12 hours "wide," and she was seeing the morning half of that. So, it would take two to three hours for whatever was visible on the dawn terminator to move to the center of the image, and another two to three hours to rotate out of view. If she had a telescope, she could measure precisely. Instead, she'd have to estimate using large recognizable features.

She closed her eyes and recalled how the Earth had looked when she was on her back in the crater. She'd definitely seen Florida near the center. She opened her eyes and gazed up at Earth again. Yes, there was Florida, still visible, but with more of the Gulf of Mexico showing—and maybe the Texas coast there near the terminator? That made sense—she had arrived here at 4 A.M. Houston time and taken about an hour to get to the RTG. April was near the spring equinox, so

dawn should be around 6 A.M.in Texas? So, it had been about an hour since the accident. That meant she still had about three hours of suit power. If she could get the reactor loaded quickly, she'd have time to grab one of those backpacks! She got back to work.

Rather than lifting the reactor into the wagon and risking it falling off the "platter," she decided to lay the wagon on its side and slide the "sandwich" into it. This was easier said than done, but by using the shovel, she was able to leverage it in and push the wagon upright. "I know you probably can't hear me, Matt, but I've got the reactor loaded, and I am going for a backpack now."

After the blast had painted over so many of the Apollo footprints, she no longer worried about where she stepped. But it still took her about fifteen minutes to reach the area near the abandoned descent stage of the Apollo 16 Orion. The scene was not the awe-inspiring one she'd imagined. The scattered bags of trash and pieces of equipment, old boots, and sheets of crumpled insulation rumpled around the legs made it seem more like a space junk yard than a national historic monument. Everything was filthy. Maybe her "taking out the trash" wasn't such a despicable thing after all?

The rover sat forlornly a good football field distance away. Ashley wished she could hop on and drive it back to the hopper, but sadly, the rover's batteries were long ago drained of power. Maybe some enterprising entrepreneur would find a way to refurbish it. Wouldn't that be a fun tourist ride?

Mindful of the time, she spotted the boxy backpacks in the pile at the base of the ladder. She heaved one onto its side. The backside nametag identified it as having belonged to John Young. The side facing toward the person's back had two straps at shoulder height and two at the waist. She grabbed the backpack by the upper straps and heaved, intending to lift it—but it was far too heavy for her. She'd have to drag it. Then she'd have to get it into the wagon and back to the hopper. She glanced up and could barely see the tiny red wagon in the distance about a kilometer away. It would be a long slog back dragging the backpack. She decided it wasn't worth it.

Matt had said she might remove some parts like tanks. But it wasn't obvious how to open it up, and she wasn't going to do any more drilling and risk another explosion! So she either had to take the whole thing or nothing. Reluctantly, she let the backpack fall where she'd found it. But right where it fell she spotted a familiar tool: a geologist's hammer! Now that was something useful! She stuck it into her leg pocket.

What about the discarded batteries he'd said would be under the LM? What did discarded batteries look like? She assumed they would be black and relatively small to fit in the backpack. All she saw under the LM were pieces of insulation and some smudged white bags with lumpy contents. Could the batteries be in there? She grabbed one and peeked inside. There was something black and box-shaped in among what looked like food wrappers. Could that be a battery? Maybe she could salvage some garbage to use for compost or melt the wrappers for use in the 3-D printer? She'd need to print a new control panel for her suit. The bag was light but bulky, about the size of a second-grader. She could easily carry two.

As she rounded the LM looking for another bag, a flash of light nearly blinded her. She stopped, half expecting another explosion. But the light had only been a reflection off of something. Something awesome! "Wow!" she exclaimed. "A gold-plated telescope!" She had seen its replica at the Smithsonian in DC! She'd just started stargazing with her dad and remembered being impressed at how beautiful it was. Her dad had explained that it was the first telescope sent to the Moon, and it had been invented by a black astronomer. And here it was, right where the Apollo 16 crew had left it!

She was not leaving without at least a quick look through it. There was no eyepiece for looking through the main lens, but there was a little finder scope on the side. Had the pointing been controlled from Earth? Regardless, she should be able to point it manually.

Earth was slightly to the west of north and about 80 degrees above the horizon from this latitude. She tried to adjust the angle using a leveling screw that promptly fell off into her hand. She tried to put it back on, but it had gotten gummed up with lunar dust. She dropped the little gold nut in her suit pocket. She rotated the telescope until she had Earth in view.

As she looked through the scope, she was overcome with homesickness. How long would it

be until she could hug her mom and dad again, play a prank on her sister, hike in the woods and whistle at the cardinals? And her cat! How she missed that annoying little ball of fur. She blinked hard to clear the tears from her eyes and rubbed her nose on the sponge in her suit. *Get control of yourself, girl! This is not helping!* Then she noticed that the coast of Texas had now moved to the center of the image. She needed to get moving!

She was not going to leave the telescope here where no one would ever see it again. She slid the telescope into the garbage bag. She grabbed another of the white bags and jogged back to the wagon with the two bags over her shoulder Santa Claus style.

She soon skidded to a stop by the wagon. She unloaded the two Apollo bags in the back. She wished she had some bungee cords to hold them in, but all she could do was hope they were heavy enough not to bounce out. She stepped into the hoop harness and trudged forward slowly, retracing her path back to the hopper.

Panting from effort, she paused to catch her breath and take a sip of water only to discover her suit bottle was empty. Oh well, she'd refill after she got the hopper pressurized.

She wondered what Matt was doing? Had he told Sarah he'd lost radio contact? Of course he had—they wouldn't keep that info from her. The news media was probably having a field day, though. They loved a good disaster. Her sponsors were likely saying they had confidence in her while privately berating the flight control team for allowing her to go off on a reckless wild goose chase to Apollo 16 when they didn't even know yet if the CRV was recoverable. She chewed her dry lips. If they couldn't get the CRV into lunar orbit, would they swallow their pride and pay the Russians to come fetch them before they starved?

Ashley trudged on, the hopper passing in and out of view as she went down into depressions and back out again. The surface was so bright, she couldn't see the stars, just a black sky above a light gray surface dotted with black shadows of rocks and boulders. The future, at least her future, was as hard to see as the stars in that black sky. But she knew, if she closed her eyes, blocked the bright surface from view, and looked up, they would appear. The stars were always there whether she could see them or not, like her family and friends up on that blue marble Earth. Her mother had tried hard to get Ashley to say no to this space mission. Mom had listened to the critics demonizing the private space business and thought it too risky. And maybe her mother had been right. But Ashley did not regret her decision. Not yet anyway. She trusted Matt and the team to get her and Sarah a ride home. Hopefully while still alive!

She pushed through the final distance to the hopper and stepped out of the wagon's harness. The cargo door remained open from when she'd deployed the wagon.

She slipped the rectangular "handle" she'd used to pull the wagon back over the top of the wagon and attached it to the winch. Afraid the RTG might slide backward, she removed the two trash bags. "Oh crap! she muttered. One of the fins of the RTG was poking out of her "sandwich" and had melted through the bottom of the wagon. She looked around for something to cover the fin that would limit the damage.

Her tools were all metal, conductors. Rocks and regolith were good insulators, and she needed to hurry and recharge her suit—and call Matt. How long had she been offline now? Two hours at least, maybe closer to three? He must think her dead. She scooped handfuls of regolith and dumped them into the back third of the wagon, then shoved the "sandwich" to the rear so the exposed fin rested on dirt. She activated the winch.

She watched anxiously as the wagon slowly edged up the ramp. The RTG shifted and dirt dumped out the back of the wagon. The hot fin was burning through the back panel! With the left hand on the handrail, she instinctively reached with her right hand to cover the hole. Her glove started smoking, and she jerked back, the load shifted, and the nuke almost fell through the bottom of the widening hole, the fin now scraping on the ramp itself. "Ack!" She studied her glove, the palm was reddish black, but it wasn't blood. The wagon's polyester had melted and stuck to her glove. What a mess! No way she could ever clean that off. The nearest replacement gloves were back on Earth. If the damage were too severe, she'd be stuck wearing mittens the rest of her tour.

The wagon was barely moving up the ramp and leaving a glassy black streak of goo on the door

from the melted fabric like burned pie filling on the bottom of her mom's oven. The winch kept pulling, but the RTG was falling out the bottom! She needed to get that nuke stowed, and fast, without causing further damage to her gloves! She was tempted to kick it, but instead, she jumped to the ground, found a rock the size of a grapefruit, and climbed back up. She pushed on the exposed fin with the rock, while the winch pulled.

Finally, the combination of her pushing and the winch pulling got the wagon all the way to the top, triggering the triangular wheel stops to pop into place to keep it from rolling backward. She wedged the rock under the fin. Though the wagon would have to be patched before it could be used again, she didn't want to risk a smoldering heat source so near her fuel tanks. The cargo compartment wasn't designed for electrically or thermally active cargo: just rock samples and supplies.

Having secured the RTG as well as she could under the circumstances, she dropped down below the spacecraft awkwardly, losing her balance and flopping on her face in the dirt. She giggled, then burst out laughing. Oh man would Sarah be mad at how much dust she was going to track into the cabin. Wait. Sarah wasn't here. She was alone. "Hello?" That's right. She'd bored a hole in her suit. What was she doing anyway? She sat up, clunking her helmet on the ramp. "Oh!" She needed to shut that and get inside. Right!

She staggered to her feet, lifted the ramp, and gave it a shove. Thankfully, it folded up and closed automatically. She turned and tripped on a bulky trash bag. The telescope's legs poked out of the opening. So pretty! What was she doing with it? Oh well, didn't matter. She grabbed it and the other bag and dragged them up to the cockpit with her. Her suit was filthy, but she couldn't dust it off with these bags in her hands now could she?

She tossed the bags into the copilot seat and climbed into the pilot's seat. Where was Sarah? Should she wait for her? She was so tired, and her head hurt. All she wanted to do was sleep . . . Better go ahead and pressurize. Fortunately, she had trained on the hopper systems so many times, she ran through the activation procedure on automatic despite her head pounding. When the green light flashed, she fumbled with her helmet release. She could barely bend her fingers in these stupid gloves! What was that black goo on her right glove? With extra effort out of sheer stubbornness, she got her helmet off.

After a few gulps of air, she felt herself waking up, coming out of a dreamlike state. She tallied her symptoms, numb fingers, headache, brain fog: hypoxia! She had been suffering from a lack of fresh air. She checked the cabin clock and did some quick calculations. Wow, she must have been breathing the last dregs of recycled air for the past ten minutes. And she was dehydrated, too. She was darn lucky she hadn't passed out! She took off her gloves and noted that her fingernails were still a bit blue. Her right hand looked bruised, maybe from pushing so hard with the rock? She reached under her seat for the emergency water bottle and drank enough to clear her throat, wishing she could wash her face, too. But she needed to conserve water. Next order of business: communications. She looked down at her suit panel. Maybe she could print a new box, but there was no fixing it here. She connected her snoopy cap to the ship's comm system. "Spaceport Houston, this is Raider 1, come in."

"Ashley! Thank God!" Matt said. "What happened? Where are you? Are you injured?"

She laughed at how her capcom had thrown protocol to the wind. "Hi Matt, it is good to hear your voice, too!" she said. "I'm back at the ship and have the nuke loaded. There was some kind of freak explosion that knocked me off my feet and took out my suit control box. But I'm not hurt."

"You're not going to believe this, but remember that little tube you thought was a telescope? Turns out it was a launch tube from the seismic experiment," Matt said. "The scientists planned to launch four grenades but stopped after three because they feared the tube had moved and might make a crater out of some other experiment."

"So there was an unexploded grenade in the tube?" Ashley concluded.

"Yep. Our Apollo 16 expert just confirmed this for us. Want to say hello to T.K. Mattingly?"

"Hello Mr. Mattingly! Thanks for helping us out," Ashley said. "I'm sorry I seem to have blown up the science experiments here. Do you know what I did to cause the explosion?"

"Ashley, I should have told you that someone at NASA is relaying our conversations. It's very early in the morning here—he's just waking up. But to answer your question, what the science team here suspects is some combination of static charge buildup and a chemical instability in the explosives. So by moving it and/or unplugging it, you set it off. Our seismometer network registered the explosion as an impact. And we're looking at your laser data now. I hear they see signs of organics!"

Ashley coughed, moondust tickling her nose. "Makes sense, I guess. I also grabbed a sample they can use to characterize the area." She reached into her leg pouch and lifted out the section of rock the drill had cracked open. On close examination, she was even surer that the rock held some of the largest zircon crystals she'd ever seen.

"That's great," Matt said. "But our priority is to get you set up at Spudis Station with that RTG before nightspan."

"I understand," Ashley replied. "I did also get those batteries, though. At least I think the black boxes in the trash bags are batteries."

Matt chuckled. "Turns out T.K. says those batteries really aren't rechargeable like modern batteries. But you might mine them for the zinc to feed the radishes. Or maybe you can take the silver and make some pirate coins!"

"Will it be enough to buy me a ride home from the Russians?"

There was an awkward silence. She had really put her foot in her mouth—making it sound like she had no confidence in the company's ability to recover the CRV. And she'd said it with the whole world listening, too. "Sorry, Matt, I just realized how what I just said might be misinterpreted . . ."

"No, no," Matt said. "I just didn't get a chance to update you on the CRV status. I'm happy to report that the newly renamed 'Casper 2' is now in a high stable halo orbit. But it doesn't have enough fuel to get into and then out of low lunar orbit. So, actually we are already in negotiations with the Russians for a refueling mission. We should know more about that soon. So yeah, hang on to that silver: we might need it to pay for your extended mission!"

Ashley was relieved to hear that their ship wasn't lost. No amount of Apollo silver was going to cover replacement cost of a crew return vehicle. A fueling mission might be at least partially covered by insurance. Still, it would be a big financial hit, and surely delay their plans to send a team to Mars in a decade. Seeing the telescope's legs poking up out of the Apollo bag gave her an idea.

"Hey Matt, would you ask T.K. a question for me? What was the name of the black astronomer who invented the gold-plated telescope that they delivered via Apollo 16?"

A few seconds later, Matt replied, "Raider 1, Spaceport Houston, T. K. says the name is Dr. George Carruthers. I'm wondering how I never heard about this before? A gold-plated UV telescope on the Moon! And invented by a black astronomer in the 1960s? Did you see it?"

Ashley smiled. Carruthers! How had she forgotten that name! Now hopefully more people would learn it. "Not only did I see it, I brought it back with me. It is absolutely gorgeous! Maybe we can find a sponsor to help me print a digital data system for it so students can see the Earth in a new light, literally." And generate a little income for the company.

"That's a genuine gold-plated idea!" Matt said.

Ashley rolled her eyes and groaned. She knew Matt would have sponsors lined up in no time. "Spaceport Houston, was NASA able to get a hold of Charlie Duke?" She patted the pocket containing the geologist's hammer. "I have something of his—or maybe it belonged to John Young? It's a small geologist's hammer."

"Raider 1, Sorry, no luck contacting Charlie. I understand he's on a flight somewhere over the Pacific where it is the middle of the night. But you can't have too many hammers."

"That's what I think, too. I'll take it along to Spudis," Ashley said. "Please send me Sarah's current location so I can fly over her and get some good high-res images to update her maps."

"Roger that, Raider 1. Good idea."

Ashley took a deep breath and let it out. Time to move on. "Houston Spaceport, Raider 1. I see the data on the rover. I'm loading the targets into the nav computer now. I'll call when I am aloft. Raider 1, out."

As the retros fired, Ashley whispered her thanks to the crew, engineers, and scientists of Apollo 16. Even if some people back on Earth condemned her for desecrating a historical site, she hoped T.K., Charlie, and the historians would describe her visit in more positive terms. After all, the true legacy of Apollo wasn't in the footprints or even what they'd learned from the rocks and experiments. The real power of Apollo was the can-do spirit that dared people to dream big and "reach for the Moon" despite the risks. She thought the Apollo 16 team, including George Carruthers, would approve of her putting the old RTG, their trash, and the telescope to good use building a future in space worthy of them all.