

LOG ENTRY: SOL 476

I think I can work this out.

I'm on the very edge of a storm. I don't know its size or heading. But it's moving, and that's something I can take advantage of. I don't have to wander around exploring it. It'll come to me.

The storm is just dust in the air; it's not dangerous to the rovers. I can think of it as "percent power loss." I checked yesterday's power generation, and it was 97 percent of optimal. So right now, it's a 3 percent storm.

I need to make progress and I need to regenerate oxygen. Those are my two main goals. I use 20 percent of my overall power to reclaim oxygen (when I stop for Air Days). If I end up in an 81 percent part of the storm, I'll be in real trouble. I'll run out of oxygen even if I dedicate all available power to producing it. That's the fatal scenario. But really, it's fatal much earlier than that. I need power to move or I'll be stranded until the storm passes or dissipates. That could be months.

The more power I generate, the more I'll have for movement. With clear skies, I dedicate 80 percent of my total power toward movement. I get 90 kilometers per sol this way. So right now, at 3 percent loss, I'm getting 2.7 kilometers less than I should.

It's okay to lose some driving distance per sol. I have plenty of time, but I can't let myself get too deep in the storm or I'll never be able to get out.

At the very least, I need to travel faster than the storm. If I can go faster, I can maneuver around it without being enveloped. So I need to find out how fast it's moving.

I can do that by sitting here for a sol. I can compare tomorrow's wattage to today's. All I have to do is make sure to compare at the same times of day. Then I'll know how fast the storm is moving, at least in terms of percent power loss.

But I need to know the shape of the storm, too.

Dust storms are big. They can be thousands of kilometers across. So when I work my way around it, I'll need to know which way to go. I'll want to move perpendicular to the storm's movement, and in whatever direction has less storm.

So here's my plan:

Right now, I can go 86 kilometers (because I couldn't get a full battery yesterday). Tomorrow, I'm going to leave a solar cell here and drive 40 kilometers due south. Then I'll drop off another solar cell and drive another 40 kilometers due south. That'll give me three points of reference across 80 kilometers.

The next day, I'll go back to collect the cells and get the data. By comparing the wattage at the same time of day in those three locations, I'll learn the shape of the storm. If the storm is thicker to the south, I'll go north to get around it. If it's thicker north, I'll go south.

I'm hoping to go south. Schiaparelli is southeast of me. Going north would add a lot of time to my total trip.

There's one *slight* problem with my plan: I don't have any way to "record" the wattage from an abandoned solar cell. I can easily track and log wattage with the rover computer, but I need something I can drop off and leave behind. I can't just take readings as I drive along. I need readings at the same time in different places.

So I'm going to spend today working on some mad science. I have to make something that can log wattage. Something I can leave behind with a single solar cell.

Since I'm stuck here for the day anyway, I'll leave the solar cells out. I may as well get a full battery out of it.

It took all day yesterday and today, but I think I'm ready to measure this storm.

I needed a way to log the time of day and the wattage of each solar cell. One of the cells would be with me, but the other two would be dropped off and left far away. And the solution was the extra EVA suit I brought along.

EVA suits have cameras recording everything they see. There's one on the right arm (or the left if the astronaut is left-handed) and another above the faceplate. A time stamp is burned into the lower left corner of the image, just like on the shaky home videos Dad used to take.

My electronics kit has several power meters. So I figured, why make my own logging system? I can just film the power meter all day long.

So that's what I set up. When I packed for this road trip, I made sure to bring all my kits and tools. Just in case I had to repair the rover en route.

First, I harvested the cameras from my spare EVA suit. I had to be careful; I didn't want to ruin the suit. It's my only spare. I extracted the cameras and the lines leading to their memory chips.

I put a power meter into a small sample container, then glued a camera to the underside of the lid. When I sealed up the container, the camera was properly recording the readout of the power meter.

For testing, I used rover power. How will my logger get power once I abandon it on the surface? It'll be attached to a two-square-meter solar cell! That'll provide plenty of power. And I put a small rechargeable battery in the container to tide it over during nighttime (again, harvested from the spare EVA suit).

The next problem was heat, or the lack thereof. As soon as I take this thing out of the rover, it'll start cooling down mighty fast. If it gets too cold, the electronics will stop working.

So I needed a heat source. And my electronics kit provided the answer: resistors. Lots and lots of them. Resistors heat up. It's what they do. The camera and the power meter only need a tiny fraction of what a solar cell can make. So the rest of the energy goes through resistors.

I made and tested two "power loggers" and confirmed that the images were being properly recorded.

Then I had an EVA. I detached two of my solar cells and hooked them up to the power loggers. I let them log happily for an hour, then brought them back in to check the results. They worked great.

It's getting toward nightfall now. Tomorrow morning, I'll leave one power logger behind and head south.

While I was working, I left the oxygenator going (why not?). So I'm all stocked up on O₂ and good to go.

The solar cell efficiency for today was 92.5 percent. Compared to yesterday's 97 percent. This proves the storm is moving east to west, because the denser part of the storm was to the east yesterday.

So right now, the sunlight in this area is dropping by 4.5 percent per sol. If I were to stay here another sixteen sols, it would get dark enough to kill me.

Just as well I'm not going to stay here.

LOG ENTRY: SOL 478

Everything went as planned today. No hiccups. I can't tell if I'm driving deeper into the storm or out of it. It's hard to tell if the ambient light is less or more than it was yesterday. The human brain works hard to abstract that out.

I left a power logger behind when I started out. Then, after 40 kilometers' travel due south, I had a quick EVA to set up another. Now I've gone the full 80 kilometers, set up my solar cells for charging, and I'm logging the wattage.

Tomorrow, I'll have to reverse course and pick up the power loggers. It may be dangerous; I'll be driving right back into a known storm area. But the risk is worth the gain.

Also, have I mentioned I'm sick of potatoes? Because, by God, I am sick of potatoes. If I ever return to Earth, I'm going to buy a nice little home in Western Australia. Because Western Australia is on the opposite side of Earth from Idaho.

I bring it up because I dined on a meal pack today. I had saved five packs for special occasions. I ate the first of them twenty-nine sols ago when I left for Schiaparelli, but I totally forgot to eat the second when I reached the halfway point a few sols ago. So I'm enjoying my belated halfway feast.

It's probably more accurate to eat it today anyway. Who knows how long it'll take me to go around this storm? And if I end up stuck in the storm and doomed to die, I'm totally eating the other earmarked meals.

LOG ENTRY: SOL 479

Have you ever taken the wrong freeway entrance? You just need to drive to the next exit to turn around, but you hate every inch of travel because you're going away from your goal.

I felt like that all day. I'm now back where I started yesterday morning. Yuk.

Along the way, I picked up the power logger I'd left behind at the halfway point. Just now I brought in the one I'd left here yesterday.

Both loggers worked the way I'd hoped. I downloaded each of their video recordings to a laptop and advanced them to noon. Finally I had solar efficiency readings from three locations along an 80-kilometer line, all from the same time of day.

As of noon yesterday, the northernmost logger showed 12.3 percent efficiency loss, the middle one had a 9.5 percent loss, and the rover recorded a 6.4 percent loss at its southernmost

location. It paints a pretty clear picture: The storm's north of me. And I already worked out it's traveling west.

So I should be able to avoid it by heading south a ways, letting it pass me to the north, then heading east again.

Finally, some good news! Southeast is what I wanted. I won't lose much time.

Sigh...I have to drive the same god damned path a third time tomorrow.

LOG ENTRY: SOL 480

I think I'm getting ahead of the storm.

Having traveled along Mars Highway 1 all day, I'm back at my campsite from yesterday. Tomorrow, I'll finally make real headway again. I was done driving and had the camp set up by noon. The efficiency loss here is 15.6 percent. Compared to the 17 percent loss at yesterday's camp, this means I can outrun the storm as long as I keep heading south.

Hopefully.

The storm is *probably* circular. They usually are. But I could just be driving into an alcove. If that's the case, I'm just fucking dead, okay? There's only so much I can do.

I'll know soon enough. If the storm is circular, I should get better and better efficiency every day until I'm back to 100 percent. Once I reach 100 percent, that means I'm completely south of the storm and I can start going east again. We'll see.

If there were no storm, I'd be going directly southeast toward my goal. As it is, going only south, I'm not nearly as fast. I'm traveling 90 kilometers per day as usual, but I only get 37 kilometers closer to Schiaparelli because Pythagoras is a dick. I don't know when I'll finally clear the storm and be able to beeline to Schiaparelli again. But one thing's for sure: My plan to arrive on Sol 494 is boned.

Sol 549. That's when they come for me. If I miss it, I'll spend the rest of my very short life here. And I still have the

MAV to modify before then, too.

Sheesh.

LOG ENTRY: SOL 482

Air Day. A time for relaxation and speculation.

For relaxation, I read eighty pages of Agatha Christie's *Evil Under the Sun* courtesy of Johanssen's digital book collection. I think Linda Marshall is the murderer.

As for speculation, I speculated on when the hell I'll get past this storm.

I'm still going due south every day; and still dealing with efficiency loss (though I'm keeping ahead of it). Every day of this crap I'm only getting 37 kilometers closer to the MAV instead of 90. Pissing me off.

I considered skipping the Air Day. I could go another couple of days before I ran out of oxygen, and getting away from the storm is pretty important. But I decided against it. I'm far enough ahead of the storm that I can afford one day of no movement. And I don't know if a couple more days would help. Who knows how far south the storm goes?

Well, NASA probably knows. And the news stations back on Earth are probably showing it. And there's probably a website like www.watch-mark-watney-die.com. So there's like a hundred million people or so who know exactly how far south it goes.

But I'm not one of them.

LOG ENTRY: SOL 484

Finally!

I am FINALLY past the god damned storm. Today's power regen was 100 percent. No more dust in the air. With the storm moving perpendicular to my direction of travel, it means I'm south of the southernmost point of the cloud (presuming it's a circular storm. If it's not, then fuck).

Starting tomorrow, I can go directly toward Schiaparelli. Which is good, 'cause I lost a lot of time. I went 540 kilometers due south while avoiding that storm. I'm catastrophically off course.

Mind you, it hasn't been that bad. I'm well into Terra Meridiani now, and the driving is a little easier here than the rugged, ass-kicking terrain of Arabia Terra. Schiaparelli is almost due east, and if my sextant and Phobos calculations are correct, I've got another 1030 kilometers to get there.

Accounting for Air Days and presuming 90 kilometers of travel per sol, I should arrive on Sol 498. Not too bad, really. The Nearly-Mark-Killin' storm only ended up delaying me by four sols.

I'll still have forty-four sols to do whatever MAV modifications NASA has in mind.

LOG ENTRY: SOL 487

I have an interesting opportunity here. And by "opportunity" I mean *Opportunity*.

I got pushed so far off course, I'm actually not far from the Mars exploration rover *Opportunity*. It's about 300 kilometers away. I could get there in about four sols.

Damn it's tempting. If I could get *Opportunity*'s radio working, I'd be in touch with humanity again. NASA would continually tell me my exact position and best course, warn me if another storm was on its way, and generally be there watching over me.

But if I'm being honest, that's not the real reason I'm interested. I'm sick of being on my own, damn it! Once I got *Pathfinder* working, I got used to talking to Earth. All that went away because I leaned a drill against the wrong table, and now I'm alone again. I could end that in just four sols.

But it's an irrational, stupid thought. I'm only eleven sols away from the MAV. Why go out of my way to dig up another broken-ass rover to use as a makeshift radio when I'll have a

brand-new, fully functional communications system within a couple of weeks?

So, while it's really tempting that I'm within striking range of another rover (man, we really littered this planet with them, didn't we?), it's not the smart move.

Besides, I've defiled enough future historical sites for now.

LOG ENTRY: SOL 492

I need to put some thought into the bedroom.

Right now, I can only have it set up when I'm inside the rover. It attaches to the airlock, so I can't get out if it's there. During my road trip that doesn't matter, because I have to furl it every day anyway. But once I get to the MAV, I won't have to drive around anymore. Each decompress/recompress of the bedroom stresses the seams (I learned that lesson the hard way when the Hab blew up), so it's best if I can find a way to leave it out.

Holy shit. I just realized I actually believe I'll get to the MAV. See what I did there? I casually talked about what I'll do after I get to the MAV. Like it was nothing. No big deal. I'm just going to pop over to Schiaparelli and hang with the MAV there.

Nice.

Anyway, I don't have another airlock. I've got one on the rover and one on the trailer and that's it. They're firmly fixed in place, so it's not like I can detach one and attach it to the bedroom.

But I can seal the bedroom entirely. I don't even have to do any hatchet jobs on it. The airlock attachment point has a flap I can unroll and seal the opening with. Remember, I stole the airlock attachment from a pop-tent, which is an emergency feature for pressure loss while in the rover. It'd be pretty useless if it couldn't seal itself off.

Unfortunately, as an emergency device, it was never intended to be reusable. The idea was that people seal themselves in the pop-tent, then the rest of the crew drives to wherever they are in the other rover and rescues them. The crew of the good rover detaches the pop-tent from the breached rover and reattaches it to theirs. Then they cut through the seal from their side to recover their crewmates.

To make sure this would always be an option, mission rules dictated no more than three people could be in a rover at once, and both rovers had to be fully functional or we couldn't use either.

So here's my brilliant plan: I won't use the bedroom as a bedroom anymore once I get to the MAV. I'll use it to house the oxygenator and atmospheric regulator. Then I'll use the trailer as my bedroom. Neat, eh?

The trailer has tons of space. I put a shitload of work into making that happen. The balloon gives plenty of headroom. Not a lot of floor space, but still lots of vertical area.

Also, the bedroom has several valve apertures in its canvas. I have the Hab's design to thank for that. The canvas I stole from it has valve apertures (triple-redundant ones, actually). NASA wanted to make sure the Hab could be refilled from the outside if necessary.

In the end, I'll have the bedroom sealed with the oxygenator and atmospheric regulator inside. It'll be attached to the trailer via hoses to share the same atmosphere, and I'll run a power line through one of the hoses. The rover will serve as storage (because I won't need to get to the driving controls anymore), and the trailer will be completely empty. Then I'll have a permanent bedroom. I'll even be able to use it as a workshop for whatever MAV modifications I need to do on parts that can fit through the trailer's airlock.

Of course, if the atmospheric regulator or oxygenator have problems, I'll need to cut into the bedroom to get to them. But I've been here 492 sols and they've worked fine the whole time, so I'll take that risk.

I'll be at the entrance to Schiaparelli tomorrow!

Presuming nothing goes wrong, that is. But hey, everything else has gone smoothly this mission, right? (That was sarcasm.)

Today's an Air Day, and for once, I don't want it. I'm so close to Schiaparelli, I can taste it. I guess it would taste like sand, mostly, but that's not the point.

Of course, that won't be the end of the trip. It'll take another three sols to get from the entrance to the MAV, but hot damn! I'm almost there!

I think I can even see the rim of Schiaparelli. It's way the hell off in the distance and it might just be my imagination. It's 62 kilometers away, so if I'm seeing it, I'm only just barely seeing it.

Tomorrow, once I get to Entrance Crater, I'll turn south and enter the Schiaparelli Basin via the "Entrance Ramp." I did some back-of-the-napkin math, and the slope should be pretty safe. The elevation change from the rim to the basin is 1.5 kilometers, and the ramp is at least 45 kilometers long. That makes for a two-degree grade. No problem.

Tomorrow night, I'll sink to an all-new low!

Lemme rephrase that....

Tomorrow night, I'll be at rock bottom!

No, that doesn't sound good either....

Tomorrow night, I'll be in Giovanni Schiaparelli's favorite hole!

Okay, I admit I'm just playing around now.

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FOR MILLIONS of years, the rim of the crater had been under constant attack from wind. It eroded the rocky crest the way a

river cuts through a mountain range. After eons, it finally breached the edge.

The high-pressure zone created by the wind now had an avenue to drain. The breach widened more and more with each passing millennium. As it widened, dust and sand particles carried along with the attack settled in the basin below.

Eventually, a balance point was reached. The sand had piled up high enough to be flush with the land outside the crater. It no longer built upward but outward. The slope lengthened until a new balance point was reached, one defined by the complex interactions of countless tiny particles and their ability to maintain an angled shape. Entrance Ramp had been born.

The weather brought dunes and desert terrain. Nearby crater impacts brought rocks and boulders. The shape became uneven.

Gravity did its work. The ramp compressed over time. But it did not compress evenly. Differing densities shrunk at different rates. Some areas became hard as rock while others remained as soft as talc.

While providing a small *average* slope into the crater, the ramp itself was rugged and bitterly uneven.

On reaching Entrance Crater, the lone inhabitant of Mars turned his vehicle toward the Schiaparelli Basin. The difficult terrain of the ramp was unexpected, but it looked no worse than other terrain he routinely navigated.

He went around the smaller dunes and carefully crested the larger ones. He took care with every turn, every rise or fall in elevation, and every boulder in his path. He thought through every course and considered all alternatives.

But it wasn't enough.

The rover, while descending down a seemingly ordinary slope, drove off an invisible ridge. The dense, hard soil suddenly gave way to soft powder. With the entire surface

covered by at least five centimeters of dust, there were no visual hints to the sudden change.

The rover's left front wheel sank. The sudden tilt brought the right rear wheel completely off the ground. This in turn put more weight on the left rear wheel, which slipped from its precarious purchase into the powder as well.

Before the traveler could react, the rover rolled onto its side. As it did, the solar cells neatly stacked on the roof flew off and scattered like a dropped deck of cards.

The trailer, attached to the rover with a tow clamp, was dragged along. The torsion on the clamp snapped the strong composite like a brittle twig. The hoses connecting the two vehicles also snapped. The trailer plunged headlong into the soft soil and flipped over on to its balloon-roof, shuddering to an abrupt halt.

The rover was not so lucky. It continued tumbling down the hill, bouncing the traveler around like clothes in a dryer. After twenty meters, the soft powder gave way to more solid sand and the rover shuddered to a halt.

It had come to rest on its side. The valves leading to the now- missing hoses had detected the sudden pressure drop and closed. The pressure seal was not breached.

The traveler was alive, for now.