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Is this ethical?



Figure 2.0 Shackleton's legendary ship, *The Endurance*. Public domain

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Before we get started on the ethical aspect of Mars One, it should be pointed out that the idea does not exclude the possibility of some contestants returning. Unlikely, but possible. Also, Mars One offers the following words of assurance on its website:

“All those emigrating will do so because they choose to. They will receive extensive preparatory training so that they fully know what to expect. Astronauts that have passed the selection process can always choose not to join the mission at any time and at any point during preparations. Back-up teams will be ready to replace any crew member that drops out, even at the very last minute. Our first and foremost priority is to offer the people on Mars as high a quality of life as we can, which encompasses the following:

- Unlimited access to email and other communication channels to keep in touch with friends and family back on Earth
- As many exploration and experimentation opportunities as are available
- The means to build and develop as much as they can themselves. They can work on the expansion of their Mars base and use the new rooms as they wish.”

Comforting words, but in the 21st century, a trip to oblivion strikes many as rather extreme, even if it is painted as a bold and unique venture. Those on the Mars One side of the fence argue that such trips have been commonplace throughout human history, citing the example of the thousands of Europeans who moved to Australia with everything they owned. No return ticket for these guys.



Figure 2.1 A short haired guinea pig. Credit: Jg4817

CONSENTING TO DIE

What about the ethics of using the Mars One contestants (Figure 2.1) as guinea pigs? This question is raised as a result of an answer Lansdorp gave in a Q&A with *The Guardian* newspaper. When asked about what research the colonists will perform on Red Planet, the Mars One CEO replied that they would provide an “interesting research topic in itself for physiologists.” Really? So the contestants will be research subjects? Nuremberg Trials anyone? Since the Nuremberg Trials, it has been a requirement for scientists who plan to use humans as research subjects to follow certain ethical rules. These rules state that research proposals must be submitted to ethics committees for approval and that *all risks* must be identified. Once the research has been approved, scientists must obtain informed consent from each research subject. Will Mars One meet these conditions? Well, as far as we know, the Mars One plan to offer its contestants as research subjects hasn’t been subject to ethical scrutiny, but the question of ethics goes beyond informed consent. Consider the fact that such a mission subjects the contestants to an environment in which reduced bone density, muscle atrophy, radiation sickness and death are guaranteed outcomes. Guaranteed. Consider also that these maladies will occur millions of miles away from a critical care facility and that Mars One has no plans to treat these conditions. It has no plans full stop, but we’ll get to that later in the book.

Before we consider the ethical implications of showing contestants dying on screen, let’s stay with the research issue for a moment. What about the psychological problems and the human dynamic during such a mission? As we will see in Chapter 4, the contestants will not have the breadth of experience that today’s astronauts can draw upon. Consequently, they will not have faced the arduous training that enables those astronauts orbiting the Earth on the International Space Station (ISS) to deal with the problems of social isolation and confinement. And without that training, combined with the duration of the Mars One mission, it is inevitable that mental health issues will arise. While this will be gold for the reality TV viewers, for those stuck in a spaceship having to deal with the drama 24/7, the consequences won’t be pretty. Ethically, if a contestant was to have a severe mental health issue, the reasonable course of action would be to suspend television coverage and get the psychological support team involved. But the TV executives would almost certainly deep six this idea and who could blame them? After all, their company may have paid hundreds of millions of dollars for television rights, and reality TV demands spectacle and drama: the more dramatic the better. No, you can be sure as eggs are eggs that any such drama will be milked for all its worth. Counseling sessions? Are you kidding? Sure it will be an invasion of privacy, but this is reality TV millions of miles away! And making the spectacle that much more dramatic will be the communications delay. Imagine if one of the crew has a meltdown (see sidebar) and an altercation ensues. The audience watching at home will be viewing the fisticuffs as it happened as long as 20 minutes earlier. Who’s to say one or more of crew hasn’t been killed in the meantime? Great viewing potential! Responsibility you say? Take a look at any one of the myriad reality TV shows out there and ask yourself if the notion of responsibility has ever been applied? Ever. Exactly.

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Figure 2.2 Lisa Nowak. Credit: NASA

Even astronauts have meltdowns

It took NASA astronaut, Lisa Nowak (Figure 2.2) 12 days, 18 hours, 37 minutes and 54 seconds to secure her place in one of the world's most elite clubs, when she flew aboard the [Space Shuttle Discovery](#) during mission [STS-121](#) in July 2006. It took her about 14 hours to destroy it. That was how long it took the 43-year old mission specialist to drive the 1500 kilometers from Houston, Texas, to Orlando, Florida, carrying with her a carbon-dioxide-powered pellet gun, a folding knife, pepper spray, a steel mallet and \$600 in cash. Nowak had discovered that Colleen Shipman, a US air force captain, was flying in from Houston to Orlando that night and Nowak wanted to be there to 'scare her' into talking about her relationship with the man at the center of a love triangle. That man was Bill Oefelein, who underwent astronaut training with Nowak, and like her, went into space for the first time in 2006, although they had never flown together.

Shipman allegedly saw Nowak, whom she had never met before, wearing a trench-coat, dark glasses and a wig, following her on a bus from an airport lounge to a car park. Afraid, she hurried to her car. She could hear running footsteps behind her and as she slammed the door Nowak slapped the window and tried to pull the door open. "Can you help me, please? My boyfriend was supposed to pick me up and he is not here," Nowak was alleged to have pleaded. When Shipman said she couldn't help, the astronaut started to cry. Shipman wound down her window, at which point Nowak discharged the pepper spray. Shipman drove off, her eyes burning, and raised the alarm. Nowak was subsequently charged with attempted first-degree murder in what quickly became the most bizarre incident involving any of NASA's active-duty astronauts.

To say the group to which Nowak belonged (her assignment to the space agency was terminated by NASA on March 8, 2007) is select is an understatement. Up to 2007, NASA had selected just 321 astronauts since the US agency began preparing to go into space in 1959. She had been subjected to NASA's rigorous screening process and had trained for 10 years to cope with the intense stress of spaceflight before her mission. Like all the other astronauts, Nowak had been subject to extensive psychiatric and psychological screening, all of which made her behavior incomprehensible.

To many, the Nowak scandal called to mind every bad science fiction movie where they send unstable characters into space. Others argued that NASA should have noticed the signs of Nowak's unraveling. These people might have had a point, but you have to remember that people in highly stressful jobs are generally over-achievers, who put a high value on performance and a low value on self-care beyond that required to perform the job. These types – astronauts in this case – do a great job ignoring and denying signs of fatigue, either physical or psychological, just like polar explorers. Instead, they assume a machine-like thought process to deal with any problems. But the human brain isn't just a thinking machine, it is also the seat of emotions, and the suppression of emotions plays out in the battlefield of the subconscious mind. That suppression and the associated physical and psychological damage eventually surfaces in skewed thought processes and actions, which

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is exactly what happened to Nowak. From our perspective, Nowak's actions appeared crazy, but her perception of her actions appeared to be a logical way to resolve her problem.

Captain Nowak's drama played out in an airport parking lot. Imagine a comparable scene on a spaceship en route to Mars carrying a group of under-trained reality show contestants.

THIRD QUARTER EFFECT

On the subject of psychological breakdown, let us consider a condition known as The Third Quarter Effect. This condition has its origins in the behavior observed in personnel who have spent time in Isolated, Confined and Extreme Environments, or ICE. ICE studies have repeatedly shown that when you put people in extreme environments for long periods of time, you can expect to see decrements in performance, which can in turn lead to less than favorable mission outcomes. For example, we know that on at least three occasions Russian missions have had to be aborted because of psychological problems suffered by the crew; possibly as a result of the phenomenon known as The Third Quarter Effect. The term was coined by Albert Harrison who, in his book *Spacefaring; The Human Dimension*, suggests that long duration space and submarine missions are characterized by three stages. In the first stage, crewmembers more often than not experience excitement and anxiety, while in the second stage the most common symptoms are boredom and depression. In the third stage, many crewmembers become increasingly aggressive and emotional. This is the phase that Harrison dubs the *third quarter phenomenon*, because it usually occurs just after halfway through the mission.

The interesting feature of the Third Quarter Effect is that the three stages occur no matter what the length of mission, whether this be four weeks, four months or four years. As you can imagine, at the beginning of any expedition the crew will be enthused about what lies ahead, but this feeling of excitement inevitably gives way to boredom as the routine sets in (Figure 2.3). For the first half of the expedition, the crew tries not to think too often about how much more time is left before they get to go home, because the finish line is just too far away. But as the mission grinds past the halfway point, the end of the mission becomes tangible. And when a little more time has passed, the crew inevitably begin to look more closely at the calendar and start thinking about returning home to their families and getting back to a normal life. But at the same time, another thought arises, and that is the fear that perhaps the mission will be extended, or maybe something terrible will happen and there will be no return. Not surprisingly, these thoughts may be manifested as the fear and tension that are hallmarks of the Third Quarter Effect. I've seen this happen in the military when I was deployed to the jungle in Belize for six months between 1987 and 1988. To begin with, everyone who hadn't been to the jungle before was excited, and this excitement was sustained for quite some time as we conducted jungle patrols and spent the weekends diving on the islands. But as the halfway mark came into view, the mood gradually changed. With two months left on the clock, the increasing tension came to the boil



Figure 2.3 Shackleton and his crew. Public domain

one evening when some of my platoon went on a bender in San Ignacio, a sleepy town straddling the border between Belize and Guatemala. Soldiers got drunk, bottles were thrown, bones were broken, skulls were split open, one soldier nearly drowned and the military police was summoned from Belize City.

While mission meltdowns haven't been quite as dramatic in Low Earth Orbit (LEO), there have been a number of instances of the Third Quarter Effect in space. In some cases, astronauts have vented their mission frustration and tensions by scapegoating, with mission control being an easy target. Skylab 4 comes to mind. Actually, the strategy of dissipating tension on an outside target is a lot safer than going on a bender and picking on a crewmember, but it is still disruptive. And the longer the mission, the more pronounced the Third Quarter Effect is. Now imagine a very long mission where the supportive role of mission control is reduced by communications lag. Worse still, imagine a mission that *has* no third quarter. Or no quarters at all! Step forward Mars One. During such a mission, our contestants will be without any of the psychological buffers that every crew has had since Gagarin. No real time interaction with family. No instant access to mission control. No option of returning home. Take any survival situation over the past 100 years and you will see one common thread about the will to survive (Figure 2.4) and it is the prospect of a reunion with friends and family. It is this that galvanizes the behavior necessary to keep going despite insurmountable odds. Remove the element of social connectedness and you have a sure-fire recipe for a less than optimum outcome. Yes, yes, yes, the one-way mission makes sense for any number of technical, engineering and financial reasons, but the psychological handicap could be so great that it may put the whole mission at risk. Ethical? Hardly.



Figure 2.4 The Mawson expedition. Public domain

Now, the Mars One crowd will try to argue that the one-way trip isn't really that extreme and besides, thousands of Europeans embarked on a similar one-way trip in the 1800s, when they left their home country without a return ticket, bound for Australia. Such an argument is flawed logically, because the Mars One astronauts will be emigrating for very different reasons than their historical counterparts. You see, back in the 1800s, immigration was driven by Britain's requirement for a penal colony, which was populated mostly by convicts and by settlers hoping to make money from a gold rush. Mars One, on the other hand, is asking for volunteers to take part in a venture for historic reasons rather than searching for a better standard of living, so it is wrong to use Australia's immigration history as a parallel to a one-way trip to Mars.

So how does Mars One get away with the one-way branding of their mission? Numbers. Pure and simple. In many ways, Mars One uses the sheer number of applicants as justification that the plan is a viable one, despite mountains of evidence to the contrary. But this is exploitation of the enthusiasm of the contestants, who are led to believe that if they are selected they will be part of history by establishing the first human colony on the Red Planet (they won't be first because SpaceX will likely get boots on the surface before them). Now there are many who would say good riddance to anyone gullible enough to think that Mars One is anything but a flamboyant attempt to win a Darwin Award, but the fact remains that every space mission to date has offered a way back to Earth.

DYING TO DIE ON REALITY TV

Another contentious ethical issue is turning the one-way venture into a reality television show. Not only must contestants give up any chance of returning to Earth, but they must also face the ordeal of having millions of people watch them en route. Nothing wrong with another coma-inducing reality television show, you may think. After all, there are plenty of people happy to kill their brain cells by watching *Keeping up with the Kardashians*, so why not kill a few more by watching contestants fly to Mars? Well, the answer lies in the very limited field experience we have of humans living for long periods in space. You may have heard about the one-year mission that took place on board the ISS between 2015 and 2016, when Scott Kelly (Figure 2.5) and Mikhail Kornienko spent 12 months on the orbiting outpost. That's a fair stretch, though Kelly and Kornienko's mission fell short of the record held by Valery Polyakov, who spent 438 days on board the Russian space station *Mir*. But 438 days is much, *much* shorter than the six-month journey and the lifetime that Mars One contestants will be spending on the Red Planet. Granted, Mars provides a gravitational field that is 38 percent the strength of Earth's, so the Mars One group will be afforded partial protection against some of the deleterious effects of reduced gravity, but we have no idea how long duration exposure to deep space affects the human body, so the Mars One contestants will effectively be lab rats in a show that will inevitably take a nose-dive (see Chapter 5).

Now let's consider the ethical concerns about how this Red Planet boondoggle is supposed to be funded. Hypothetically, Mars One reckons it will cost about six billion dollars to establish a Mars colony and sustain the lives of the contestants. Now, anyone who has worked in the space industry will tell you that this figure is spectacularly unrealistic. Almost as unrealistic as expecting that the Mars One reality television show will generate about four billion dollars in revenue, but let's indulge the Mars One organization and accept their wild assumption that millions of people around the world will watch the show. But, as anyone who watches reality television knows, these shows often have short life spans, so what happens when people get bored with watching crewmembers pressing buttons, flicking switches, reading checklists and dealing with radiation sickness? Well, when the money dries up, the chances are the supply chain will dry up too. No more food, oxygen or medical supplies. Mars One will have to explain to their contestants that the mission will have to be abandoned due to lack of funding. What will the contestants do? This is where it could get interesting. Don't forget that the contestants will have control of the cameras. Perhaps they could switch them off? Perhaps they could film the first death on the Red Planet and temporarily resurrect interest in the enterprise, although it probably wouldn't be enough to save them.

On the subject of saving a failing reality television show, let's talk about sex. There is always the remote possibility that before the end of the first season, one of the crew could have been 'knocked up', in which case there would be a ratings bonanza. In reality, this is extremely unlikely, because the crew will have long since been sterilized by all the radiation. But let's indulge. Is it really ethical to give birth on the surface of Mars? Probably not. We have absolutely no knowledge of how a human fetus will develop in a reduced gravity environment. What will Mars One do to prevent such an event? Will they sterilize



Figure 2.5 Scott Kelly. Credit: NASA

the crew? Will they provide contraceptives? (Figure 2.6) Will these contraceptives have been tested in space? By whom? And what if the surface of Mars turns out to be an unfavorable one to conceive? Well, that torpedoed the idea of establishing a colony doesn't it? In fact, the Mars One base will perpetually face extinction unless there is a steady stream of humans from Earth. Hmm. Seems someone hasn't thought this through, although Mars One at least acknowledges the challenges of interplanetary sex:

"The Mars settlement is not a suitable place for children. The human ability to conceive in reduced gravity is not known, neither is there enough research on whether a fetus can grow normally under these circumstances."

Mars One website statement on the issue of sex and the ethical consideration of conceiving children on the Red Planet.



Figure 2.6 Contraceptives: These probably won't be needed, but you never know. Best be prepared. Credit: Bryan Calabro

Another aspect that seems to have been given short shrift is the issue of social isolation. The Mars One contestants will be the most isolated humans in history. And because of the distance from home, real time interaction will be impossible. In fact, for the rest of their lives, the only real time interaction the Mars One contestants will have will be with each other (and with any subsequent arrivals if, by some act of divine intervention, they manage to stay alive long enough to meet them). We know from decades and *decades* of research, and by combing through the annals of Antarctic exploration, that prolonged social isolation may lead to mental illness, often manifested by depression, anxiety, chronic fatigue, insomnia and emotional instability. It's a problem that the Mars One team has considered and here is what one of their experts thinks:

"It all starts with attitude. Think of it. When a person finds herself, or himself, on Mars, with no way of being able to come home, and potentially questioning the decision that they have made, what is going to ground them in the choice they have made?"

Attitude! Of course! Why didn't I think of that? *Attitude* is the solution to all those problems of homesickness and dysphoria. Never mind that even the most highly trained astronauts have suffered feelings of isolation. Never mind that even some of the boldest and most fearless explorers have succumbed to homesickness. Apparently, it was all a question of *attitude*. Thank you Mars One! But just suppose one of the Mars One contestants does suffer a major breakdown. What then? Who will be responsible? Perhaps

applying the right attitude can also help the Mars One contestants deal with life indoors? Because from the moment they land, these would-be colonists will be stuck inside a bunker, unable to venture out on account of the lethal radiation, the unbreathable air and the paralyzing cold. And this confinement will take place in habitats that provide about 50 square meters per person. Now imagine a regular day in your life. Imagine all the sensory experiences and all the different environments you take for granted. The Mars One contestants will live out the rest of their – albeit short – lives with just a very, very small fraction of this. As you might expect, extended periods of confinement provoke the same problems as social isolation (Figure 2.7): anxiety, boredom, depression, and cognitive impairment – take your pick. And then there’s the loss of privacy. Don’t forget that the movements of the Mars One contestants will be observed 24/7. How do you think being under constant surveillance will affect this group? Don’t forget that they will already be under tremendous stress and we know from countless research studies that, even under the best circumstances, being watched can itself cause fatigue, anxiety and stress. The Mars One team have yet to make any comments about the effects of social isolation and confinement. Perhaps they’re secretly hoping that these factors will conspire to bring about meltdowns in the crew, thereby generating tension and a boost in ratings? Who knows?



Figure 2.7 The Cupola of the International Space Station. Credit: NASA

“The only type of person that I can honestly picture myself having trouble living with is someone who is consistently negative, or worse, not a team player. Personally, I'm a glass-half-full girl. I have an endless supply of optimism and I approach challenges and obstacles with humor. I never call something a problem. Instead I put my nose to the grindstone and figure out how I can best contribute to a solution.”

Kellie Gerardi, Mars One Final 100 Candidate

“I don't think there is a specific personality that I would not be able to get along with at all. I think every person has a diverse mixture of personality traits, so there is always something that I can find to relate to with a person. If there is a will there is a way. I am highly adaptable and my humorous nature does help me relate to others. I think if a person just takes time to get to know another person, there is always a way to coexist. Most people do not seem to know their own limits and who they are, but if they are open enough to others, they can also discover themselves. Traits that might not agree with my personality are a lack of curiosity, no sense of adventure, no ability to think and act in stressful and extreme situations, an unwillingness to cooperate, and dishonesty.”

Andreea Radelescu, Mars One Final 100 Candidate

REAL EXPLORERS

What does Mars One say in its defense? Well, one of the standard responses has been to compare the conditions faced by contestants on the Red Planet with the conditions faced by explorers in the 'Heroic Era of Antarctic Exploration'. The argument is that humans have suffered appalling hardship before, so presumably they can do it again. This argument is weak in the extreme. First of all, explorers such as Amundsen and Shackleton knew they had a reasonable chance of making it back alive, rather than the prospect of living in a confined bunker and an early death. Second, these great explorers of old *did* suffer appalling hardship, but those conditions would probably be judged unacceptable in the modern era. And third, even if these conditions were deemed acceptable, chances are the explorers of today wouldn't be up to the task. You see we live in a mollicoddled society in which the comfort blanket gets comfier every day. There are still explorers, but the dangers faced by this group today are incomparable with those faced by Mawson and his ilk (Figure 2.8). Explorers today are rarely more than a satellite phone call away from rescue. In short, today's explorers, however bold they may appear, would still be woefully unprepared for the harsh realities that would await them on the Red Planet. And this unpreparedness will be costly in the extreme. Ask yourself if you would allow your children to watch a reality television show in which the contestants are dying from radiation sickness, bleeding from every orifice, and/or suffering from profound confinement-induced paranoia. This isn't so much about being risk averse or cowardly; it is about being smart. And being smart does not mean sending a woefully unprepared crew on a suicide mission,



Figure 2.8 Douglas Mawson. Public domain

because one thing we've learned over the years is that nothing weakens political will quicker than a disaster.

"We wanted to get some idea of what will happen when a motivated, high-performing crew is confined in a spacecraft-like environment for a full 17 months, simulating a mission to Mars and back. The assumption has been with the six-month space station missions that anybody can tolerate them. OK, you have trouble with your sleep or something but you're only up there six months, it won't last. If you go on an exploration mission, you'll adapt. But our study shows that's not true. The people did not adapt. In fact, these problems just cumulatively created a greater and greater physiological and behavioral burden on the crewmember."

David Dinges, University of Pennsylvania's Perelman School of Medicine

But let's get back to the woeful unpreparedness of today's current crop of explorers. As you can see from David Dinges' quote, there has been plenty of research conducted on the subject of confinement and social isolation, and the results have been less than encouraging. That quote refers to the Russian-European Mars500 boondoggle, in which three Russians and three Europeans were sealed inside a tin can for 520 days to simulate a mission to the Red Planet (Figure 2.9). During the ground simulation, the crew suffered from sleep disorders and crew communication issues – neither of which bode well for longer journeys – although such problems were judged to be manageable since the crew knew there was an endpoint.



Figure 2.9 The Mars500 guinea pigs. Credit: ESA

Any normal mission comprises an outbound, a landing and an inbound component. Any psychologist will tell you that if you have to remove one of those components, it should be the second, which is exactly the thinking behind Dennis Tito's Inspiration Mars idea (Figure 2.10) – a fly-by of the Red Planet which will take about the same length of time as Mars500. Not only is Inspiration Mars a whole lot more feasible, cheaper and ethically sound than Mars One, the mission would also test the technology required for the outbound and inbound phases of the mission.



Figure 2.10 Inspiration Mars banner. Credit: Inspiration Mars

RULES

The business of space exploration is a risky one, in which rockets explode with alarming regularity (SpaceX in 2015, Orbital, Soyuz, etc., etc.). But, as we've discussed in this chapter, an exploding rocket may not be the worst thing that could happen to the Mars One contestants. They could suffer agonizing deaths brought on by radiation sickness, or they could all simply go mad from extreme confinement and isolation. Or both. Consider the following scenarios:

Scenario 1

Imagine you are one of the (un)lucky four to have been selected as the first Mars One crew. You are three months into the mission when the spacecraft suffers a rapid decompression caused by a micrometeorite puncturing the vehicle's skin. Thanks to immediate action by the crew the hole is repaired, but life support consumables have taken a hit. In fact, the oxygen tanks now only have enough oxygen to support three crewmembers for the remaining three months that it will take for the spacecraft to reach Mars. According to the very best assessment made by mission planners, immediate action must be taken to prevent Loss Of Mission (LOM) and/or Loss Of Crew (LOC). In short, that action means one of the crew must be euthanized to ensure that at least three make it to Mars intact. What does the commander do? Should he/she be sacrificed? After all, perhaps he/she is the largest member of the crew and therefore consumes the most oxygen. But if the commander is killed, who is going to command the mission? Should Mission Specialist #1 (MS1) be sacrificed? But MS1 is the crew doctor, so who will treat the contestants after landing? Perhaps the engineer should be terminated, but then who will repair all the systems for the remainder of the trip? And since it was the quick actions of the engineer which saved the mission following the rapid decompression, it would be unfair to kill him wouldn't it? The scientist then? But if the scientist is killed, who will make the discoveries on the surface? It's a tough call and it has to be made immediately, otherwise Mars One is looking at a definite LOM. But which guidelines are followed and who makes the decision? Is it the commander? Mission control? Bas Lansdorp? Perhaps the crew should just draw straws and be done with it?

Scenario 2

Let's take another scenario. This time, the crew are two days away from the critical Entry, Descent and Landing (EDL) task when mission control receives news that the pilot's wife and two kids have been killed in a car accident, while driving to a television studio to be interviewed for the Mars One reality television program. This is particularly bad news because the pilot's back-up died from radiation sickness just three days previously. Does mission control tell the crew and the pilot immediately or do they wait until after landing? And what happens if that information is leaked and the pilot receives the information before the EDL? Does that mean the mission is aborted?

Scenario 3

Three months after landing, the crew has been reduced to just two crewmembers, after one contestant died from radiation sickness and the other committed suicide by blowing herself out of the airlock. Worse, the consumables have taken a hit after food was spoiled following a fuel leak and oxygen was inadvertently vented following a life support system malfunction. There is now only enough food for one crewmember to survive until the next resupply mission and even that will be tight. Once again we're faced with a euthanasia dilemma, but with a twist: in this case it isn't just one crewmember having to kill another, but what to do with the corpse after the kill. Remember, food supplies are below critical, so it would make sense to eat the corpse. Are there any procedures for this? What would you do Mars One? It's your call.

THE RAGGED EDGE

A manned mission to Mars lies beyond the ragged edge of what is achievable today, and it will do for many, *many* years to come, unless Elon Musk has something up his sleeve that he's not telling us. And when astronauts do finally venture into the void, they will embark on a mission in which many, *many* things will go wrong. Best be prepared then when it comes to the issue of ethics, so crewmembers at least have a framework to guide them in making lifeboat decisions. It will also help if crews know the answers in advance to the types of scenarios depicted previously, because trying to make decisions when everyone is panicked is only going to make an already bad situation worse. And it's not as if advance crisis planning hasn't been done before. Remember the Apollo missions? In the event that Neil Armstrong and Buzz Aldrin never made it back to lunar orbit, President Nixon had the following speech ready:

"Fate has ordained that the men who went to the Moon to explore in peace will stay on the Moon to rest in peace. For every human being who looks up at the Moon in the nights to come will know that there is some corner of another world that is forever mankind."

Now you may think that I'm exaggerating here and we needn't worry about nasty events such as rapid decompression and radiation sickness. After all, we've been sending humans into space for decades now and we've been fairly successful at it. Correct, but a manned mission to a space station or the Moon does not even begin to come close to the reality of the myriad problems posed by a multi-year journey to the Red Planet. Which is all the more reason to have an ethical framework in place. Let's consider a few more examples in which such a framework might be needed. We'll begin with one of my favorite subjects – the nonhuman life that lives inside us. Genetically, only about one in ten cells in our bodies are *homo sapiens*, with the rest being comprised of a microbiome. This microbiome is known to have effects on our health, but what we don't know is how long duration space-flight affects it. Is it possible that deep space radiation could cause changes that might manifest as a disease which could ultimately wipe out the Mars One colony? And on the subject of nonhuman life, let's consider alien life. After all, one of the activities of the Mars

One contestants will no doubt be the search for microbes or anything else that could boost the ratings. But what if life is found and the Mars One colonists are deemed to be contaminated? What then? Surely we can't allow the next mission to travel to Mars because the risk of infection would be too great. What ethics protocols are in place for that scenario? Then again, if Mars One decides to go ahead anyway, what authority can stop them? And before we move on from the topic of alien life, what about a baby born on Mars? While the Mars One contestants will have given their consent to take part in the mission, that won't hold true for a baby born on the Red Planet. This baby would be deprived of all the resources available to babies on Earth, so such an event would surely be unethical. But what document says otherwise? The advantage Mars One has when it comes to deciding what is ethical and what is not is that the private space industry is still in its infancy and there are no ethical blueprints for how commercial space crews should behave. But death and serious illness are inescapable in a mission that is as risky as Mars One.

Mars One

The Ultimate Reality TV Show?

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