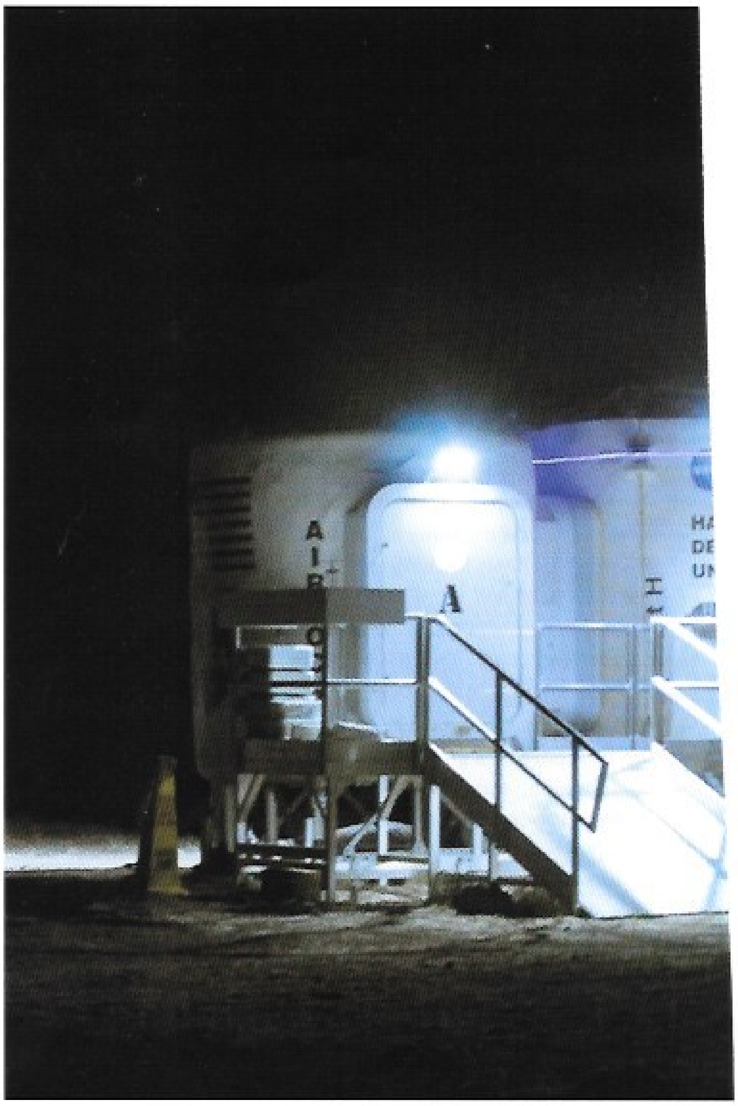
# Welcome to Mars

By Henry M. Holden



**AFTER A six-month trip on the cycler, a crew of six astronauts is ready to head down to the surface of Mars. The vehicle that they will use is a combination of the Apollo capsule and a lunar rover that was attached to the cycler.**

As the cycler gets closer to Mars the astronauts will see things they have never seen before. They will see Mars in three dimensions, something no human has yet to experience.

They will be looking at a giant mountain in front of them. Olympus Mons is named after the tallest mountain in Greece, which was the legendary home of the gods. If you put Olympus Mons on Earth, it would cover the Philippines, and stand three times taller than Mount Everest, the tallest mountain on Earth.

On Earth we see the blue oceans and white clouds. Approaching Mars they will see a red sky, the result of the red dust on the planet that swirls up during dust storms. There are no green plants or rivers of water on the surface.

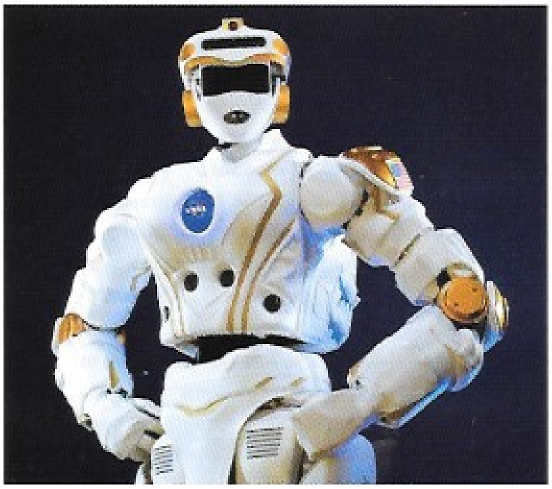
Mars has been flown past, orbited, crashed into, and probed, but the first humans to land on Mars is an historic event, akin to Apollo 11's landing on the Moon.

## Touchdown

Landing on Mars will be different than landing on the Moon. For example, the Moon does not have air, but Mars does. The atmosphere will slow the lander during entry. The lander's shape, similar to the Apollo capsule, will also help slow its descent in the thin atmosphere. But the air will also heat the capsule, and a heatshield similar to the Apollo spacecraft will protect the astronauts from the excessive heat.

A parachute will deploy about 11 miles above the surface, delivering a sudden jolt to the astronauts, causing the lander to sway back and forth like a carnival ride. The parachute and heatshield will be jettisoned from the landing zone about a mile above the surface.

It is now the job of the retrorockets to slow the lander down and make a smooth albeit dusty landing, not unlike the Moon landings. However, the dust should settle much faster because of the light gravity on the planet.



## Building infrastructure

Years of tele-robotic work on Mars' infrastructure from Phobos have taken place before this landing could be made. Tons of building materials, supplies, and expandable habitats have been shipped from Earth and landed robotically similar to the early landings of the rovers.

Astronauts on Phobos directed Robonauts to unpacked supplies, and erect habitats to protect the astronauts from dust storms and radiation.

When the astronauts touch down on Mars they know that the air is too thin to breath, and

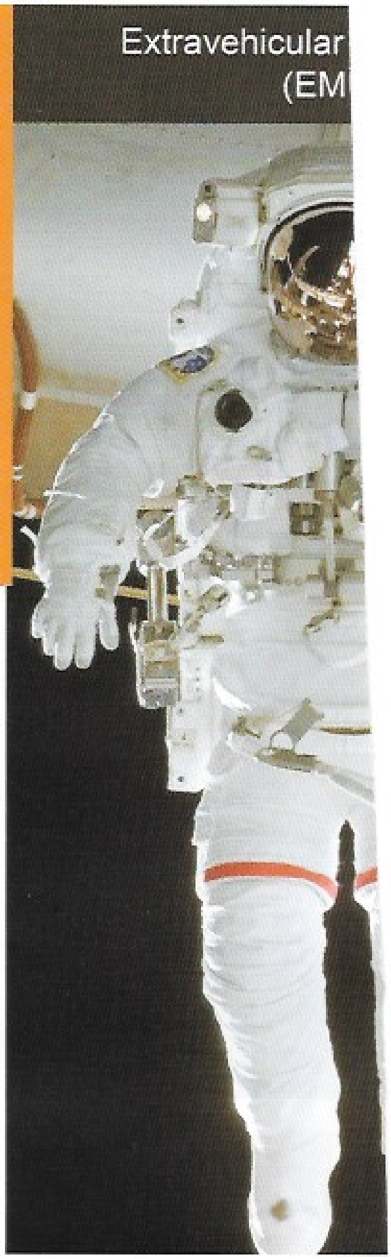

A view of the space habitat at night, docked with the Space Exploration Vehicle. (Image: NASA)


A version of the deep space habitat. This configuration includes the Habitat Demonstration Unit with the X-Hab loft on top, a hygiene compartment on one side and airlock on the other. (Image: NASA)

Robonaut 5, a six-foot, 300-pound humanoid robot, will be programmed to perform damage control after a Martian dust storm that has damaged a habitat. Robonaut must be able to complete three objectives: align a communications dish, repair a solar array, and fix a leak in the habitat. (Image: NASA)

A version of what an astronaut-driven Mars rover might look like. Based on what we know about the soil this vehicle may be more functional and efficient if it had tracks instead of wheels. (Image: NASA)

NASA recently released a new prototype spacesuit for future Martian exploration. The Z-2 design can effectively "dock" with a Mars rover or with some sort of habitation placed on the surface. A major advantage of this design is that you can keep the Martian dirt on the outside and never track it through an airlock by exiting through the back of the suit. Of course, this design will likely go through many iterations in the next two decades leading up to launch. (Image: NASA)




radiation too high for plants of humans to survive. That is why astronauts drove the rovers on Mars remotely from Phobos. Over a period of more than a decade they built pressurised domes called habitats covered in dirt or equipped with glass filters that would shield the astronauts from the deadly radiation.

## Living above ground

However, the ultimate plan is to live above ground in permanent habitats where the astronauts will not need to wear the spacesuits because the temperature has been adjusted to mimic Earth. Mars has plenty of sunlight. Scientists say that giant mirrors in orbit around Mars could redirect that sunlight to heat Mars' Polar icecaps. A specific temperature increase will release the carbon dioxide frozen in the icecap. Carbon dioxide is a greenhouse gas that traps heat. And that is a good thing for Mars. As the temperature increases more carbon dioxide is released, traping more heat.

Once it is warm enough for water on the surface, plants can grow. There is plenty of carbon dioxide for the plants to produce oxygen. Combined with the extraction of oxygen from the water found on the planet, the astronauts will then have enough oxygen to breathe.

When the astronauts arrive on Mars they will be wearing pressurized spacesuits. The suits will protect them from a possible leak in the descent vehicle. The suits will be different than the ones used on the Moon. In space the astronauts are weightless and so are the suits. Astronaut Buss Aldrin recalled, "I discovered on the moon, carrying a heavy suit around on the ground is tiring." These new suits will be lightweight and *flexible*, and provide protection from radiation and also provide for their personal environment.

## Transit on Mars

The first human explorers on Mars are expected to be quite mobile, with the ability to explore long distances from their habitat, a region being called an "Exploration Zone." In current planning activities, NASA assumes an Exploration Zone radius of approximately 60 miles (100 km).

The first humans to land on Mars will find themselves in a broad, relatively flat landing zone, away from the habitat area for safety. That means the crew and cargo may be far away from the habitat and scientific

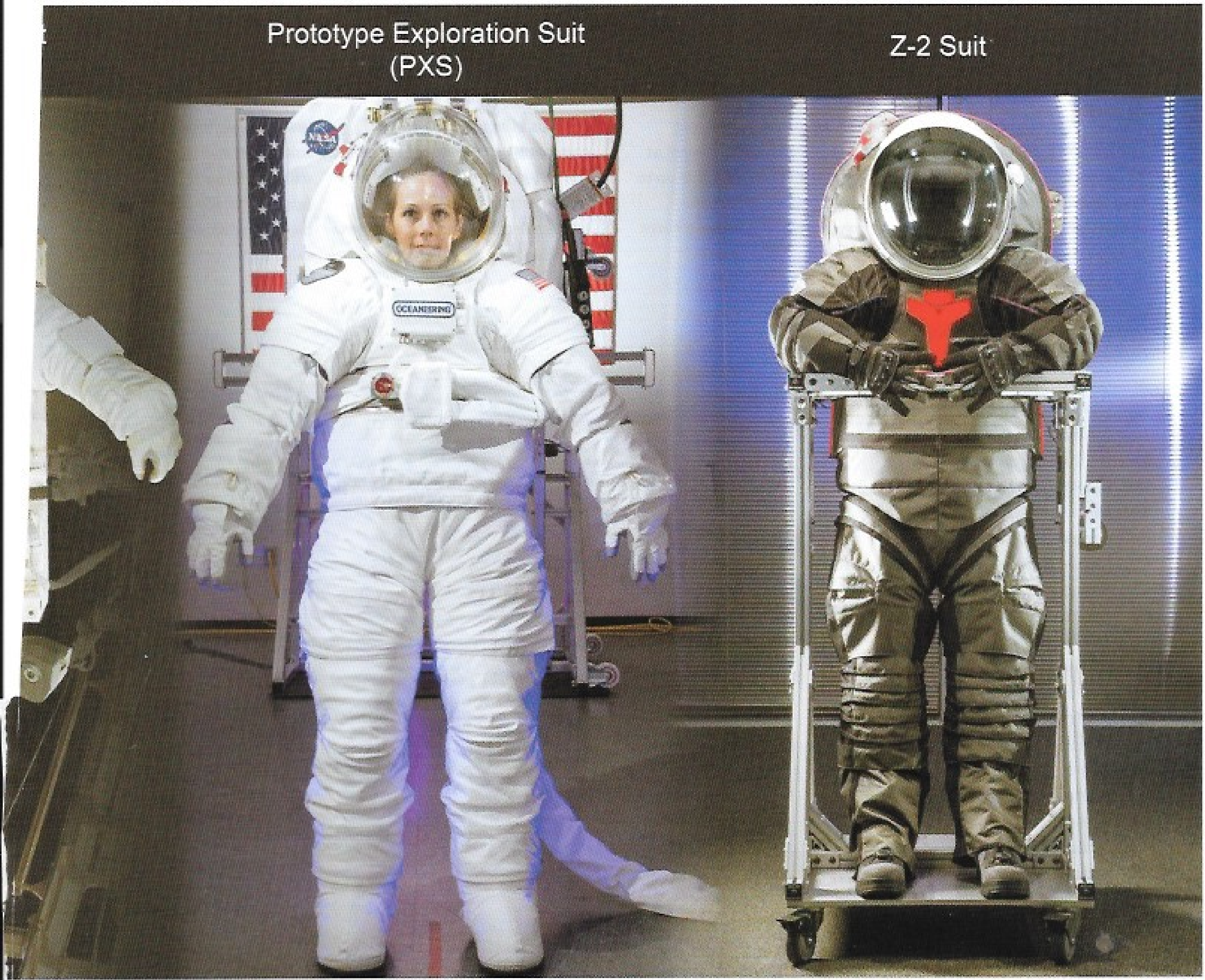
buildings, and beyond practical walking distance. That is why the landing vehicle will double as a pressurized rover to get the crew to the habitats quickly and safely.

When the rover arrives at the habitat location the astronauts step into a special room before they enter the main building. There is plenty of dust sticking to their spacesuits. Since the dust has iron in it, special magnetic brushes will pull the dust off their suits and boots. Once cleansed of all the magnetic dust they will enter the building through a special airlock similar to those used on the ISS. Once inside, they pump air into the airlock, and then remove their helmets and spacesuits and change into clothing similar to that worn on the ISS. They are the first humans to smell Martian air.

## Power on Mars

Since the colony will grow with equipment and people, special power plants are needed. Solar power will not be enough since dust storms prevent the solar cells from operating, and the length of the storms may put a strain on the battery life. A power option may be a wind turbine using the force of the dust storms as its source. In the thin air these storms may roll in at 100 ft./s (30m/sec.), enough to operate the turbines efficiently.

Geothermal energy may be another source. There are many




volcanoes on Mars and they do not have to be active to have hot magma beneath them.

Nuclear power plants can be built from Martian materials but the fuel is rare and dangerous, and requires special processing. This option may require importing the fuel from Earth. The priority at this point looks like geothermal heat providing the most plentiful and cleanest fuel.

## Living off the land

Living off the land is different when the land is 140 million miles away. "In situ resource utilization is key to our exploration of the universe," said Robert Mueller, senior technologist at Swamp Works. "We must find ways to make what we need once we are at our destination. For example, the soil on Mars could be used to make modular structural building blocks to make shelters, landing pads and other useful structures. We are looking for creative and novel solutions."

Growing food on Mars may be the easiest challenge to overcome. Mars has everything needed except the seeds which the astronauts will bring with them. Plants need nutrients to grow. Plants absorb three, oxygen, hydrogen and carbon from the air and water. Martian soil provides the other nutrients although it is not known where the richest deposits are yet. The soil nutrients are nitrogen, phosphorus, calcium, potassium, magnesium and Sulphur.

Eventually, extracting carbon dioxide from the polar icecaps will create a planet warm enough, and air thick enough to thaw the ice trapped in the soil and block harmful radiation. Then, fungi, and algae growing together in symbiosis will form lichens, an early measure of biological progress. ✈

The EMU (operational spacesuit on ISS) is pictured on the left, the PXS (advanced prototype) is in the middle and a version of the Z2 (advanced prototype) is on the right. The Z-2 suit is designed for maximum astronaut productivity on a planetary surface – exploring, collecting samples, and manoeuvering in and out of habitats and rovers. The Z-2 uses advanced composites to achieve a light-weight, high-durability suit that can withstand long-duration missions in the harsh environments found on Mars. Adjustable shoulder and waist sizing features maximise the range of crewmember sizes who can fit into any single suit.
(Image: NASA)