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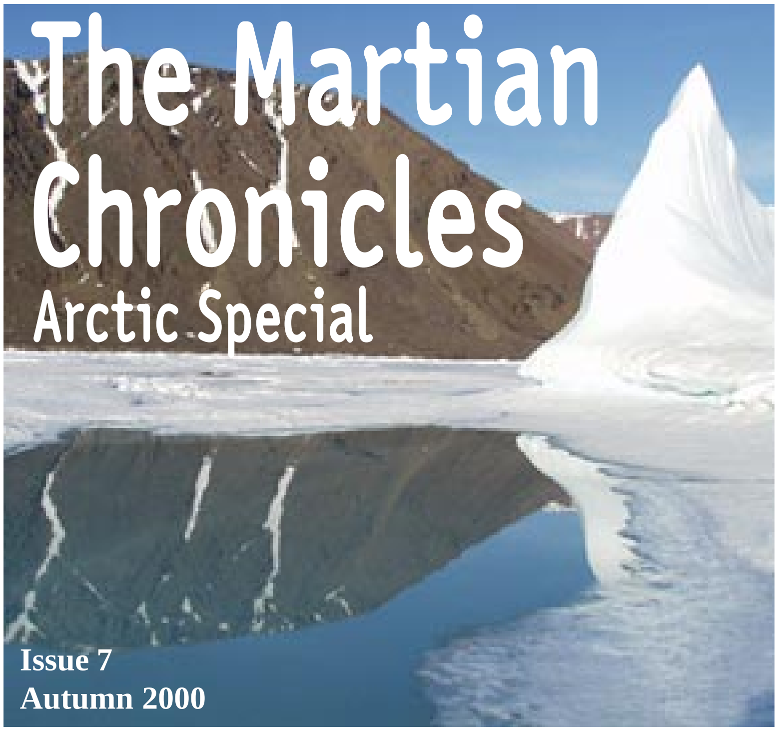

The Martian Chronicles

Arctic Special

Issue 7
Autumn 2000

Contents

Dear Reader,

For the past four summers, scientists from around the world travelled to Haughton Crater, Devon Island, Canadian Arctic to learn more about "Mars on Earth." This issue of The Chronicles presents a short collection of some of the research that is being conducted. Working and living in the Arctic helps us understand the difficulties that astronauts will face when they go to Mars.

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The newsletter is produced by the **Mars Society Youth Chapter** and the **MIT Mars Society Chapter**.

Enjoy The Martian Chronicles!

Hydrothermal Activity in an Impact Crater

Gordon "Oz" Osinski

It is now widely recognized that impact cratering is a ubiquitous process that affects all the terrestrial planets. The surface of the Moon, where other geological processes stopped billions of years ago, records this process clearly. On Earth, however, impact craters are continually erased by erosion, volcanism and tectonic activity. Thus, despite the fact that the Earth has been more heavily bombarded than the Moon, only about 160 terrestrial impact craters have been recognized to date, although several new structures are found each year. So why is the study of the impact hazard important? Well, we hope to learn what has impacted our planet in the past, and what effects these past impacts had on the structure of the Earth, its atmosphere, and its biosphere. Indeed, it is now accepted that a large impact event about 65 million years ago on Mexico's Yucatan Peninsula redirected biological evolution on Earth. This event formed a crater approximately 180 km in diameter and resulted in the extinction of about 75% of life on Earth, including the Dinosaurs.

Bruno Escarpment The pale grey impact-produced breccias, provided the heat source for the hydrothermal activity at Haughton.

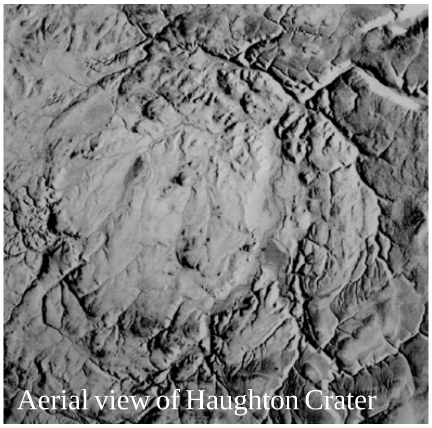
It is well known that hydrothermal systems will develop anywhere in the Earth's crust where water coexists with a heat source. It may also be possible that hydrothermal systems provided a warm, wet site for the origin of life on Earth and other planets (e.g., Mars). During the last two summers in the Canadian Arctic, we have found evidence for the existence of a hydrothermal system formed by the interaction of hot, impact-generated rocks with groundwaters at the 24 km-diameter, 23 million year old Haughton impact structure on Devon Island. From comparisons with other impact craters and from certain thermal considerations, it may have taken as long as tens of thousands of years for the land to cool below 50 °C following the impact. During this time, Haughton would have represented a warmer, wetter environmental niche relative to the surrounding devastated terrain. There is then, the possibility of life after death!

The beautiful **Lake Sapphire** stands out as a modern day oasis. Hydrothermal vents on the lake floor may have provided warm, wet sites for the re-establishment of life.

Mars on Earth

Pascal Lee

Mars today is mostly a cold, windy, barren, rocky desert, with many ancient impact craters, channels, valleys, canyons, possibly ancient lakebeds, and many other features. No place on Earth is truly like Mars: on Mars gravity is weaker, the atmosphere is thinner, drier and made of carbon dioxide (CO_2), radiation from space is more intense, temperatures can be much colder. But the polar regions on Earth come close in some respects. On Devon Island in the Canadian High Arctic, there is a unique combination of circumstances: an ancient impact crater (Haughton Crater) set in a cold, windy, barren rocky desert, with nearby channels, valleys and canyons that bear a strong resemblance to many of the channels, valleys and canyons seen on Mars. What then can we learn about Mars by studying Haughton and Devon? What can we learn about *how* to explore Mars with robots and humans? To answer these questions, the NASA Haughton-Mars Project began studies in 1997 and has visited the site every year since. Devon is turning out to be a Mars analog wonderland and is the site chosen by the Mars Society to establish its Flashline Mars Arctic Research Station.


Aerial view of Haughton Crater

Haughton Crater is 20 km in diameter and formed 23 million years ago (Miocene). The exact size and speed of the impactor are unknown, but it may have been 0.5 mile across and travelled at several tens of kilometers per second. At the time of the impact the Earth was warm and Devon had a climate somewhat like that of Toronto today. There were trees (conifers, leaf-bearing trees) and many animals (a little Rhinoceros, rabbits, fish). In an instant, all life at the site was wiped out. From a biological standpoint, the impact was a resetting event on at least a regional scale, and biological studies at Haughton are very important, even if there were no Mars connection. The rocks that were impacted (mostly ancient marine sediments over 300 million years old, replete with fossils, some of primitive corals and stromatolites) were in part vaporized or crushed and ejected from the crater. Even basement rocks from about a mile deep were excavated and launched into the sky. As the ejected rocks rained back down, heaps of impact rubble accumulated to form the beautiful Haughton impact breccia, still well preserved today.

The Haughton breccia is now permeated with ground-ice and may provide the closest natural analog to the martian regolith (the surface rubble on Mars generated by impacts). By studying the breccia, we might for instance learn about


Geologists examining a breccia hill.

the possible distribution of subsurface ice on Mars. After the impact, temporary hydrothermal vents became active in and around the crater. They provided isolated sites of enhanced moisture and warmth and are therefore of great biological interest. Might similar impact-induced ancient hydrothermal vents be found on Mars? Water also collected inside Haughton crater and lake sediments were deposited. The lake waters eventually drained away but the ancient lakebeds can still be found. By studying these lakebeds, we can learn how to recognize possible counterparts on Mars, sample them and study them for their climatic and fossil record. There are also the many channel networks, valleys and canyons outside Haughton Crater. Most of these were formed in direct connection with past glaciations, either by direct glacial carving or by the melting of glacial ice. If the valley networks and canyons on Mars were formed in a similar way, then there might be no reason anymore to invoke a warm climate on Mars in its past. Our studies on Devon are opening the alternative perspective that Mars may have always been climatically cold, albeit wet at times, not “warm and wet”. What would that mean for its prospects for harboring life? At Haughton, microbial life proves to be very adaptable and can be found almost everywhere - inside rocks, at the bottom of ponds. Even if Mars was always cold, its propsects for having possibly evolved life remain very good.

In all our wanderings on Devon we are also learning how to explore Mars with humans. We test communication systems with imposed time delays for links with Mission Control, we try out new robotic technologies, new spacesuits, we study human factors and a variety of other exploration technologies and strategies that are essential to understanding how a human mission to Mars can be successfully carried out. The Flashline Mars Arctic Research Station will serve in this context as a very valuable operational testbed, a realistic framework for constraining how humans will have to live and work on Mars to be effective explorers. Our work on Devon will represent an important step in the direction of getting humans to Mars.


A polar bear taking at a stroll at the periphery of Haughton Crater.

Learning about past climate conditions in the High Arctic

Darlene Lim

The Canadian High Arctic is a distinct region of our planet in the way that it supports life, responds to shifts in the climate, and affects the environments of the rest of the globe. Investigation of High Arctic climate and environmental change is needed to better understand their global effects and to monitor this pristine and sensitive region. This necessitates an understanding of the region's natural variability and of how it has changed through time. Given the remote and isolated nature of this area, it is not surprising that this past climate data from the High Arctic is sparse. However, through a recent increase in scientific activities geared at understanding High Arctic climate change, this is slowly changing.

Darlene and Marianne extracting a sediment core.

One method of retrieving long-term past climate data in the High Arctic involves tapping into the wealth of information trapped in the sediment record at the bottom of the existing (e.g. Sapphire Lake in Haughton Crater) and extinct lakes (e.g. Haughton Crater which became a lake post-impact, but has since drained out) found on Devon Island and other High Arctic sites. Essentially the sediment reads like the pages of a great climate book, since through time organic and inorganic fallout from within and around the lake accumulates and provides a historical climate record that would otherwise be unattainable. By taking a sediment core of the lake we can acquire this precious information. This type of research, aimed at the study of lake history, is termed paleolimnology.

The biological remains of diatoms, for example, found within these sediment cores, can be used as biological mechanism to track and understand past climate change. Diatoms are unicellular algae with glass (siliceous) cell walls, and are used as biological indicators of past climate change, since their populations will shift as their environment shifts, thus allowing us to infer changes in a lake's climate history. They preserve exceptionally well in the sediment record, and their remains can be incredibly ornate and beautiful (see Feb 1999 National Geographic for more info).

The High Arctic is a beautiful and pristine region, and through further paleolimnological studies we hope to better understand its climate history as a tool for predicting and managing future climate change in this sensitive area.

Biology of Haughton Crater

Charles Cockell

The Haughton Impact Crater is set in a polar desert biome in the high arctic. Although finding environments that are exactly Mars-like is impossible on earth, an impact crater in a polar region is the best analog we have. Our work is focused on understanding the types of habitats that are made possible by an impact event and the types of life that colonize craters. We are studying the cyanobacteria (an ancient lineage of photosynthetic bacteria) that live in the impact shocked rocks and we are examining the types of microbes that live in the lakes inside the crater, particularly the cyanobacterial mats. If there was ever life on Mars, then this crater might be used to refine our search criteria for life. We are also interested in studying how these microbes survive the extreme environment by examining the types of UV screening compounds they produce to protect themselves from 24 hours of UV exposure, since UV radiation on Mars is 1,000 times more damaging to DNA than on earth. In addition to its relevance to Mars, our work will provide valuable insights into the patterns of colonization in craters in general and also the biology of high arctic deserts. By characterizing the microbial populations of the crater we contribute towards other work in Canada to understand the ecology of the high arctic. Over the next few years we will incorporate the biology program at Haughton with simulated mars exploration from the Mars Arctic Research Station.

A patch of flowers in Haughton Crater.

Building the Flashline Mars Arctic Research Station on Devon Island

Robert Zubrin


Lifting a panel into place using a pulley method.

The Mars Society took a giant step forward this summer with the successful construction of the Flashline Mars Arctic Research Station on Devon Island.

Devon Island, is located circa 75 degrees north in Canada's Nunavut Territory. Consisting largely of polar desert with a 15-mile diameter meteorite impact crater, the completely uninhabited island is one of the most Mars-like environments on Earth. Since 1997, NASA scientists led by Dr. Pascal Lee have been exploring the area in order to explore Mars by geologic comparison. At its Founding Convention in 1998, at the suggestion of Dr. Lee, the Mars Society decided to make the construction of a simulated human Mars exploration station on Devon Island its first major project. The purpose of the station would be to continue the geologic exploration of Devon, but do it in the same style and under many of the same constraints as would be involved in conducting such activities on Mars. By doing so, researchers would be forced to confront some of the problems of human Mars exploration and begin the process of developing appropriate field tactics for exploring the Red Planet.

Starting in the fall of 1998, a volunteer Mars Society task force was formed to define the project further, and during 1999 private funds were raised allowing the project to be initiated in earnest. In January 2000, a contract for fabrication was let to Infrastructure Composites International (Infracomp) of Commerce City Colorado, whose unique ultrastrong, comparatively lightweight, and weatherproof fiberglass honeycomb technology provided an attractive option for the Devon Island Station.


Laying out the panels for the hab.

Infracomp's craftsmanship proved to be excellent. However, for various reasons, the fabrication effort fell seriously behind schedule. This resulted in a crisis in early June, when it became clear that unless something was done, the structure would not be ready in time for the scheduled June 28 shipout. This crisis was overcome however, by the mobilization of additional labor from Mesa Fiberglass, Pioneer Astronautics, and volunteers from the Rocky Mountain Mars Society, some of whom worked up to 2 weeks in the fiberglass factory with no compensation in order to get the structure out of the factory on time. Accordingly, on June 28, three trucks carrying the components of the Station left Colorado for Moffett Field, CA, where, together with gear for the NASA-led Haughton Mars Project, they were loaded on US Marine Corps C-130 aircraft for flight to Resolute Bay in the high Arctic.

The plan was to deliver the station components to Devon Island via C-130 paradrop, as the large fiberglass panels comprising the station were much too large to be brought in by the small Twin-Otter aircraft used for general transportation between Resolute Bay and Devon Island. Five paradrop sorties from Resolute to Devon were needed. The first three paradrops carrying the walls, legs and some of the dome sections of the habitat occurred on July 5. These drops were largely successful, in that the payloads were delivered safely to the ground, but fell wide of the Haynes Ridge target construction site. The fourth drop, on July 8, carrying the remaining domes and other equipment, went well. However, July 8th's fifth and final drop, was a disaster. The payload separated from the parachute at an altitude of 1000 ft, causing the complete destruction of the habitat fiberglass floors, the trailer that had been shipped to the Arctic to enable movement of the large 800 lb fiberglass panels in the event they did drop wide of the target site, and the crane required by the plan to construct the station.

With the loss of the trailer, the floors, and the crane, the construction crew that the Mars Society had paid to fly to Devon to assemble the station declared that building it this year was impossible, and left the island. At this point, it seemed to most observers that the project was doomed. Indeed, one journalist covering the events went so far as to ask me "Dr. Zubrin, do you see a parallel between the failure of your mission and that of the Mars Polar Lander?" My reply was "There's a parallel in that we both hit a rock. But the difference is that we have a human crew here, and we are going to find a way out of this."

Refusing to give up, Pascal and I assembled a new makeshift construction team consisting of a combination of Mars Society scientist-volunteers, Inuit youth hired from Resolute Bay, and journalists, who, having come to cover the construction of the station, were strongly encouraged to participate in the effort. Frank Schubert, a general construction contractor from Denver and Founding Member of the Mars Society was brought in to direct the construction effort, with the assistance of his foreman Matt Smola, and Infracomp president John Kunz. A new trailer, "the Kunzmobile" was constructed out of wood and parts of a wrecked baggage cart from Resolute Bay airport, and using it, the team managed in three days of heavy sledding in freezing rain to move all the mistargetted habitat components to the construction site. Wooden floors to replace the ruined fiberglass decks were designed, and materials for their construction were secured in Resolute Bay. To replace the crane, an alternative ancient-Roman style construction technique was devised, utilizing large labor teams with bracing timbers and guy ropes operating in coordination with a scaffold and a winch to lift the 20 ft by 7 ft 800 lb wall panels into place. Shortly before the wall-erection effort was to begin, the weather cleared, and the team seized the opportunity to get the job done fast in good weather by instituting 14-hour work-days. In three days, the walls were up. The decks were then partly built out, and then block and tackle gear was used to haul the 350 lb dome sections up onto the upper deck. Once there, a scaffold was constructed, and two dome sections plus the central core were erected to create an arch. The dome sections were then added in, with the last one being brought into place around 7 pm July 26. Interior buildout then commenced rapidly.

The **F**lashline **M**ars **A**rctic **R**esearch **S**tation

On the evening of July 27, I sent a message to the Mars Society Mission Control in Denver to establish contact in preparation for the commencement of simulation operations the next day. "Mission Control, this is Flashline Station. Are you there? Please Respond." Mission Control replied;

"Flashline Station, this is Mission Control. It's good to hear from you.

"Clearly, failure was not an option."

In a ceremony attended by about 50 scientists, Inuits and journalists on the evening of July 28, the station was formally commissioned. Speeches were given by NASA Ames scientist Carol Stoker, British Antarctic Survey scientist Charles Cockell, Pascal Lee, and myself. At the conclusion of my speech, a shotgun was fired in salute to the red, green, and blue Martian tricolor flag flying atop the station. I was then given a bottle of champagne, which was smashed against the habitat to christen it. This provoked a sigh from the crowd. Pascal, however, immediately reassured them; "It's all right folks. It's just Canadian champagne."

The first crew, consisting of Pascal Lee, Mars Society webmaster Marc Boucher, Frank Schubert, the Discovery Channel's Bob Nesson, and I then entered the habitat for a largely symbolic one night and one day occupation and simulation. A more thorough four-day shakedown simulation was begun on July 30. Commanded by Carol Stoker, the crew of the shakedown consisted of Stoker, Marc Boucher, NASA Ames' Bill Clancey and Larry Lemke, the University of Toronto's Darlene Lim, and Bob Nesson. In the course of the next several days, this group lived and worked in the hab, supporting a series of exploration traverses on Devon Island and the field testing of a Hamilton Sundstrand Mars spacesuit prototype. To report of their activities, the crew engaged in Mars-earth simulated time-delayed dialogue with Mission Control in Denver.

On August 4th, simulation operations were discontinued. The hab was then sealed for the winter. Based on experience gathered to date, plans are now being developed for the summer of 2001, when the station will be used to support 8 weeks of Mars operations field research in the high arctic.

Everything did not go right on Devon Island. Neither, however, can we expect everything to go right on the first human mission to Mars. The military has a saying; "All plans fail upon contact with the enemy." In the wild Arctic, all plans fail on contact with reality. The same will be even more true on Mars. When venturing into the unknown, the unexpected will happen. But what we proved on Devon Island, is that a resourceful crew can deal with it.

On the piloted Mars mission, the human crew will be the strongest link in the chain.

Robotic Geologists

Bill Clancey

In 1972 a geologist, Harrison Schmidt, walked on the moon. His experience enabled him to understand how the hills, valleys, and rocks were related. When unexpected discoveries were made, he used his time wisely and searched for good rock samples to bring back to earth.

But people have not walked on Mars yet. Instead, in 1997 we sent a remotely controlled "rover," called Sojourner, to take photographs and make measurements. This data was sent back to earth for scientists to study. With the aid of 3-d photography, our "telescience" experience was almost like being there. Or was it? What could people do if they walked on Mars directly that they could not do by remotely controlling a rover?

Well, one big problem is the time delay. Sojourner was programmed to move only 7.5 cm and stop to wait for the next command. Its laser sensor could only "see" 20 cm ahead. This is like not being able to see beyond the tips of your shoes. Scientists had to typically wait 20 minutes for a command to be received on Mars and another 20 minutes to find out what the robot did, and so on. It could take hours just to move Sojourner one meter!

A person walking on Mars could see something a kilometer away and go get it. However, sending people to Mars is much more expensive than sending machines, and it is dangerous—three years is a long time to be away from a hospital. Why do not we just send smarter robots? Could we invent a robot that could decide where to go and what rocks to pick up, just like Harrison Schmidt? Maybe some day this would be possible. But not very soon.

Sojourner was not a true robot; it was remotely controlled by people sitting at workstations back on Earth. Sojourner could navigate to go where it was told to go, but it could not recognize rock types like a geologist could; it couldn't think about how the valley in which it moved was formed by water or wind; it could not reason about how to use its time wisely (before it died in the martian winter). In short, Sojourner could not explore.

What do we need to know in order to build a smarter robot? We need to develop a machine that can climb cliffs and go around boulders and crevices, the way a geologist can go to an outcropping on a slippery slope (see picture below of a geologist on Devon Island). We do not know how to build a machine that is as physically coordinated as people. We also need to understand better how human perception, reasoning, and memory work. How do people recognize similarities, form analogies, adapt to new variations, and reason about unexpected situations? We need to understand how people work together, so we can build a robot team that divides up tasks, and uses good judgement in interpreting what we want them to do.

A geologist looking for interesting features on a steep hill.

We have a long way to go, but progress is being made in computer, cognitive, and social sciences. We will soon send better teleoperated rovers; eventually we will send robots that are able to work independently for more than a few minutes without us watching. Even when people walk on Mars, they will want such machines to assist them, perhaps like the way machines help people in car assembly plants doing work that is mechanical, unsafe, or requires more strength.

So the question is not whether we should send people or robots to Mars. First, we will continue to send machines that scientists control remotely. Eventually machines will become "robotic", able to physically move over difficult terrain, and even "decide" where to go. But almost certainly we will be able to send people safely before such robots exist. Then we will send robots *and* people, and the real question will be, how can they best work together?"

The Recluse – Mars Fiction

Chapter VI: The Last Trial

Rich Reifsnyder

Jason Blake was simultaneously sweating and racked with cold shivers. These were a whole new range of symptoms of stress he had acquired in the many complications of his journey to Mars. *Could this be radiation sickness?* he wondered, recalling the solar flare from a week ago. The fuel tanks and water supplies were supposed to block the radiation, but could some cancerous rays have leaked through? *No, it's just stress. Be calm. The computers will handle the entire descent maneuver.*

"Blake," said Cynthia at MC, "by our calculations, this will be the last transmission you receive before you encounter atmospheric effects. We'll be monitoring your progress, but you're on your own. Remember to look at the flight plan at all times and be ready for manual corrections if an engine fails."

"Thanks, Control. Blake out."

The 0.05-G light came on as the vessel hit the upper atmosphere. Blake heard rattling; he heard the thin metal groan and creak as the ship warmed up. His teeth jarred and rattled until he thought his skull would shatter. He was sweating bullets as the cabin temperature reached 30 degrees Centigrade. His arms felt flimsy as deceleration reached three gravities.

Numbers flashed on his screen: altitude and velocity figures. The capsule had deployed three solid-fueled beacon landers a month earlier; only one had survived the descent.

Explosive bolts fired; the heat shield fell away. The landing legs stretched and locked into place. He was still pressed into his seat by air drag. He couldn't see a thing: a dust storm had kicked in and his visibility was zero. All he had were the flashing green numbers on his screen. He waited for the engines to fire.

At twenty kilometers he heard a *pop*. The engines had fired, but instantly died. He panicked. Had the engines failed? He was plummeting to the surface!

He flipped the manual engine-firing switches. Only one of the six engines had failed; the rest were at full throttle.

But now the graphic of the landing profile had switched off. The ship was no longer flying on automatic. Somehow he had to land the capsule manually, using the flight plan.

Shivering from stress, he flipped through the flight book to the landing profile for five engines. Beside the illustration was a long list of tiny figures for the ideal position and velocity every fifteen seconds; his gaze darted between this list and the beacon transmissions. One hand gripped the steering column with enough pressure to rupture his veins as he nudged the stick up to fire the maneuvering thrusters.

Another engine cut off; he flipped through to find the revised flight plan in case of engine cutoff in mid-flight. At five hundred meters up, his fuel reserves were less than ten percent.

He glanced at the radar map compiled by the beacon during its descent. Directly beneath him he saw an unusual shadow. Was it a boulder? It looked big enough to overturn even his large capsule. It was directly beneath him; he was now firing thrusters vertically. His aching teeth were now chattering from fear.

He decided he couldn't risk landing on top of that thing. He nudged the stick to one side, tilting the capsule ten degrees and accelerating it to one side. In a slow, fluid S-motion he tilted the capsule back, then straightened it out. Once again, the craft was vertical.

At an altitude of ten meters the fuel ran out and the engines sputtered and died. Blake's frail vessel plummeted and struck the sandy surface at fifteen meters per second. Blake's neck twisted uncomfortably and he acquired a splitting headache. The sound of the crash echoed endlessly in his head.

His vision blurring, his heart fluttering, he looked around. Through the windshield was a deep pink sky clouded with dust. He tried to sit up but his arms turned to jelly; he had to wrap his hands around the ceiling handgrips and lift himself to a sitting position. The storm already seemed to be clearing up, and he could see a plain of reddish sand dotted with large rocks. In the distance was the dark silhouette of a rocky outcropping.

His eyes flooded with tears. After three years of dreaming and planning and six months of mind-numbing isolation and cold, bleak, infinite space, he had finally touched down on another world and lived to tell about it.

He got himself to his feet, supporting himself on the cabin walls the whole way. He wasn't just weak in the knees due to six months of weightlessness; he was thrilled to the point of fainting. Immediately he donned his spacesuit, depressurized the cabin, and stepped outside.

He looked down at his boot in front of him, pressed into the regolith. He knew that this would be his home, all of it, and he would have the rest of his life to enjoy it. He would never return to Earth, and he didn't know whether he would survive for many decades on the resources of Mars or die within a year, but it wouldn't matter. It would be a life he would never regret.

He sank to his knees, lowered his head to the ground, and wept with joy.

The End

The first 5 chapters of The Recluse are available at http://chapters.marssociety.org/youth/

Planetary Exploration Networking: The Internet for a crew on Mars

Steve Braham

When we finally send human explorers to the surface of Mars, we are going to need ways to bring modern networking to the Red Planet itself. NASA and Simon Fraser University have been collaborating with Canada's Communication Research Centre (CRC), and with funding from the Canadian Space Agency, on PlanetNet - a project to investigate concepts for such a network.

Explorers on Mars will use a wide range of tools to explore their surroundings. These will range from fixed experiments such as monitoring weather, to advanced teleoperated robots and spacesuited astronauts roaming around the surface; experiments will need to constantly deliver data back to base. Robots will send back high-

The satellite dish providing the HMP team with a communications link.

resolution data and receive commands; astronauts will transmit their life signs and position, as well as communicate through audio and video with base camp.

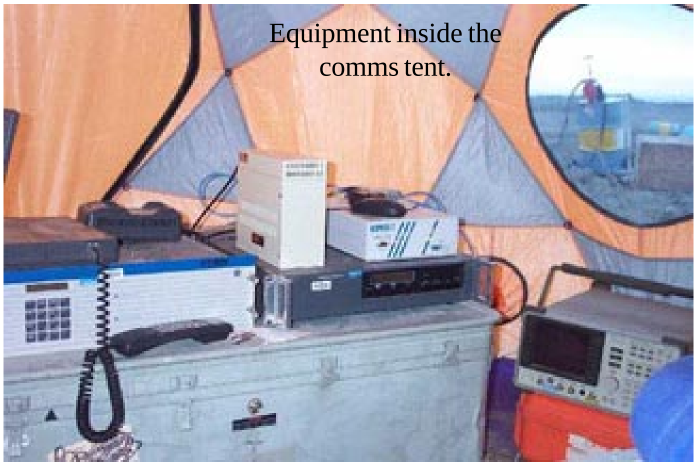
The PlanetNet project is looking at advanced radio systems that can transmit high-speed data over long distances in the Martian environment, including reaching into canyons where much of the interesting scientific studies may happen. These systems use next-generation radio technology developed in Canada, and will eventually form the backbone for an internet over the entire Haughton-Mars field region.

The base will communicate with Earth via high-speed digital links, relaying all the telemetry data, as well as TV images, for Humanity watching back home. The communications network will be accessible to the astronauts from anywhere. For the Haughton-Mars Project (HMP), we use a high-speed space-based networking link back to CRC to connect the region to the Internet back on "Earth". We call this PUF – the PlanetNet Uplink Facility. Working with our PlanetNet partners, as well as HMP

A crew inside FMARS - working and relaxing.

members like Marc Boucher of SpaceRef, we have been able to deliver live data of our research back to the world via the network. PlanetNet provides the primary support for returning field exploration data, telemedicine data, and mission support operations for HMP.

Much work needs to be done. We need to understand in what ways radios will behave differently on Mars relative to our Earth-based Mars analogue sites. That means understanding how the Martian atmosphere works, as well as how the surface is different. We need to make systems easy to use, easy to fix, flexible, and robust to extreme temperature, pressure, and radiation effects. Finally, we need to understand what is needed to make these systems easy to deploy on Mars while in a space suit. Can robots position communication elements? How do we power everything, and detect problems? Can we minimize the amount of time a crew must spend on EVA? We are finally taking a first step in putting together the infrastructure that will be needed by humans on Mars - and that makes the research exciting for the PlanetNet team!



Equipment inside the comms tent.