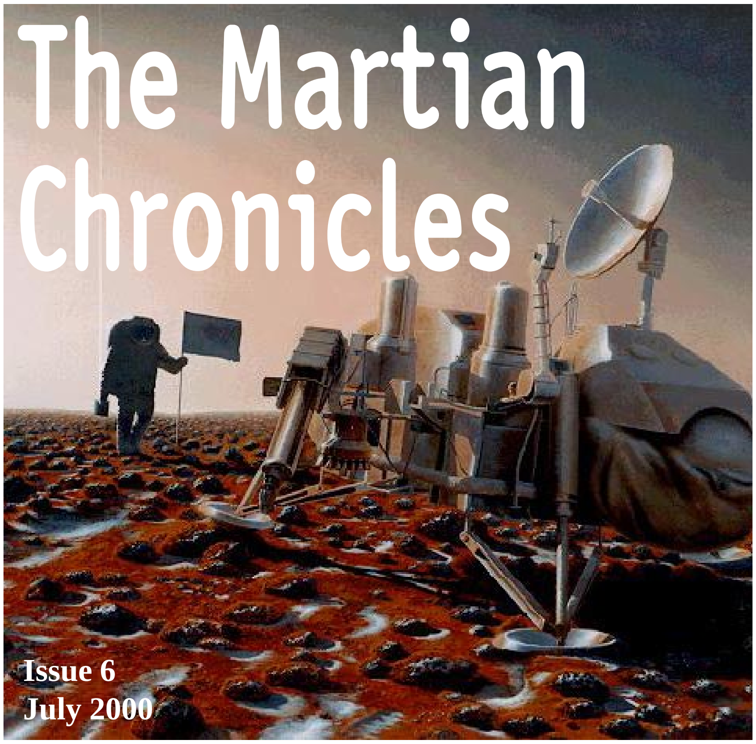


http://chapters.marssociety.org/youth/

Contents

Space Update (p1) ~ Odyssey to Mars (p2) ~ Mars Youth Projects (p3) ~ Meet the Scientist - Dr. Wilson Greatbatch, Pacemaker Inventor (p4) ~ Humans vs. Robots (p6) ~ The Recluse - Part V (p7) ~ Photoman (p8) ~ Mars Q&A (p8)

Dear Reader,

The Martian Chronicles were started as an outreach effort, aiming to excite youth about the exploration and near-future human settlement of Mars.

Please distribute them freely!!! To be added to the announcement list, or to receive paper copies for distribution, contact Margarita <mmm@mit.edu>.

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

Enjoy The Martian Chronicles!
Sincerely,
Margarita Marinova.

Space News Update

David Pinson

Compton Gamma Ray Observatory - At the beginning of June, NASA directed the Compton Observatory, the Gamma-Ray equivalent of the Hubble, to burn up in the Earth's atmosphere. The destruction of the satellite followed NASA's upper management decision that continued operation of the satellite was too risky, despite internal protests to the contrary. The re-entry capped a successful 9-year mission for the CGRO, which was dropped off in orbit by the shuttle Atlantis in 1991.

Space Station Schedule - The International Space Station's construction should finally shift into high gear this summer. The coming six months will see seven space station missions - three by the US shuttle and four by Russia - which will bring the station to a manned capability. The long-delayed service module is schedule for launch from Russia in July, another shuttle logistics flight is set for September, a shuttle truss assembly flight also is in September, and the first crew for the space station is set for launch in late October.

International Space Station

Launch Vehicles - The new Lockheed Martin Atlas rocket, the Atlas 3, was successfully launched last month. In addition to carrying a communications satelite, it tested technologies for the new U.S. Evolved Expendable Launch Vehicle (EELV) program. The Sea Launch venture by Boeing failed on its last launch, though recovery efforts are underway to return it to flight this coming month.

Mars Success? - NASA has announced that the soil scoop robotic arm that was on board the Mars Polar Lander spacecraft last year was a success. Oddly enough, the MPL spacecraft failed last December as it was approaching the red planet, with obviously no data having been returned by the arm. One Congressional leader said that the statement damages NASA's credibility as a leading institution.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

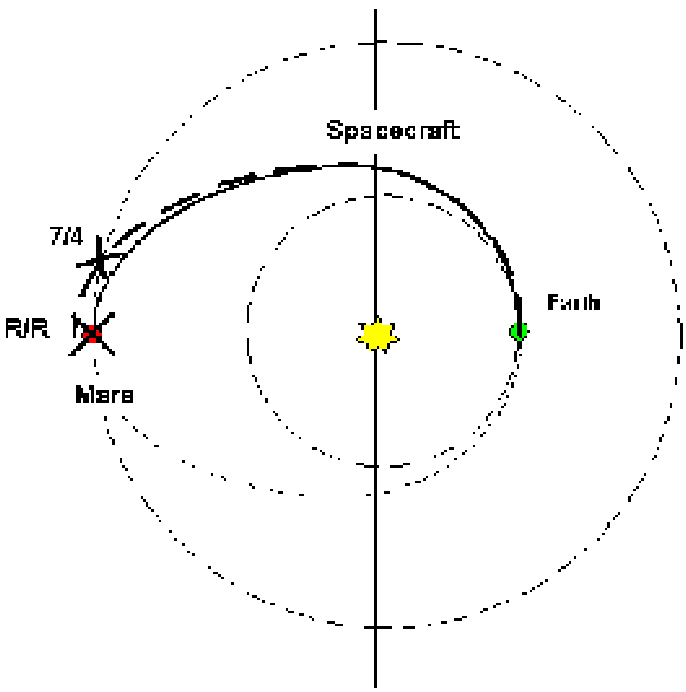
Produced by: **MIT Mars Society Chapter**
Mars Society Youth Chapter
Distribution funded by:
Massachusetts Institute of Technology

2001 - Odyssey to Mars

William H. Clark

The Earth to Mars trajectory is the subject of my dissertation research. NASA makes it seem quite simple, but it's not! Consider a few details.

The Mars missions typically follow an elliptical path and meet the red planet at the opposite side, at apoapse. (See illustration.) This is the minimum energy trajectory. At apoapse, the velocity of Mars is 24.13 km/sec and the spacecraft is going 21.5 km/sec. They are both going about the same direction, but Mars is going 3 km/sec faster. In practical terms, Mars' diameter is 6800 km, so the entire planet will pass by the spacecraft in about half an hour That's a pretty small target, in a 250+ day mission!



The Earth-to-Mars Trajectory

These relative speeds mean that, because the s/c is moving slower, it must wait at the railroad crossing for Mars, as it comes barreling down; then deftly maneuver into orbit at just the precise moment.

Folks, there's only one technology in the universe that I would trust to get me out of that kind of situation - my own legs! It's asking a lot for an autonomous s/c to maneuver its way to safety on its own (timely feedback from Earth is not available because of the time lag.)

The July 4 landing of Sojourner intersected Mars before apoapse. In this circumstance the spscrcraft was able to make a proactive approach to Mars, versus reactive. Their relative velocities weren't much different, but the geometry is a little more tractable because the spacecraft is approaching at an acute angle, not head-on.

It is a very subtle thing that you must experience for yourself. You can do so with a free computer program available at http://get-me.to/mars You input some numbers, then the program finds an optimum trajectory, and displays all the results - where and when all five of the Trajectory Correction Maneuvers (TCMs) were done ; just like on a real mission! There is also a free four chapter introduction to orbital mechanics that describes in laymen's terms all the facets of the trajectory itself.

You'll find - just like the mission planners - that it is a very slippery situation. Change one value by 1% and the s/c might not reach Mars at all, but follow it around the curve of apoapse, and not catch up for months! Change it the other way and you might get there, but the total energy requirement doubles - so, practically speaking, you won't have the fuel to really get there at all. Other values will, unexpectedly, add 30 days to the mission!

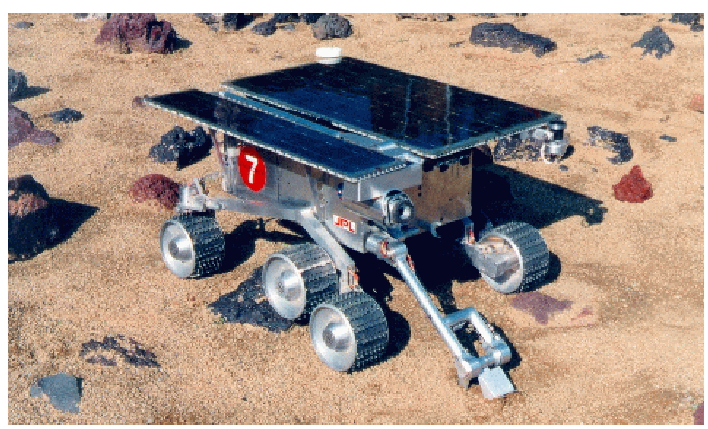
All of which is not the program's fault - it's values are accurate to 14 significant digits (1/10th of a centimeter!). It's because it is an extremely non-linear problem. You'll see!

Mars Rover Bumper Sticker Contest Winner:

Gene Johnson

I'd rather be driving a Mars Rover!

To view all entries, visit http://chapters.marssociety.org/youth/BumperSticker.shtml



Mars Youth Projects

Check out some of the projects that your fellow Martians are involved in!

Grant Bonin and Jaimey McKee

Winners: silver medal, Senior Engineering Category, Canada Wide Science Fair

Coherent architecture for exploration of Mars. Sending humans to Mars must be done simply and inexpensively. We set out to design a mission that employed little hardware, and relied on indigenous Martian resources. We built and tested a reactor that could make fuel from the Marian atmosphere. We concluded that a mission to Mars could be accomplished affordably using our ideas.

Chris Cameron, Massaponax High School

The feasibility of a crewed mission to Mars. The report and its components explore past as well as current mission plans being discussed, such as the Mars Reference Design Mission. The project looks at what it would take to put people on Mars, and how large an impact this would have.

Gavin Mendeck

Last fall, NASA's Exploration Office at Johnson Space Center asked an engineering interdisciplinary senior design class at Texas A&M University to evaluate and design a system to land 35 metric tons (which would include humans) from martian orbit to the surface. After evaluating parachutes, parafoils, rockets, rotors, airbags, landing legs, and lighter-than-air balloons (to name a few concepts), the class's final design included a lifting-body entry shield, parachutes to slow down, storable-liquid rockets for the final deceleration and maneuvering to the landing site for a soft touchdown using simple landing legs. The class found that while the thin Martian atmosphere can certainly help slow down landers equipped with parachutes, for massive payloads such as this it may be

more efficient to use a purely propulsive system instead of relying partly on parachutes and the fickle atmosphere. Several of these graduating students have since accepted offers to work for NASA and NASA contractors in the Houston area.

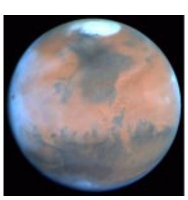
Elizabeth Tay

For centuries, mankind has been scouring the skies in search of extraterrestrial life. But what is life? How do we know when we've found it? My essay briefly goes through a few criterion for the existence of life, the search for life using planet detection techniques and radio astronomy, and ideas of astronomers Frank Drake and Enrico Fermi. "The truth is out there" - whether we find a hostile civilisation of giant bugs waiting to attack or an advanced civilisation with so much to teach and so much to learn, the search for extraterrestrial life promises to be an exciting journey with lots of room for hope, faith and imagination.

Shawn Goldman

In the fall, I will be looking at the effects of biological systems, such as microbacteria, have on the ratios of iron isotopes, much like the carbon isotope ratios that are one of the current means of searching for past life on Earth, Mars, or elsewhere. Isotopes are atoms of the same element that have different number of neutrons. Specifically, the fractionation of iron isotopes in magnetite produced by magnetotactic bacteria (the same particles that were found in ALH84001) is of interest. Thi is one of the most solid pieces of evidence that point to past Martian life in ALH84001.

3rd Annual Mars Society Conference



Ryerson University, Toronto, Canada

August 10-13, 2000

To **register**, visit www.marssociety.org

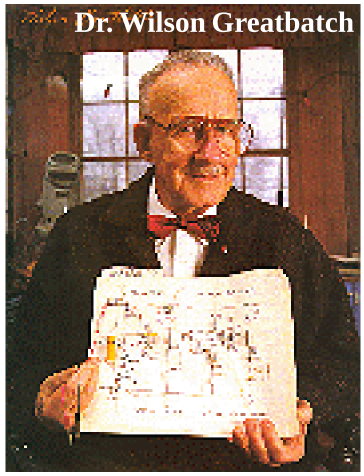
Have a great time learning more about Mars and meeting fellow Mars enthusiasts!

Conference organized by the Mars Society Toronto Chapter: http://chapters.marssociety.org/toronto/

Meet the Scientist

Dr. Wilson Greatbatch

Inventor


Dr. Wilson Greatbatch

Dr. Wilson Greatbatch was born in Buffalo NY in 1919. He served in the US Navy for five years in WW II partly as a rear gunner in carrier-based dive-bombers in the South Pacific. His small nine-plane squadron used up 27 airplanes during six months of combat and lost about a third of the combat air crews that flew in them. As he said, "The Good Lord must have had something He wanted me to do because I came back without a scratch".

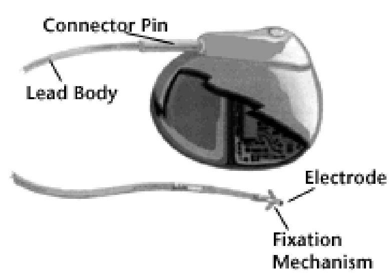
After graduating as a GI Bill student in Electrical Engineering from Cornell University in 1950, he went on to achieve a Master's degree from the University of Buffalo in 1957 and to invent the Implantable Cardiac Pacemaker in 1958. He also participated in the instrumentation of the first animals to be launched into space in the USAF American Space Program in the 1950's. He has since been granted four honorary Ph.D. degrees, has been elected to Fellow Grade in nine professional Societies and has been inducted into three Halls of Fame. In 1986 he was granted the National Medal of Technology by President Bush. He received the Lemelson/MIT Career Achievement Award and is a member of the National Academy of Engineering.

Q: What were your interests as a child?
A: I was always curious about how mechanical and electrical things worked. We made some very sophisticated rubber-band guns and had neighborhood "wars" with them. We took my father's old Model T Ford truck apart to get the magnets out of the magneto, (to his distress). I built my own short-wave receivers and transmitters and got my amateur radio operators ("ham") license when I was sixteen years old. Electricity fascinated me because there was something going on that you couldn't see. You had to use a meter, or even a neon bulb, and later, an oscilloscope, to *see* what was going on.

Q: In what areas did you focus your studies as an undergraduate and a graduate?
A: From my wartime experience I concentrated my studies on communication and science, antennas in particular. My stress was on math, physics, chemistry, and information theory. Cornell at that time was building their first space radio telescope, later to become the facility at Arecibo, PR where the reflector was a hollowed out mountain. They needed technicians with expertise in soldering and they hired us ex GI's to build the equipment. I always thought that it was wonderful that Cornell let undergraduates be an active part of this cutting-edge technology of space exploration back in the 1940's.

Q: What inspired you to work on developing a cardiac pacemaker. How did inventing the pacemaker change your life?
A: The GI Bill supplied only half enough to feed my family. (Three kids at the time. My only honor when I graduated from Cornell was that I had more kids than anyone in the class!). One of my many jobs was instrumenting 100 sheep and goats at the Cornell Psychology Dept. Animal Behavior Farm. (A good experience since I later got the job of instrumenting the first monkeys in space because I knew what conditioned reflex was). One summer two brain surgeons came down from Boston on sabbatical doing experimental brain surgery on some of our animals. They taught me about complete heart block - when a nerve bundle which carries the "beat" signal from the auricle to the ventricle in the heart becomes nonfunctional. When they explained it, I knew I could fix it with an implantable device, but not with the vacuum tubes and storage batteries we had at the time. Transistors hadn't been invented yet. But I kept this in mind. Then transistors were invented and became readily available in the late 1950's. I had saved $2000 and also had enough to feed my family for two years, so I quit all my jobs (to my wife's concern!), gave the family money to my wife, took my $2000 and went up into my wood-heated barn workshop in the back of my house. I built 50 pacemakers there in two years. With Dr. William Chardack, and Dr. Andrew Gage (a high school classmate), we put 40 of them into animals and 10 into human patients. The thing worked, I licensed it out to the Medtronic Co. who then made 300 the first year. Last year over 600,000 pacemakers were implanted in patients world-wide. Thus the pacemaker and ongoing developments like implantable lithium batteries, provided me with a series of new careers, and changed my life forever. Now we have over 700 people working to make or license most of

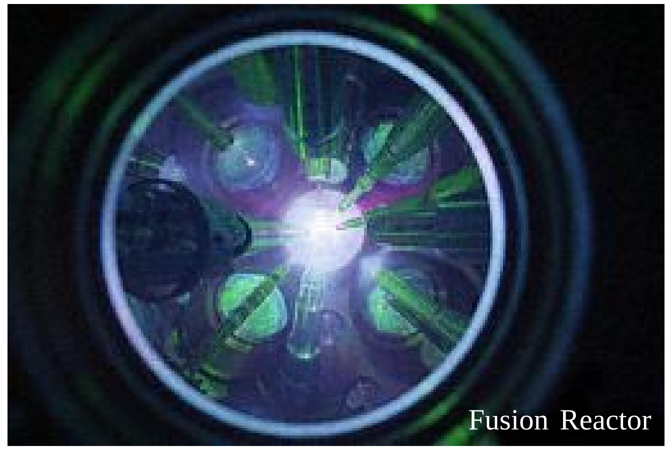
Pacemaker design



the world's implantable batteries, and we give them AND THEIR CHILDREN full tuition and books wherever they want to go to school.

Q: Do you think that being an inventor is part of being a scientist or do you feel that the two are vary different.
A: In my case, they are the same. I enjoy using pure science to create and debug a device, but I also enjoy the commercialization of it. Most scientists are interested only in the creative aspect, the proving out of the correctness of an idea. The engineer must use all the tricks of the physical, and natural sciences, but must add an economic factor, usually cost-effectiveness and societal ethical concerns. Most inventors are much more concentrated on the practicality and effectiveness of a device or a method, with less concern for the science background. I need the whole spectrum to stay interested.

Q: What are your current research projects?
A: I am interested in the energy that will power the Earth for this century and will get us to the Moon and eventually to Mars. By 2050AD we will have run out of all the economically recoverable fossil fuels. We will have run out of places to put the toxic residues from our nuclear fission reactors, and all the alternative forms of energy. Solar, geothermal, water power, bioenergy etc. will only supply 25% for the energy we will need to feed the 10 billion people that will be on earth at that time. We will have no place to go but nuclear fusion. Nuclear fission divides heavy atoms like plutonium and uranium into smaller elements and releases energy, and some very toxic wastes. Nuclear fusion joins two nuclei of light elements like helium or hydrogen and makes much more energy. Heliium-4 is the innocuous gas they put in kid's balloons. It has 4 heavy particles (two protons and two neutrons). An isotope of helium-4 is helium-3, which has only one neutron. Two hilium-3 nuclei can be joined to make one helium-4 nuclei. One neutron comes from each helium-3 to make up the two neutrons in the helium-4. Two protons from one helium-3 to complete the helium-4 nucleus. The remaining two protons in the remaining helium-3 nucleus come off at 5 million electron-volts of energy, like a slow H bomb. The fuel (He-3) is non-radioactive, the process produces no radioactivity, and the residue is non-radioactive. It is a perfect fuel. It doesn't even produce any greenhouse gasses.


Fusion Reactor

So what's the hitch? Well first of all, the reaction takes place at a temperature much hotter than the surface of the Sun. Secondly, there's practically no helium-3 on Earth! But I tell my engineering students that these are just minor engineering challenges. This is what I work on now. Maybe if your editor will give me more space sometime, I'll tell you how I think it can be done. I can hear her screaming now that I've used up more than my page allowance here.

But WHO will do all this. Do you think I will? By 2050? No, I won't even be around.

BUT ONE OF YOU MIGHT!!

> Don't fear failure and don't crave success. The reward is not in the results, the reward is in the doing. Failure is a learning experience. He who has never failed has probably never done anything. Just immerse yourself in the joy of doing. You will find true happiness and the Good Lord will smile on your efforts.
>
> **- Wilson Greatbatch PE**

Q: Do you think that the science methodology has changed much since you started your career?
A: Science methodology has changed radically in that devices, instruments, and techniques for measuring and controlling have radically changed. But the scientific method, the thinking patterns and the scientific ethics are still the same. Break the BIG problem into a bunch of little sequential ones and solve them one at a time.

Q: What do you consider to be the greatest accomplishment in your life?
A: My most important invention was the implantable cardiac pacemaker.

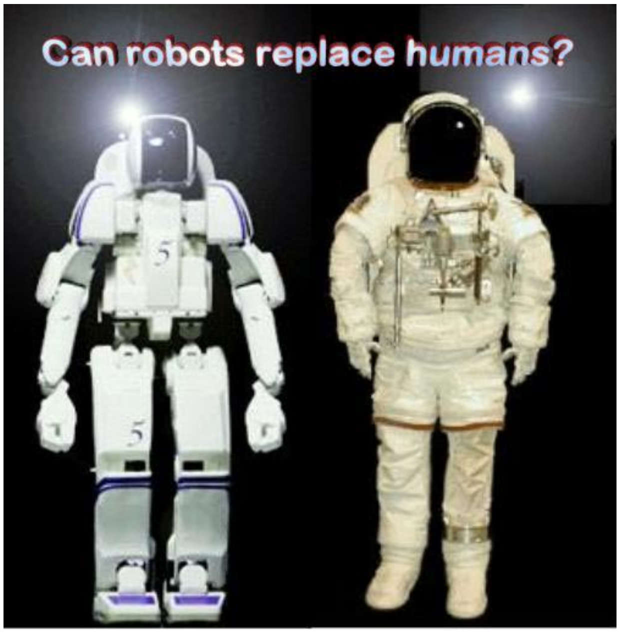
Q: What would be the three words or a sentence that describe you best?
A: The sentence that best describes me is "One of the Lords smaller people".

Humans vs. Robots

by Vesna Nikolic

Space is a very dangerous place, especially for astronauts doing EVA's (ExtraVehicular Activity - NASA's term for spacewalking). So, people might ask themselves, why don't we replace humans with robots?

There is no atmosphere to protect astronauts and their spacecrafts from the cruel environment of space. The temperatures can get as high as 300F (about 150C) in the sunlight and –200F (about –130C) in the shade. If a human were exposed, the lack of pressure could cause bursting blood vessels. Micrometeoroids and space debris traveling at high speeds can penetrate human skin and thin metal. Other environmental factors include high-energy particles from the Sun, and radiation. In order to perform an EVA, an astronaut has to wear a spacesuit in order to protect himself from this environment, and spend a lot of time in preparation for EVA.



Spacesuits are 14 layered garments custom built for every astronaut. They provide breathing air, pressure and temperature control for the astronauts. Currently, spacesuits are heavy and motion limited, therefore making every EVA a very hard physical task, which could potentially take hours.

In space, there is no weight. Astronauts can drift in space by simply pushing themselves off the spacecraft. Tethers and AMU's (Astronaut Maneuvering Units) have to be used in order to get back to the spacecraft.

BAT (Beam Assembly Teleoperator) is a robot that assists astronauts in EVA's by bringing tools, orbital replacement units, and performing rescue to potentially consciousness astronauts. But why spend money on making this robot, and why waste space on board of the spacecraft, and the fuel to get the robot to orbit, just so that it can serve as a an assistant? Why not just add a few more components to that robot and then make it do the repairs on its own?

In 1997, two astronauts spent 6 hours in EVA with a mission to catch a 3,000-pound, slowly spinning satellite with their own hands. The question is, why do we risk human lives, and thousands of dollars of equipment for protecting their lives, in order to perform a single EVA repair mission? Why not just use robots? Then, humans could stay in a protected environment controlling those robots. Robots would be like mobile shuttle arms.

Honda has made a humanoid robot that can walk on two legs and perform some specific human duties (like tight a bolt, or cut a tie), so why not use an already made robot? We could add a few jets on its side in order to move the robot if it gets too far away from the spacecraft (the robot could be either moved towards the spacecraft, or towards the Earth in order for the robot to burn in the atmosphere). We could also add suction cups on its legs. The suction cups would help the robot move when it's close to the spacecraft (the robot would basically climb the spacecraft), and they would also provide security when repairing components (so that the robot doesn't move by the force opposite of its motion). With a few minor changes to this already made robot, we could save the astronauts the danger of EVA.

Now what are some advantages of having robots instead of humans performing EVA's? Robots don't need spacesuits. Robots don't need to spend a lot of time in preparation for EVA. If a meteoroid penetrates through the metal, the robot would not die, but instead be repaired. If a robot gets too far away from the spacecraft, it can be brought back by smaller jets, or it could be let to burn in the Earth's atmosphere.

NASA and other space agencies are currently working on a similar project called the "Robonaut" (check the 1999 article by SpaceDaily at http://www.spacedaily.com/spacecast/news/robot-99h.html). This is basically a robot that will replace humans in EVA's. Unfortunately, there is not enough information given to the public about this robot.

A few people would argue that robots couldn't replace humans, because of the complexity of human chores. The shuttle arm and the new arm on the future ISS are two robotic components that prove that robots can replace humans in some chores. Can we make these components a little bit smaller and make them detachable, and help protect our astronauts from the long EVA repair missions?

What will be the role of astronauts then? Astronauts could, besides doing various scientific and technological experiments on board of the spacecraft, control the robots from inside the protected environment. Also, if there are situations that robots cannot handle, humans can always handle them.

The Recluse

Chapter V: Vacuum

Rich Reifsnyder

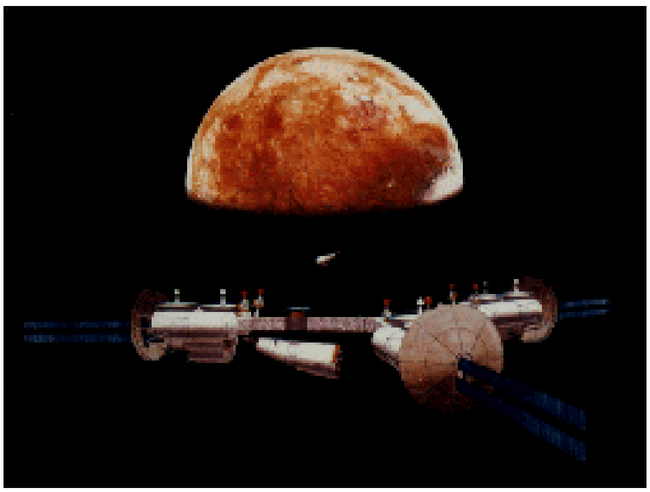
"Warning: depressurization. Air pressure at 68% of normal…"

Murphy's Law states "Anything that can go wrong, will go wrong." Jason Blake was discovering that the hard way: though the odds against it happening on his voyage were several thousand to one, a meteoroid had breached the hull of his fragile capsule. He had less than thirty seconds to don his spacesuit before the reduced pressure would pull the air out of his lungs.

His first reaction was to hyperventilate, to saturate his blood with oxygen while he still could. It would be impossible to hold his breath in once the cabin was in vacuum. To the side of the cockpit seat was his spacesuit.

He grabbed the pants, and slapped the buckle of his safety belt to free himself from the seat. The suit was made of spandex, which provided skintight pressure and was safer than the balloon suits NASA used to hold in an atmosphere. He tugged hard on the suit; the legs of his sleepwear bunched up painfully around his shins.

He grabbed the upper garment, which for safekeeping had the helmet already latched in place, and as he slipped it on he found it more and more difficult to breathe. Finally he sucked in as much air as possible, held it for several seconds, and forced it out explosively. He could no longer breathe.



He prayed that the backpack with the two oxygen tanks was full. He couldn't remember whether he had checked it after his last EVA. His throat was constricting; he couldn't even gasp. He shut his eyes to prevent them from rupturing and fumbled around for the rigid tube that connected to the oxygen tank. He guided it into the valve over his neck.

The blast of cold oxygen burned his throat but soothed the pressure in his lungs. "Warning: depressurization. Air pressure at 7% of normal," chanted the computer over his suit radio. His task now was to find the leak in the hull and seal it.

He suddenly became aware of a new kind of pressure. He thought at first it was a heart attack, but then realized that, in the reduced pressure, the small amount of nitrogen in his blood was bubbling and vaporizing in his blood vessels. It was the bends.

He could barely move his fingers, and the pain was spreading to his chest, stomach, legs, and even his neck. With this sort of pain he would only have a few minutes to seal the leak before he blacked out, not the hours afforded him by the oxygen tanks.

He opened a closet and picked out one of his books. His fingers were on fire as he grabbed the pages of the books and ripped them out. He let them drift in midair and hoped they were large enough not to clog the air ventilators.

He found another spacesuit oxygen tank and opened the valve full blast. Then he held it toward the wall, so that the air would fill the room without whipping the pages around. As he watched, the paper flapped in the breeze, but several sheets were converging at a point near the hatch. They slapped into the hull, and then a hole a few centimeters in diameter was ripped in them.

Blake closed the oxygen valve, located the hull repair kit and drifted over to the leak with the kit and the oxygen tank. He pulled the paper away, and stuffed it through the hole, one page at a time, so he could be rid of them. He rummaged through the repair kit and found a single disc patch. It was an insulation-filled wheel of carbon fiber, ten centimeters in diameter and a centimeter thick. He sprayed epoxy in a ring on one surface of the patch using a squeeze tube, and a layer of binder in a ring around the little hole in the hull. He pressed the disk in place.

Then he opened the oxygen valve yet again to partially pressurize the cabin. The pressure, with any luck, would hold the disk in place. He sprayed epoxy around the edge of the patch and then a layer of insulation foam. He waited for two minutes, the pain in his joints throbbing.

He wasn't sure if the epoxy was dry but couldn't stand it any longer. He sailed through the ship turning the ventilators back on to flood the cabin with fresh oxygen and nitrogen. Soon he could hear the computer calling its notices from outside is helmet in addition to the suit radio: "Air pressure at 90% of normal. Air pressure at 95% of normal. Air pressure normal."

He took off his helmet and inhaled deeply. The pain in his joints had diminished to a dull ache. He inspected the patch, carefully prodded it to see if the epoxy had bonded.

He heard the radio chime; it was a call from Mission Control. "Jason, please report in! We've just received a broadcast that you're losing atmosphere. Please report in so we can advise you on the solution."

Blake smiled, then broke out into raucous laughter. "Don't worry about a thing, MC, the situation is under control." He had performed the first spacecraft repair without Earth ground support in human history.

With only one month to go in his interplanetary voyage, he knew he would enjoy smooth sailing.

To Be Concluded…

Mars Q&A

Q: In Moore's book "Atlas of the Universe," while discussing Martian surface features, he states: "Whether there is any active volcanism going on now [on Mars] is a matter of debate." I had always taken for granted that all Martian volcanoes were dormant. Is there any evidence of active volcanism on Mars today? - Nathan Johnson

A: There is no evidence for currently active volcanism on Mars (which would require us to see an actual erruption), however, there is evidence for recent activity. Some volcanoes have lava flows that seem to be quite recent. This does seem to point towards the idea that volcanism on Mars is dormant and not extinct. - Margarita M.

The Mars Society Youth Chapter was created to provide Youth the opportunity to become more involved in the Mars Society and other Mars-related issues, and to provide a more effective outreach effort to other Youth. http://chapters.marssociety.org/youth/

The Mars Society is an international non-profit organization committed to furthering the goal of robotic exploration and human settlement of the Red Planet. www.marssociety.org