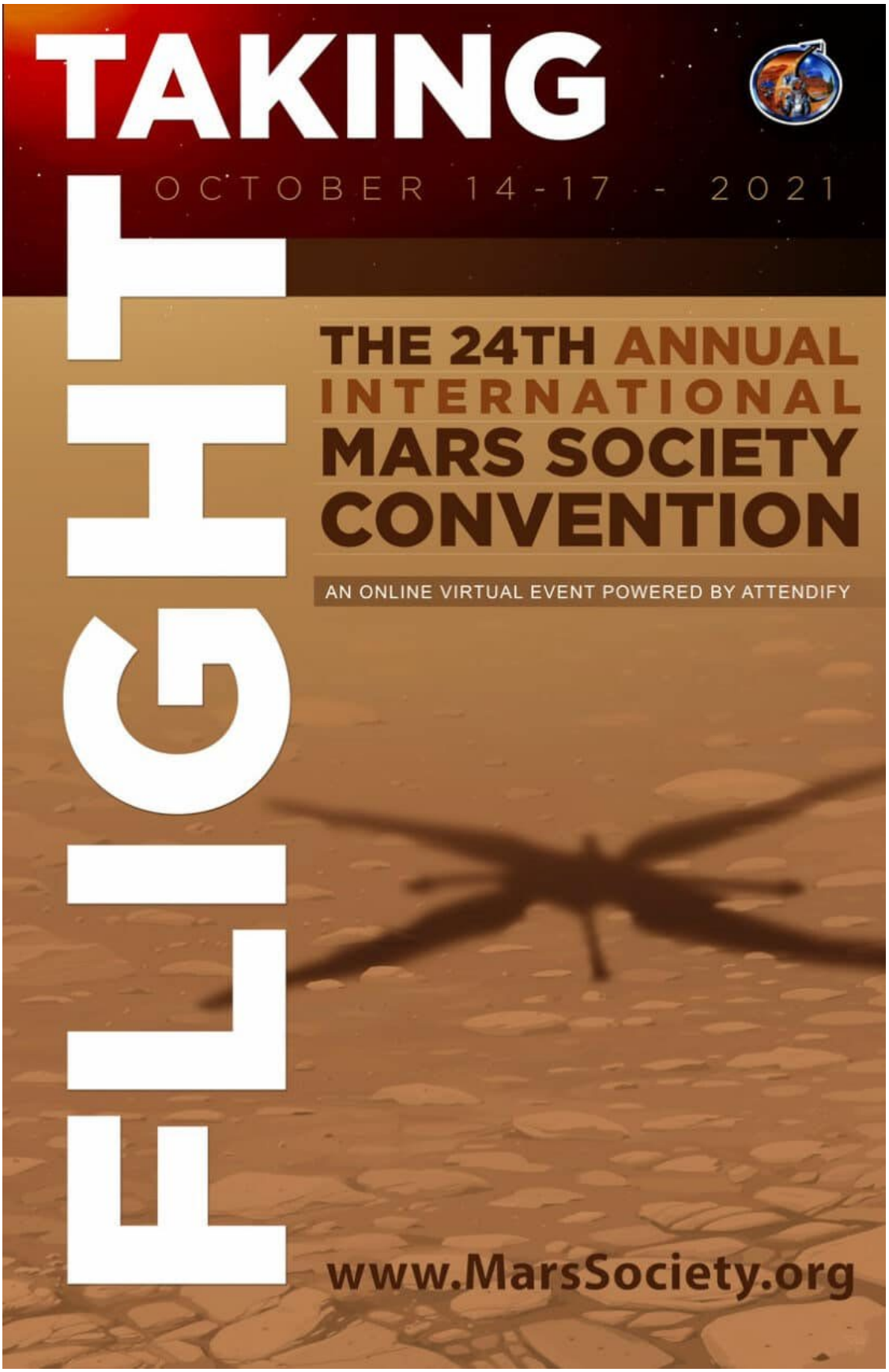
TAKING
FLIGHT
OCTOBER 14-17 - 2021
THE 24TH ANNUAL
INTERNATIONAL
MARS SOCIETY
CONVENTION
AN ONLINE VIRTUAL EVENT POWERED BY ATTENDIFY
www.MarsSociety.org

All Times PDT	Thursday October 14th			
	Morning Plenaries			
9:00 AM	Dr. Robert Zubrin, President, The Mars Society - Reaching Mars this Decade			
9:30 AM	Bruce Banerdt, NASA JPL - Mars InSight Mission Update			
10:00 AM	Omran Sharaf, Project Manager - UAE Mars Hope Mission Update			
10:30 AM	Vera Mulyani, CEO & Founder, Mars City Design - The Future Alchemists			
11:00 AM	Dr. Nathaniel Putzig, Planetary Science Institute - Exploring for Underground Ice on Mars			
11:30 AM	Dr. David Poston, SpaceNukes - Space Nuclear Power			
12:00 PM	Dr. Karl Stapelfeldt, NASA Scientist - Search for Exoplanets with Telescopes			
12:30 PM	Alfredo Munoz - Digital twins of Martian Cities as a new frontier for Space Analogs			
	Afternoon Sessions			
	Tech A	**Tech B**	**Medical**	**Outreach**
2:00 PM	TA-1 Raymer: The Raymer Manned Mars Airplane		MD-1 Squire et al: Induced Torpor and Advanced Propulsion Systems	O-1 Gathu: Space Boot Camp (A Novelty Space Project)
2:30 PM	TA-2 Ng et al: Martian Biolith: composite for closed-loop manufacturing	TB-2 Hussain: Investigating possible water activity on Mars using Earth volcanos		O-2 Friedman: The Science Fiction connection to Mars
3:00 PM	TA-3 Phillips: Mars Transit Direct	TB-3 Lehmitz: Green Dreams: The value of plants beyond the greenhouse.	MD-3 Marggraff: Countermeasure to Reduce Isolation during Long-Duration Missions	O-3 Calanchi: A Martian Literary Project: Mission 1/2021, Unveiling a Parallel
3:30 PM	TA-4 Peláez-Fernández: The role of AI in the space industry and Mars	TB-4 Krishna et al: Rovers and Evidences of Life on Mars		O-4 Kaufman: Colonizing Mars: What Does the Average Person Believe

4:00 PM	TA-5 Parks: Five Ecological Principles for In Situ Resource Utilization	TB-5 Gurrea: Update on Mars Direct 3.0	MD-5 Sridharan et al: Mars and COVID-19: The psychological effects	O-5 Ebenbach: The Role of Science-Fiction in Reaching Mars Successfully
4:30 PM	TA-6 Behrens: The Critical Mission Sequence for Mars	TB-6 Bai: Mars Global Power Grid - Offering Sufficient Energy	MD-6 Gilkar: Kymira: Astronaut Physiological Health Monitoring Using Smart Underlayer Garment	O-6 Melton: Why Become a Mars Society Ambassador?
5:00 PM	TA-7 Nagesh: Settlement & Life Support Using In-Situ Resources	TB-7 Morley/Bowen: Borebots: Unlocking Subglacial Lake Access in Mars South Pole	MD-7 Avinav: Neurosurgical procedures possible to carry out in space	O-7 Barboza: Training High School Tiger Teams for Simulated Mars Missions.
5:30 PM	TA-8 Plata: The InstaBase Concept	TB-8 Sridharan: Technology-enabled Robotic Exploration (TREX)	MD-8 Sarmiento et al: Microalgae: protein and antioxidants for food and oxygen	O-8 Letherwood: The Mars Leap- An immersive Mars museum
6:00 PM	TA-9 Plata: Design Choices for the GreenHab	TB-9 Gaviraghi: The martian global city as the first ecumenopolis	MD-9 Dubé: The case for Space Sexology	O-9 Pass: Expanding the Scope of Astrosociology in Order to Settle Mars
6:30 PM	TA-10 Ford: Silkworms as an Industrial Organism for Martian Biosystems	TB-10 Nagesh: Conceptual Design Of Martian Habitat And Life Support System Using In-Situ Resources	MD-10 Elavarasan: Synthetic Biology for Gene editing of edible plants	O-10 Barboza: Can we grow food using Martian soil?
7:30 PM	**Break (7pm - 7:30pm)**			
	Thursday Evening Program			
	Panel - China's Space Program: The View from China (Moderated by Angela Cui - Director, Mars Society China)			
8:30 PM	How China's exploration ambitions are helping to shape the future of future of Mars exploration Dr. Joseph Michalski, Laboratory for Space Research, The University of Hong Kong			

2021 Mars Society Convention Schedule

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THURSDAY SESSIONS

Tech A-1: TA-1
The Raymer Manned Mars Airplane

Daniel Raymer

Conceptual Research Corporation

If national governments and certain billionaires have their way, humans will reach Mars sometime in this century and set up permanent bases. Eventually they'll need a way to get around. This paper describes the conceptual design and analysis of a manned Mars airplane configured for exploration, research, cargo transport, photography, and the linking of multiple settlements. Design development is being done by an international team of volunteers based on the configuration concept developed by lead author Dr. Daniel P. Raymer and incorporating rocket propulsion concepts suggested by James French.

A two-man vehicle was developed based on overall requirements similar to the capabilities of the classic "Jeep" of WWII fame, namely a crew of two plus cargo to a total of 500 lbs, carried at least 260 nmi. It is assumed that the flight control system will be capable of fully autonomous operation when desired and that when carrying humans, they need not be trained pilots. VTOL operation is assumed due to the deplorable lack of paved runways on Mars. Results to date indicate that, with sufficiently advanced technologies, such a manned Mars airplane should be feasible.

The configuration presented herein seems viable ("existence proof") and the analysis to date indicates that it would work and will provide the range and payload capability desired. Now we Just need people living on Mars to need it.

(This presentation will be an update of Dr. Raymer's AIAA SciTech 2021 paper)

Tech A-1: TA-2

Martian Biolith: composite for closed-loop manufacturing

Shiwei Ng, Stylianos Dritsas, Javier G. Fernandez

Singapore University of Technology and Design

Given plans to revisit the lunar surface by the late 2020s and to take a crewed mission to Mars by the late 2030s, critical technologies must mature. In missions of extended duration, in situ resource utilization is necessary to both maximize scientific returns and minimize costs. While this presents a significantly more complex challenge in the resource-starved environment of Mars, it is similar to the increasing need to develop resource-efficient and zero-waste ecosystems on Earth. Here, we make use of recent advances in the field of bioinspired chitinous manufacturing to develop a manufacturing technology to be used within the context of a minimal, artificial ecosystem that supports humans in a Martian environment.

By using simple chemistry and chitin (a biopolymer that is likely to be part of any biological based artificial ecosystem) in varying ratios with martian regolith simulant, we developed a material that is available in an resource scarce environment of Mars.
Without the need for high temperature or pressure, we demonstrated the viability of material to use in a wide range of applications; from casting a tool of practical utility to additive manufacturing of a scaled martian habitat model.

Tech A-1: TA-3

Mars Transit Direct

Darian Phillips

Space Advocate

Mars Transit Direct utilizes an Interplanetary Transit Vehicle, ITS, aka the Hermes, which shuttles to and from LEO to Mars Orbit. Since it remains in orbit, size and weight can be dramatically increased, compared to that of a payload launched from the ground. It consist of, from fore to aft, an IDA port (modified Bigelow Galaxy), Dynasty (modified ISS Destiny, w/Flight Deck, Galley & Lounge), workout room (modified Bigelow Sundancer), V Truss w/5 State rooms (modified Bigelow BEAM), bathroom (modified Bigelow B330), science lab and storage room (modified Bigelow Genesis I & II). Last at the rear, 2 docking ports for lander (SpaceX Red Dragon) and MAV (modified Zubrin's Mars Direct ERV), with each port and module on opposite axis. Fuel tanks will be mounted about the longitudinal axis extending after approximately 800ft. The dry weight is approximately 2 million lbs. 40-50 SpaceX Raptor engines will be utilized for power. With fuel the wet weight is approximately 30 million.

Tech A-1: TA-4

The role of AI in the space industry and Mars

Miguel Peláez-Fernández

Science Club International

An intense presence of human activity on Mars will depend on multiple factors. Most of them are economically driven. We know that Artificial Intelligence is driving a lot of traction in business and it is by nature a toolbox to create automatic spaces. In this sense, AI will play a fundamental role on the Mars goal in multiple phases.

We will review those phases where the AI industry will have a meaningful impact. Going from the current impact to the space industry, to the role that it will play on interplanetary trips, and how it will look like to implement AI solutions on Mars.

Tech A-1: TA-5

Five Ecological Principles for In Situ Resource Utilization

John Parks

Tetra Tech

As humanity prepares to depart Earth during the next two decades in order to visit and eventually permanently colonize the wider solar system, governments and private industry currently are looking to Mars as an initial interplanetary settlement target. A critical component of settling and permanently inhabiting Mars by 2050 will be sustainable in situ resource utilization (ISRU). This will include a strategic and targeted transformation of Martian ecology in order to bioengineer the biophysical and geochemical environment to make planetary conditions more suitable for human adaptation. Fortunately, a wealth of past experience and investment in managing Earth's natural resources provides humanity with the opportunity to learn from, apply, and adapt internationally-accepted sustainable development principles in the context of interplanetary colonization, starting with Mars. Specifically through the lens of sustainability relating to natural resource extraction, management, and transformation on Mars, there are five key principles to be applied relating to colonization and ISRU: taking an ecosystem-based approach to management; the role of r/K selection for succession; the application of intermediate disturbance regimes to maximize introduced species diversity and fitness; consequences of genetic drift and inbreeding due to insufficient and fragmented terraformed habitat; and interplanetary adaptation of landscape ecology theory. Each of these key principles will be discussed with recommendations for their adaptation and application within the context of ISRU on Mars. Successful adaptation and application of these natural resource management principles from Earth will not only increase the likelihood of successful and sustainable colonization, but also help to expedite the necessary ecological transformation and bioengineering that will be an inherent and unavoidable aspect of terraforming Mars with maximum consideration given to ecological integrity and conservation while minimizing human conflict relating to natural resource scarcity, competing ISRU objectives, and incompatible extractive agendas.

Tech A-1: TA-6

The Critical Mission Sequence for Mars

Chris B. Behrens

The popular conception of Mars exploration missions are Apollo-driven – plant a flag, collect some rocks, and come home. But physics, chemistry and economics drive these early missions in a way that is not immediately obvious. In order to pave the way for future missions, early missions must accomplish key milestones in a critical sequence akin to revealing cards in solitaire. Without these milestones, subsequent missions will have drastically reduced payloads and be greatly more expensive.

As Dr. Zubrin outlined in The Case for Mars, the key to Martian exploration is in-situ resource production, both oxygen and propellant. Unlike with lunar missions, the physics of a Martian mission preclude carrying enough propellant to return to Earth, at least according to the practical limitations of the technical stacks in place today. Clearly, producing it using Martian resources will be cheaper, if possible.

Propellant is fuel and oxidizer. The leading fuel candidate for this process is simple Methane, CH4. The reaction is simple – hydrogenate Carbon Dioxide. Indeed, if you leak hydrogen gas into the raw Martian atmosphere, you'll get methane, and detection of methane on the surface of Mars is thought to be attributable to hydrothermal and volcanic activity on Mars. Carbon Dioxide, we have in abundance – this is the primary constituent of the atmosphere of Mars. Hydrogen is the problem. The only practical source of hydrogen on Mars is water, which also produces the oxidizer portion of the propellant. While early missions may transport their own hydrogen feedstock, establishing a reliable water source at reasonable scale will be a mission imperative. This sequence will mandate mission aspects such as strong and oriented astronauts on day Mars landing plus one, and the power requirements for the tech stack cast doubt on solar power as the solution.

Tech A-1: TA-7

HUMAN SETTLEMENT AND LIFE SUPPORT SYSTEM ON MARS USING IN-SITU RESOURCES AND MAKING LIFE MULTI-PLANETARY

Anand Nagesh

VTU

The next logical step for Mars exploration is the permanent settlement, where crews that go to Mars stay and build a new society. We are taking the first steps now, but there are major problems. A critical element of planning human settlement missions on Mars involves life support systems. The requirements for air, food, water, and waste disposal materials total well over 100 metric tons and possibly as much as 200 metric tons. Recycling and possibly in-situ utilization of indigenous resources on Mars and therefore enabling critical capabilities for self-dependence. Our report is based on a design of a preliminary Martian base as a permanent colony for 110 people and its subsystems as efficient, economical, and practical as possible with current technologies known to mankind.

The purpose of this study is to find solutions to the problems faced by encouraging colonization on Mars. The life-support system playing a vital role in colonization has various major problems. Using a cross-sectional analysis, this study analyzed methods to collect water, farm (using hydroponics, aeroponics, and opaline silica harvesting), and generate oxygen from different sources.

Today we implement our knowledge of stars and planets not only in the educational field but in life space science. If the results of this paper are confirmed by further research, a herculean task requiring monumental effort will instead become a difficult but surmountable engineering challenge. In this paper, all these methods will help in creating a great impact to solve the Problems faced during the colonization of Mars.

Keywords: Space Life Science, Future exploration, Mars Settlement, Domes, Life Support System

Tech A-1: TA-8

Design Choices for the GreenHab

Doug Plata

The Space Development Network

The GreenHab is conceived of as a large module of an even larger, inflatable InstaBase. The Space Development Network's Agriculture Working Group (AgWG) recently determined the design parameters of the GreenHab. This presentation will describe the options and why the Group made the particular choices that it did. This includes: The GreenHab's size, radiation shielding, thermal management, lighting for growth, configuration of the plants, in situ soil versus hydroponics, aquaponics, and waste management. This presentation will also describe the agricultural process and the role of (tele)robotics. Finally, a brief overview will be given on our thinking about aspects of nutrition, food processing / labor, and the culinary arts.

Tech A-1: TA-9

The InstaBase Concept

Doug Plata

The Space Development Network

The InstaBase concept is for a large, unified, inflatable base with all the components necessary to support an Initial Crew of eight. The significant advantages of inflatables over rigid or 3D-printed habitats will be explained. The risks involved with inflatables will also be addressed. The layout of the InstaBase will be shown with a more detailed explanation of each module. The InstaBase would be rapidly set up and shielded (tele)robotically just prior to crew arrival. The possibility of a vinyl InstaBase as part of an analogue base will be proposed. Finally, a video tour of a full-scale mock-up of the InstaBase will be shown.

Tech A-1: TA-10

Silkworms as an Industrial Organism for Martian Biosystems

Stellie Ford

Mars Society of Philadelphia

Early in human civilization, silkworms carved out their niche in the luxury and consumer goods industries. Silkworms persist as a humble industrial commodity, but researchers have begun to tap into their potential for high volume bioproduction. By understanding their biological features and investing in the development of key protocols, we can make silkworms a valuable part of the Martian biosphere.

Silkworms have a 2-3 month life cycle once hatched and they subsist solely on a diet of mulberry leaves. Shelf stable mulberry powder offers a cheap and dense feeding solution for early settlement and a buffer to agricultural production. Their eggs overwinter and are thus well suited for long duration space flight. Once hatched only one generation is needed to establish a self perpetuating breeding cycle. From here the true potential of silkworms emerges.

At a baseline, sustained production of silkworms as an industrial commodity can meet a significant portion of a colony's soft goods demand. They also provide a high protein food source and a layer of biofiltration for aquaponics. Transgenic silkworms go further and offer a platform for the large-scale bioproduction of known, perishable consumables like collagen [A], vaccines [B], antibiotic dressings [C], and recombinant immunotherapeutics [D]. More broadly silkworms serve as a model organism for biological research [B, E], furthering the ability of colonists to advance research in fields adjacent to colonization.

Regardless of what systems we use, as future Martians we will need to balance our use against the strength of the systems that support it. The humble silkworm continues to provide robust value after centuries of competition and by incorporating it into the Martian biosphere we can hope to join it on its journey.

Tech A-2: TB-1

Martian Cast Iron Habitat Pressure Hulls

Ben Smith

Lunar Homestead

The most critical component of any off-Earth settlement is the pressurized habitat hull. Sure, a functioning settlement needs lots of other technology, but no pressure hull equals no people. And you can't have a settlement without people. Besides, we need a cool container to put all the other nifty gadgets into.

Habitat pressure hulls must be made from locally available materials using locally constructed equipment. Any settlement reliant on Earth for the resources and/or technology needed for habitat construction is at extreme risk and far from sustainable. Fortunately, Martian Homesteaders will have relatively easy access to significant amounts of iron in the form of abundant iron oxides in the surface regolith, as well as potential basalt resources beneath the regolith. Additionally, the technology required to extract the iron and form it into pressure hulls should be simple enough to be manufactured locally, allowing the Homestead to accelerate its expansion. However, we still need to do a lot more research before we have functioning prototypes.

This presentation outlines why iron is the obvious choice for Martian settlement construction and the advantages of cast Martian iron over other construction materials and techniques. It also covers how we would use cast iron to create components and pressure hulls. Finally, this presentation explains some of the research needed to determine if this is a viable option for settlement construction and how anyone can help.

Tech A-2: TB-2

Investigating possible surface liquid water activity on Mars using Earth-based Mud Volcano analogues.

Muhammad Mehdi Hussain

Dr Muhammad Akbar Hussain

Mareekh Design

Mars has long been considered a dead world with no liquid water on or near its surface. It is a cold, dry and frigid world. The old adage of 'follow the water' makes us think that if any life ever existed on Mars, it would be fossilized in dry lake beds, frozen in time for millions, even billions of years.

Mareekh Design team is studying the dark streaks on the slopes of Martian landscapes found in recent satellite imagery. While theorized as possibly being dry sand avalanches, we find stark resemblance of many of these streaks to the mudflows emanating from the vents in the mud volcano fields in Balochistan province of Pakistan. These mudflows composed of brine mixed with fine clay, ooze out with methane pressure and flow downhill on the surface until eventually drying out.

Could the same mechanism be going on, on the surface of Mars? Mars seems dry, yet it locks oceans worth of water just underneath its surface in the form of permafrost. While it is not known if Mars has any current volcanic activity below its crust, there is evidence suggesting existence of areas with fairly recent volcanic activity. We believe it is possible that the trapped heat and pressure from intermittent underground volcanic activity and gravitational forces may be causing occasional melting of water in the permafrost, which, combined with fine Martian regolith and possibly methane, may burst out occasionally to the surface appearing as dark streaks before drying out. This may be analogous to the mud volcanic activity in Balochistan and other places on Earth. If this is true, it will not only be an exciting discovery of the existence of liquid water on Mars on or near its surface, but also increase the prospects of finding life on the red planet.

Tech A-2: TB-3

Green Dreams: The value of plants beyond the greenhouse

Matthew Lehmitz

University of Wyoming

One of the primary goals of the myriad space analogs that are continuously running on Earth is to find better ways to help people work through the difficult emotional and psychological elements of living in tight spaces away from the larger world. One of the best ways to do this is by adding plants inside the living areas. Having plants in the living areas can provide a healthful effect and literally bring the quarters to life. Much the same as is done on a regular basis with buildings worldwide. Bringing more living things in from the greenhouse provides a variety of benefits to general health and improved living and should be considered for any future extraterran habitation.

Tech A-2: TB-4

THE FIRST MARTIANS – A BRIEF REVIEW ON MARS ROVERS AND EVIDENCES OF LIFE ON MARS

K M ADITHYA KRISHNA

HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

The possibility of life on Mars has attracted the interest of scientists for many years. One of the major reasons for this concern is due to the similarity and proximity of the planet to our Earth. Mankind has launched dozens of missions to Mars to find out more about our planetary neighbour. Among them are rovers equipped with special tools to study the chemical and physical composition of the Martian surface and atmosphere. In 1997, Sojourner became the first rover to autonomously drive on Mars. Later, in 2004, the twin robotic geologists named Spirit and Opportunity landed on opposite sides of the red planet and carried out field geology and atmospheric observations. In 2012, Curiosity was set out to determine whether the Planet had the conditions conducive to the survival of microbes. Similarly, Perseverance which landed in February 2021, is currently in search of signs of ancient life. The youngest member of the rover family, Zhurong landed in May 2021 is currently investigating the geology and rocks and minerals of Mars. With the knowledge we have obtained from these rovers, we have made a slew of fascinating discoveries that support a high probability of past and current life on Mars. Thus, in this unifying context, the current work provides a brief review on the Martian Rovers and summarizes the evidence associated with the existence of First Martians (i.e.) the possibility of living organisms existence on Mars obtained from these rovers. It is certain that Mars keeps throwing out new enticements with every touchdown of rovers and that we still have a lot to find out about this amazing planet and its extreme environments.

Tech A-2: TB-5

Update on Mars Direct 3.0

Miguel Gurrea

The Mars Society Spain

This is a follow up on the presentation made last year at the conference, which was well received By the audience including Dr. Zubrin and others.

Mars Direct 3.0 inherits the name and some ideas (such as the Mini-Starship) from Dr. Zubrin's Mars Direct and Mars Direct 2.0 architectures. Then, in combination with new concepts and ideas, it attempts to design the safest first crewed Mars mission that establishes the founding stones for a flourishing Mars base.

This architecture makes use of both Starship and Mini-Starship, taking advantage of Starship's massive payload capacity and Mini-Starship's lower fuel production needs, as well as proposing a new method for landing the crewed Mini-Starship on Earth.

But perhaps one of the most (if not the most) appealing advantages is the overall safety of the mission, with multiple contingency plans in case a variety of failures or dangers occur. This Includes a global dust storm using only solar panel technology.

Last year's presentation can be found here: https://www.youtube.com/watch?v=bS0-9BFVwRo

The presentation will include updates and changes based on feedback and update on the state of the Mars Direct 3.0 paper that will be submitted for publication at a later date.

Tech A-2

TB-6. Mars (Global Power) Grid - Offering Sufficient Energy

Jianlong Bai

CSSC-XD

"Series of Independent Survival on Mars", the author's planning to publish here, and the beginning, Part 1 - Energy Solution is particular for this year's conference. The abstract: Quite a few problems have to be encountered by the colonists on other planets. The primary is Energy, which is the foundation of survival, not like on Earth "food just enough for survival", there is no sufficient sunlight on Mars. So this paper gives the energy solution: devices of energy collection and Multi-function Energy Storage are integrated into a global power grid of Mars; the decisive technology - Converter-train has been offered by the author; at the same time, transform-set has been proposed to constitute AC local smart grid (or sub-grid) for Mars' community. Converter-train can realize dozens of MV extremely high voltage transmission; A conceptual design of the upgraded wind power plant will include the energy collection ability of wide wind speed range; Energy storage will balance the grid power supply-demand. And via integrating transform-set technology with them, all the devices can provide inertia to stabilize AC local smart grid. With Mars Power Grid, sufficient even surplus power can be provided for cooking and heating, planting and even stockbreeding, transportation, industry, etc. Then it will realize colonists self-sufficient totally on Mars.

Tech A-2: TB-7

Borebots: Unlocking Subglacial Lake Access in Mars South Polar Layered Deposits

Quinn Morley
Tom Bowen

Planet Enterprises

It is now believed that subglacial liquid water exists on Mars, at a depth of 1.5 km in the South Polar Layered Deposits (SPLD). This evidence was published by Orosei et al. in 2018, and immediately sent reverberations through the aerospace community. Chris McKay, Senior Scientist for the NASA Ames Research Center was heard on the Planetary Radio podcast saying: “If we’re going to do astrobiology, we need to not just see it, we need to get a piece of it, we need to get a sample of it. So I think this becomes a very strong argument for deep drilling.” Prior to this discovery, the SPLD was already one of the most scientifically significant formations on Mars, having witnessed atmospheric and climatic changes dating back to 4 billion years. There is currently no deep drilling system ready to take on this task, with the technology leader (the InSight HP3 “mole” probe) stuck just centimeters under the ground. Furthermore, there are no autonomous deep drills currently above TRL 4 in the NASA technology pipeline. Planet Enterprises proposed and received a NASA Innovative Advanced Concepts grant to study an autonomous drilling system that would utilize a Perseverance-type rover as a drill rig. The rover would be outfitted with minimal but appropriate science instruments, and a drilling strategy that has a high level of redundancy. The drilling strategy does not rely on cables; instead, self-contained robots drive up and down the borehole autonomously. These robots are nicknamed “borebots" and are about 1 meter long. Locomotion is achieved using a rubber tank track system that presses against the sides of the borehole. Around a dozen borebots could work in sequence to perform deep drilling work, using the rover as a service station, home base, and science laboratory.

Tech A-2: TB-8

Technology-enabled Robotic Exploration (TREX)

Dharshun

Sridharan

Piston Labs

“About six years from now”. This was Elon Musk’s response in 2020, when queried as to when SpaceX wsa likely to land humans on Mars.

“One Hundred Percent”. That is the total area of Mars that has been mapped. For contract, just under a quarter of the world’s oceans have actually been mapped on Earth.

“Mars is entirely inhabited by Robots”.

What this highlights is an ever-increasing emphasis for humanity to invest in its curiosity, and ultimately achieve the complex goal of colonizing and settling on Mars.Curiosity is the magical word. Humans are built with an inherent curiosity-complex. It is almost like humans are hardwired to be curious. However when it comes to Mars, curiosity may actually be lethal as there are still a number of unknowns. And the biggest risk is realized when exploration of the planet is considered. Luckily, there are technologies that may de-risk “curiosity”-driven activities. Specifically, what is meant by this is to introduce a new Robotic Paradigm where one can converge the technologies of Terrestrial Networking Capabilities, Internet of Things, Virtual and Augmented Reality, together with Artificial Intelligence-enabled Robots to do much of these activities, delivered through an Avatar delivery mechanism. Whilst the capability may not exist at this point in time, the component technologies do and are maturing every day.

This paper looks to introduce, explore and design a conceptual technology-enabled architecture of the future robot for exploration of Mars. With recommendations on how this technology can not only de-risk “curiosity”-driven activities on Mars itself, but also how it can benefit the Earth as we know it.

Tech A-2: TB-9

The martian global city as the first ecumenopolis

Giorgio Gaviraghi

Universidade Federal do Mato Grosso

Ecumenopolis (from Greek: oecumene, meaning "world", and polis "city", thus "a world city"; is the hypothetical concept of a planet wide city. The word was invented in 1967 by the Greek city planner Constantinos Doxiadis to represent the idea that in the future urban areas and megalopolises would eventually fuse and there would be a single continuous worldwide city as a progression from the current urbanization, population growth, transport and human networks. While such concept has been widely utilized in science fiction (Asimov, Star Wars etc), it is currently happening in our planet, at least from the point of view of communications, our planet is a virtual global city, being accessible to everybody from anywhere. In the near future, it may be possible that the first ecumenopolis will be on planet Mars. In effect several outposts, bases and settlements , by different organizations will be built on \Mars, some will be specialized for availability of resources such as water or other minerals. Others due to more favourable climate, or accessibility from space , others due to different nations willingness to create their individual martian cities. While physically it may not be possible to connect them all, they will certainly be virtually connected and integrated in a functional relationship network between them due to the number of commonalities, limitations and problems that they are sharing together . In this paper we want to analyze their differences, their features and their relationship in view of a future martian colonization development that may prove easier if a cooperation between initiatives and urban planning is implemented , avoiding useless duplications and locating different functions and infrastructures in the most convenient locations in a general martian Master Plan.

Tech A-2: TB-10
Conceptual Design Of Martian Habitat And
Life Support System Using InSitu Resources
Anand Nagesh

Humanity has explored Mars since 1960, and we've never been closer. The next logical step for Mars exploration is the permanent settlement, where crews that go to Mars stay and build a new society. We are taking the first steps now, but there are major problems. It seems to believe that mankind is worth saving and the best way to do that is by spreading ourselves out rather than relying on one planet that could kill us all if we're not careful. Also if we can terraform mars then it'll teach us how to restore the earth to a friendlier state. A critical element of planning human settlement missions on Mars involves life support systems. The requirements for air, food, water, and waste disposal materials total well over 100 metric tons and possibly as much as 200 metric tons. Recycling and possibly in-situ utilization of indigenous resources on Mars and therefore enabling critical capabilities for self-dependence.

This report is based on a design of a Martian base as a permanent colony for 110 people with its subsystems as efficient, economical, and practical as possible with current technologies known to mankind. The purpose of this study is to find out the solutions to the problems faced by encouraging colonization on Mars.

Medical: MD-1
Radioprotective effects of induced astronaut torpor and advanced propulsion systems during deep space travel

Tim Squire
Alexander Ryan
Samuel Bernard

Townsville University Hospital

Objectives.
1. Investigate how the circadian clock and body temperature may contribute to radioprotection during human torpor on deep space missions.

2. Estimate radiation dose received by astronauts during a transit to Mars with varying propulsion systems.

Methods.
We simulated three types of conditions to investigate the potential radioprotective effect of the circadian clock and decreased temperature on cells being exposed to radiation such that may be the case during astronaut torpor. These conditions were: Circadian clock strength: strong vs weak, Light exposure: dark-dark vs light-dark cycle and Body temperature: 37C vs hypothermia vs torpor. We estimated transit times for a mission to Mars from Earth utilizing chemical, nuclear and electrical propulsion systems. Transit times were generated using the General Mission Analysis Tool (GMAT) and Matlab. These times were then input into the National Aeronautics and Space Administration (NASA) Online Tool for the Assessment of Radiation In Space (OLTARIS) computer simulator to estimate doses received by an astronaut for the three propulsion methods

Results.
Our simulation demonstrated an increase in radioprotection with decreasing temperature. The greatest degree of radioprotection was shown in cells that maintained a strong circadian clock during torpor. This was in contrast to relatively lower radioprotection in cells with a weak clock during normothermia. We were also able to demonstrate that if torpor weakened the circadian clock, a protective effect could be partially restored by an external drive such as lighting schedules to aid entertainment i.e.: Blue light exposure for periods of awake and no light for rest times. For the propulsion simulation, estimated transit times from Earth to Mars were 258 days for chemical propulsion with 165.9mSv received, 209 days for nuclear propulsion with 134.4mSv received and 80 days for electrical propulsion with 51.4mSv received.

Medical: MD-2

Modeling the effect of curcumin on cancer and healthy breast cells under Martian surface radiation conditions

Siddhant Sharma
Busra Elkatmis
Brooke Carruthers
Jéssica Carneiro

Blue Marble Space Institute of Science

Radiation can induce tumorous growth formation but treatment with radiotherapy in breast cancer cell lines such as MCF-7 has demonstrated a reduction in cancer cells. Similarly, bioactive compounds such as curcumin have been shown to slow the development of breast cancer. In this study, we review the current biochemical understanding of curcumin as it pertains to the treatment of breast cancer treatment and propose a computational model to predict and elucidate the effects of curcumin on cancer and healthy breast cell lines under conditions induced by radiation on the Martian surface. In our proposed model, we will be utilizing computational modeling to analyze the expression of WTH3, a gene known to inhibit cell proliferation via the activation of tumor suppressor genes and is differentially expressed in cancer and normal breast tissue. The aim of this work is to compare the level of expression of the WTH3 gene in healthy cancer cells and MCF-7 under radiation conditions on the Martian surface. To analyze this differential expression between the MCF-7 cell lines and under radiation conditions, we propose the use of RNA-Seq technology and DesSeq2, observing the up or down-regulation of WTH3 gene expression with the workflow. Further computational modeling of a multicellular system to simulate the radiation flow in culture systems of 3D cells will be done, employing the use of Geant4 (an open-source radiation transport package) and the modeling of cancer cells via established NEATG methods (Pantziarka 2016). Analogous to the results that will be obtained through our models, biological products based on curcumin may be applied to astronauts in Martian environments to solve the problems of radiation in space travel and future establishment missions.

Medical: MD-3

A Countermeasure for Long-Duration Space Expeditions to Minimize Effects of Social Isolation and Latency Delays Between Astronauts and Their Family and Close Friends Using Time-Shifting Communication

Mary Jo (MJ) Marggraff

Kinoo, Inc.

Future expeditions to the Moon and Mars will require extended time away from Earth. It is well established that social isolation on these unprecedented long-duration space expeditions (LDSE) poses a serious risk to astronauts' behavioral health that can detrimentally impact other critical health and performance areas: physiological, task execution, and interactions with other crew members. It is therefore essential to mitigate the hazards of social isolation with effective countermeasures and support astronauts' adaptation and resilience needed in the course of these expeditions. Studies show that highly valued social support on LDSE comes from astronauts' family and close friends. Furthermore, effective countermeasures will not only mitigate the risks of social isolation to sustain astronauts in space but will mutually support astronauts' close counterparts on Earth. In addition, effective connectedness must reduce the effect of time differences and distances that cause problematic communication delays. A start-up company, Kinoo, Inc., is developing a system that can achieve increased feelings of connectedness between remote loved ones by time-shifting communication to overcome the perception of transmission latency in space. Since all phases of a mission are critical periods for connection, this proprietary, patented method can be applied to all phases of the mission: pre-mission training, during-mission, and post-mission re-entry, to fully integrate needed support for the astronaut and his or her loved ones. To demonstrate how the system works, a brief example of astronaut-in-space connecting with loved ones on Earth will be available at the Mars Society Convention, pending approval by organizers. Kinoo is eager to gain greater understanding of social isolation and the value of this innovation may bring. To that end, Kinoo is interested in analog research opportunities for this countermeasure that will contribute to supporting astronauts' space health and performance on upcoming expeditions.

Medical: MD-4

Reserved for Track Speaker

Medical: MD-5

Mars and COVID-19: The psychological effects

Dharshun Sridharan
Nipuni Silva
Robert Smeets

Piston Labs

Mars. The next frontier. But wait, Humanity has not quite conquered the corners and depths of our planet. For example, it is still largely unknown what lies beneath some of the world's greatest oceans. To be specific, just under a quarter of the world's oceans have actually been mapped. To further emphasize this fact, the remaining area is equivalent to twice the size of Mars.So why is Mars, and colonisation and settlement of Mars, suddenly a global agenda? It is something that the last decade has helped answer, or bring awareness to, and strangely enough, there are substantial benefits for Earth by heading towards the red planet.

However, there are some key challenges that must be overcome to make this Martian dream come true. These include technology challenges, and extend to arguably the biggest challenge, 'human factors'. Physical and physiological challenges can be difficult to overcome, but are no match for psychological challenges, and that is what this paper looks to explore.

Specifically, how do the physiological challenges that transiting to, colonising, and settling Mars bring. But also, how do the parallels of COVID-19, assist with methods to mitigate these challenges, how do the pressures faced in elite-sport create a parallel to future missions to Mars, assist with hypothetical approaches for future spaceflight.

A number of paradigms are raised in this paper to help analyse how challenges to colonising, and settling Mars can be mitigated, with a focus on overcoming psychological challenges, one of the most uncontrollable areas in Humanity itself.

Medical: MD-6

KYMIRA: Astronaut Physiological Health Monitoring Using Smart Underlayer Garment

Ashfaq Gilkar

SGAC

The SGAC have instigated a Digital Mars Analog Simulation to be developed and implemented. Using KYMIRA's non-invasive, continuous, biomonitoring smart garments as a potential scenario within a Mars Habitat or during excursions. This telemedicine solution can help to monitor and track astronaut health trends over the duration of the mission as well as accelerate clinical decision making when rapid decline or an acute event takes place. The smart garment is worn under EVA suits, similar to compression clothing. Garment sensors enable non-invasive, continuous and simultaneous physiological measurements. The smart garment is worn under loose fitting outfits or EVA suits, similar in principle to compression clothing. Garment sensors enable non-invasive, continuous simultaneous measurement. A key aspect of KYMIRA's proposed technology is the use of multiple physiological biomarker recordings to enable accurate medical assessment. When doctors, such as Cardiologists and Emergency Medicine physicians, make treatment decisions for patients with ECG abnormalities they do not only rely on the ECG results but must assess other aspects of the patient's physiology. Being able to measure multiple parameters drastically improves accuracy and speed of diagnosis which would be crucial, given the environment, light-delay, and lack of full medical assessment facilities and staff available. Besides diagnosing serious and acute deteriorating health conditions, this same system would be used to objectively measure long-term physiological trends in Astronauts and help evaluate corrective measures. For example, individual muscle conditioning as well as an adherence to appropriate exercise and training regimes, tailored for a specific astronaut's needs could be better enabled via this smart garment system.

Medical: MD-7

neurosurgical procedures possible to carry out in space

Avinav Sahoo

Hi Tech Medical college

Manned space flights are increasing, the purpose being to colonize celestial bodies like Mars. Brain injury has been NASA's main concern for astronauts during space travel. Micro gravity makes normal things difficult to do let alone neurosurgical procedures. This article is a discussion of possible problems we are going to face in microgravity or zero gravity if we perform neurosurgical procedures , the possible neurosurgical procedure that would be feasible to carry out in zero gravity or micro gravity.

Review of literature-
The problems that we would be faced during performing neurosurgical procedures in microgravity or zero gravity are impaired visualization, difficulty in restraining both the patient and crew members, and floating debris.

Restraining the patient by straps to the table on the operation theatre which needs to be magnetically fixed to the floor of the operation room. Restraining the surgical crew can be done magnetically to the floor of the operating room will solve the problem.

Floating debris in the form of blood, irrigation fluids, pus and bone from drilling skull can be reduced by covering the part to be operated by glove box. Glove box is a windowed, sealed container equipped with two flexible gloves that allow the user to manipulate nuclear materials from the outside in an ostensibly safe environment. This can be used to contain the part to be operated this containing the floating debris that could be sucked out using suction to clear the surgical field. We should also minimise the debris by performing minimally invasive surgeries like burr hole craniotomy, stereotaxic removal of bleed, tumors , minimally invasive spine surgeries and other forms of minimally invasive surgery like coiling for aneurysms.

Robotic neurosurgery could be used to perform to have great control over the instruments used.

Medical: MD-8

Evaluation of the production of Haematococcus pluvialis, Chlorella sp. and Arthrospira maxima as an alternative source of protein and antioxidants for the production of food and oxygen for space travelers in exploration rovers.

German Sarmiento
Mario Colorado
Fabio Quimbaya
Arnulfo Tellez

The Mars Society Colombia

The goal is the establishment of totally self-sustaining microalga cultures facing the possibility of being an alternative for the production of oxygen and food for travelers. Thus, microalgae cultures can be a terraforming tool in the colonization of Mars, since on that planet areas have been found where the water is in a state of freezing. However, within the variables to experiment for the development of systems microalgae on the Moon or other planets, or in transport vehicles, are among others the tests of biologicals as suitable diagnostic tools to determine the effect of physical and chemical agents on test organisms under experimental conditions specific and controlled. These effects can be both inhibition and magnification, evaluated by the reaction of organisms, such as death, growth, proliferation, multiplication, morphological, physiological or histological changes. The adaptation of microorganisms to the environmental conditions of the area where It is expected that the crops should be started taking into account the effects that may manifest at different levels, from subcellular structures or enzyme systems, to whole organisms, populations or communities. These elements are raised under 14 key subsystems for the settlement of humans in another celestial body.

Medical: MD-9

The case for Space Sexology

Simon Dubé

Concordia University

Space poses significant challenges for human intimacy and sexuality. Life aboard confined and remote space habitats during long-term travel, exploration, or settlement may detrimentally affect the sexual and reproductive functions of astronauts. It can also restrict privacy, limit access to intimate partners, impose strict hygiene protocols and abstinence policies, and heighten risks of interpersonal conflicts or sexual harassment. Together, this may jeopardize the health and well-being of people living in space, along with crew performance and the success of our space endeavours. Yet, little attention has been given to human eroticism in space—e.g., love, sex, and intimate relationships. This situation is untenable considering our upcoming space missions and expansion. It is time for space organizations to embrace a new discipline, Space Sexology: the comprehensive scientific study of extraterrestrial intimacy and sexuality. To make this case, the presentation draws attention to the current lack of research on space intimacy and sexuality; discusses the risks and benefits of extraterrestrial eroticism; and proposes an initial biopsychosocial research program framework to envision a broad, collaborative scientific agenda on Space Sexology. This presentation also underlines some anticipated challenges faced by such an innovative field and suggests potential paths to solutions to aid in its development. It concludes that space programs and exploration require a new perspective—one that holistically addresses the intimate and sexual needs of humans—in our pursuit of a spacefaring civilization.

Medical: MD-10

Synthetic Biology for Gene editing of edible plants to thrive on the Red Planet: A study on Moringa on Mars.

Ilankuzhali Elavarasan
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Habitat Marte Space Analog Station, Brazil

Rather than taking plants that aid only as a food source and generate lots of waste parts, multipurpose plants that not just form as a food but also aid in medicine making, nutrient benefit and psychological aid can be modified and taken to space.

One of my proposals considered in this paper is the Moringa plant. Moringa oleifera is a plant that is often called the drumstick tree or the miracle tree. It also has antifungal, antiviral, antidepressant, and anti-inflammatory properties. A variety of food can be prepared from different parts of the Moringa plant, it has prolonged life span and also aids in medicine making. All the parts of drumsticks can be used medicinally.

The Moringa plant also releases a form of resin or Drumstick tree resin (gum) which is used to treat various ailments. Apart from medicinal usage the gum could also be used as a resin for 3D printing, aerospace/spacecraft structural parts, habitat layers, etc. Though being multipurpose, the tree isn't resistant to insect/pests and environmental stressors like excess radiation.

Hence Trehalose, a protectant produced by plants can be used. Significant levels of trehalose in plants act as protectants against various abiotic stresses, including heat, drought, high salinity, and UV rays. It also protects against the protein degradation that occurs during severe abiotic stresses.
The trehalose synthesizing gene - trehalose-6-phosphate phosphatase, OtsB, and trehalose-6-phosphate synthase, OtsA can be extracted using the CRISPR technique and added to the moringa seeds or young plants. Gene edited plants can be sent to the ISS for testing radiation resistance and adaptability and taken to Mars to form as a food, nutrition and psychologically aiding source for future astronauts.

Moringa experiments are being considered for research in the Habitat Marte space analog station, Brazil.

Outreach: O-1

Space Boot Camp (A Novelty Space Project)

ISAAC GATHU

MARS SOCIETY KENYA

Kenya as a country is slowly rising from the dust in terms of its involvement in the Space industry. This comes at a very good time when organizations and institutions in the country are gradually positioning themselves in various fields within the space industry. One such organization is the MARS SOCIETY KENYA; a non-profit organization aimed at informing the general public of the importance of taking care of the environment (in this case - Mars) and with a dream of one day being part of the solution as humankind on Mars will be involved in terraforming the 'Red Planet'.

MARS SOCIETY KENYA is in the process of establishing a Mars Habitat Simulation Programme / Research Station to be set up in the country (in a remote region, probably in the furthest parts of Turkana County in Northern Kenya), where the citizens and any other willing party can practice and experiment on a Martian-like environment, even as we purpose to eventually have a human presence on Mars.

Space Boot Camp will be the entry level and it will be open to the general public regardless of one's demographic status. Setting up the boot camp will depend on the nature of the agreement. The camp will have the necessary infrastructure required to train astronauts. It will also make use of STEM education and its benefits to the Space industry. Membership will be in two ways; general and special.

Upon completion, special members will be tested at various levels and only those who show extraordinary performance will be selected for internship at the space port. The purpose for this is to raise our own team that understands the dynamics at the port and are passionate to see the success of any project they will be working on.

Outreach: O-2

The Science Fiction Connection to Mars

Ron S. Friedman

Science Fiction is arguably the most important fiction genre that can influence the public to support a Mar Mission.

In the past, Asimov, Robert Heinlein, Douglas Adams, Star Wars and Star Trek inspired Elon Musk to found SpaceX.

New stories can inspire the next generation of scientists, engineers, entrepreneurs and the general public to support the idea of making our civilization spacefaring.

Outreach: O-3

A Martian Literary Project: Mission 1/2021, Unveiling a Parallel

Alessandra Calanchi
Simonetta Badioli

University of Urbino, Italy (EU)

Mars exploration involves many different issues, among which humanities are not a priority if compared to economy, biology, engineering, ecology. In our opinion, however, the human heritage, made of cultures, literatures, and arts, ought to provide a robust basis for what we might call a migration – and settlement – not only of the bodies, but of the minds. In a future which is not so far away, cities will be built, schools and museums will be organized, and we must be ready for this to happen. Our generation will probably not be there, and I think it is crucial now to let the younger generations have a multifaceted knowledge of the history of the representations of planet Mars, also including literary and filmic storytelling.

Many young people are familiar with disaster movies, fictional alien invasions, and imaginary wars between Martians and terrestrials. On the contrary, a very different and almost unknown literary production exists which portrays the Red Planet as a utopian world, inhabited by smart people who have been able to build a much better civilization than ourselves and offer to be our guides. In American literature, which is our field of interest, several examples exist of these amazing narratives, dating back to a period between 1890 and 1910. Rediscovering these narratives today can be a great stimulus both for readers and researchers, as well as an opportunity for a serious common reflection on the extremely modern ideas expressed by their authors about sustainable economy, gender equality, and environmental care.

It is our intention to propose and analyze one or two novels every year for some years to come. We intend to start with Unveiling a Parallel by Alice Ilgenfritz Jones and Ella Merchant, the first American novel entirely set on Mars, published by two women of the West in 1893.

Outreach: O-4

Colonizing Mars: What Does the Average Person Believe

Dawn M Kaufman

Throughout the current research community, concerning the colonization of Mars, almost all of the research done is from a scientific perspective. Because of this, the average person, who is not necessarily part of this scientific community, rarely gets to voice their own specific concerns. While there is the occasional poll taken asking simple yes or no questions and some researchers look into certain ideas and topics that would concern people, very rarely does the average person have any sort of say in how Mars colonization should be done.

Historically, on Earth when people colonize new places there are lots of issues that arise. Whether it is conflicts within the colony itself, or conflicts with the motherland, there have always been certain problems that seem to emerge. While it is important for students to learn all about these conflicts in school, it is also important that they are able to apply what they know about the past to future plans. Also, in the past, when countries have made efforts of space exploration or big technological advances, it would tend to turn into a sort of competition of who can get it done faster. This behavior that comes with the territory of space exploration, scientific discoveries, and colonization is what leads to the average population being left out of the decision making process.

Within this study, high school students will voice their concerns of each of the main five topics seen throughout research in this field; social, agriculture, government, technology, and health; and they will be assessed in comparison to the concerns of the scientific community to answer the question: how does the typical 16-19-year-old in Long Beach consider the ethical issues that may arise when creating a colony on Mars compared to the scientists actively involved?

Outreach: O-5

The Role of Science-Fiction in Reaching Mars Successfully

David Ebenbach

Georgetown University

Science fiction has long played a surprising and important role in science itself, inspiring young people to pursue STEM careers as well as shaping ideas that have led to technological advances; imagining a bright future helps us to attain it. In that same vein, science fiction has plenty to teach us in our pursuit of Mars.

The most obvious role for fiction is to help us think through technical and logistical hurdles, and there's plenty of relevant work to turn to on these points. Perhaps less obvious, but potentially even more important, science fiction can help us appreciate the complicated and central human element that will shape any endeavor to visit or colonize the red planet. This includes paying attention to individual psychology—what it will really be like for a person to go on a journey like this—and also attending to social dynamics and to the ways that we carry culture, tradition, and human nature wherever we go, for better and for worse.

The speaker, author of the novel How to Mars, will discuss fiction by authors such as Ray Bradbury, Octavia Butler, Ellen Klages, and Kim Stanley Robinson. He will also discuss discoveries derived from his own creative process and share from his work.

Outreach: O-6

Why Become a Mars Society Ambassador?

James Melton, PhD

Speaker/Author & Mars Society Ambassador

The Mars Society goal of Humans to Mars needs to be shared with the world. So, what is the best way to share this vision in a credible way?

When in Boca Chica, Texas, Dr. Robert Zubrin and Elon Musk emphasized that now is the time to, “Spread the word of the unlimited future that will be opened by making humanity space-faring.” The Mars Society was already a step ahead of the game by identifying a, “Get the word out” strategy as a priority.

Now the next phase is to move into action by sharing this passion, knowledge and awe-inspiring concept in a manner that will capture the imagination of the general public and gain support from all corners of the globe.

No doubt you have a passion for Mars and space, but are you getting the word out?
By participating in the newly-formed Mars Society Ambassador Program, techniques will be shared to groom the delivery of the Mars Society vision that will spark the interest of your audience. A side benefit of this will be to enrich your speaking skills to support your personal and business world, as well as gaining additional Mars Society members,

To be identified as a Mars Society Ambassador, this session will:

- Outline the criteria required to become an Ambassador.
- Provide methods to deliver information in a concise manner.
- Impart techniques to capture the attention of an audience.
- Generate an audience attitude of, “What we can do together!”
- Present a Power-Point program that can be customized.
- Design, deliver and debrief your presentation.
- Discover your reservoir of communication tools.
- Offer training material to accomplish the task.

Outreach: O-7

Training High School Tiger Teams of Junior Astro Sociologists, Astronauts, Engineers, Scientists and Pilots for Simulated Mars Missions.

Bob Barboza

Barboza Space Center

What are simulated Mars Mission Tiger Teams? A tiger team is a specialized, cross-functional team brought together to solve or investigate a specific problem or critical issue.

The term “tiger team” originates from the military and was made famous by NASA who deployed a tiger team during the Apollo 13 mission in 1970. During the Apollo 13 lunar landing mission, part of the Service Module malfunctioned and exploded. NASA formed a select technical team tasked with solving the issue and bringing the astronauts safely home. This “Tiger Team” later won the Presidential Medal of Freedom for their work on that successful mission.

I asked my colleague Dr. Jim Pass, CEO of the Astrosociology Research Institute and its senior research scientist, if he would help me to add three astrosociologists on special assignment to the Barboza Space Center’s Mars Mission Tiger Team Settlement Project.

We have thirty students enrolled in our space program and thirty students enrolled in our aviation program. Students work on tiger teams consisting of ten high school students. We encourage all of our students to choose career paths including majors and minors in science and engineering.

Outreach: O-8

The Mars Leap- An immersive Mars museum

Charles Letherwood

IXITID Concepts

Apollo rode to space on the dreams of a planet, but Jeff Bezos made the world question space exploration altogether. Why? One went 'for all mankind' while the other went for those who can afford it. 'Average people' dream less today because they don't think space is theirs, but if 'average people' could experience the final frontier… just once… what would the dreams be like then?

The Mars Leap is a groundbreaking immersive exhibit about Mars exploration, combining space adventure with an experiential storyline and challenging educational content to benefit audiences, museums, supporters, and sponsors alike.

Visitors learn the science and real-world value of space exploration by joining a Mars Direct mission scouting Martian colony sites. Personalized, immersive experiences and open-ended scenarios allow a depth, range, and complexity unique in current museums. Environmental and equipment simulations, scenic elements, computer graphics, scale models, and more convey the reality of a Mars mission. Visitors will know space is for them, personally, because they'll taste it for themselves.

Museums benefit from improved educational techniques, compelling content, and new networking and marketing opportunities. Just one example is a competition (with significant scholarship awards) built around The Mars Leap content, encouraging involvement from schools and groups across each display region.

Companies and organizations gain a venue to promote science and technology to millions over the exhibit's 10-year lifespan. Content tailored around sponsor's technologies connects them with space enthusiasts and helps cultivate their next generation of STEM professionals.

The Mars Leap will help inspire the spirit and develop the knowledge to make a real Mars Leap possible. This presentation will outline progress to The Mars Leap, and explain how viewers can participate through time, talent, or sponsorship.

Mars can be ours in 2023. This presentation will explain how.

Outreach: O-9

Expanding the Scope of Astrosociology in Order to Settle Mars

Jim Pass

The Astrosociology Research Institute (ARI)

Activities related to space exploration and related activities are overwhelmingly characterized by a STEM-heavy approach; that is, one that focuses most strongly on physical and natural sciences, technology, engineering, and mathematics. While the social sciences are becoming increasingly involved with issues related to outer space, the number of social scientists participating is quite low compared to those scientists involved in STEM education and research. Thus, the human dimension is not nearly studied enough, nor planned for, as humankind increasingly focuses its attention on settling Mars. There is a serious, too often unrecognized, need to add social-scientific planning and analysis to all efforts that seek to place a settlement or smaller population-size base on the Red Planet. Two major examples will be discussed.

First, the Astrosociology Research Institute (ARI) is working to increase astrosociology in academia and beyond. Its “Astrosociology in the Classroom” program aims to first add materials to lectures for various social and physical science classrooms, and expand from there. One model of an expanded presence is the Introduction to Astrosociology course taught by Dr. Gerhard Sonnert at Harvard University. A related initiative is under review to expand the scope of astrosociology in the classroom.

Another of ARI’s initiatives emphasizes familiarizing high school students with astrosociology by placing social science students interested in space on “Tiger Teams.” This program works in conjunction with the Bob Barboza Space Center, which is located at Ontario International Airport in California, to integrate physical and social science students in simulations related to living and working on Mars. Of great significance is the fact that the astro sociologist on each Tiger Team serves as its leader, as this creates an unusual – and overdue – emphasis on the importance of collaboration among the various sciences, as well as other related disciplines and fields.

Outreach: O-10

Can we grow food using Martian soil?

Bob Barboza

Barboza Space Center

A team of high school Junior astronauts are taking their biology, botany, and chemistry lessons to a whole new level. They want to create Martian soil and grow food. They are excited about all things Mars and are willing to do the hard work to accomplish their goals and objectives. Our students understand that plants will have to live in a temperature controlled protective structure with air, soil, water, light, and the right combinations of macro and micronutrients.

The Barboza Space Center trains high school tiger teams of junior astronauts, engineers, pilots and scientists. One of our tiger teams is in charge of growing food for other tiger teams on special assignment. We are located at the southern California Ontario International Airport and we service the Fontana and Chaffey Unified School Districts. We received a grant to create a special program to explore the career paths associated with space and aviation.

To simulate growing food on Mars, we created a system of robotic hydroponic agricultural gardens, and other growing environments that would help our tiger teams to grow food with the help of robots. We invite you to explore our project photo essay. It helps us to share what it took for our tiger teams to meet their goals and objectives. This Mars project helped to feed our sponsors during the pandemic. Our southern California tiger teams will continue to explore new and creative ideas that will make growing food on Mars a reality.