# Horizons

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The Newsletter of AIAA Houston Section
The American Institute of Aeronautics and Astronautics

September / October 2013
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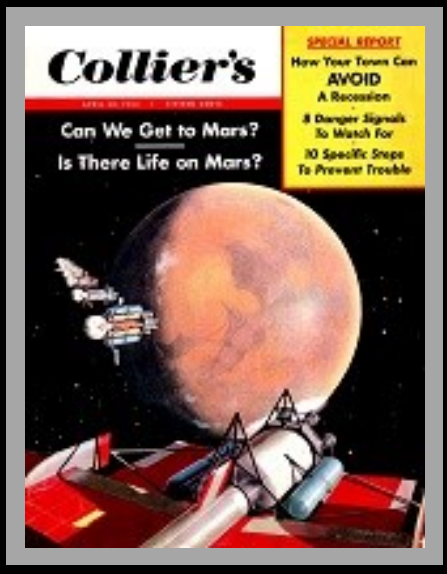
# 100 Year Starship Public Symposium

## Pathway to the Stars, Footprints on Earth

## Hyatt Regency Houston
## September 19-22, 2013




**Also, Continuing in this Issue! Part 8 of 8:**
***Man Will Conquer Space Soon!***
**(Collier's 1952-54)**

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# September / October 2013
# Horizons, Newsletter of AIAA Houston Section

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*Horizons is a bimonthly publication of the Houston Section of The American Institute of Aeronautics and Astronautics.*
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*Cover: The interior of the Hyatt Regency hotel in downtown Houston looking up from the lobby. This hotel was the site for the 100 Year Starship 2013 public symposium. Image credit: Wes Kelly.*
*This page: part of Vincent van Gogh's 1889 painting The Starry Night.*

# Collaboration for Success in Human Spaceflight

Chair's Corner

MICHAEL FROSTAD, CHAIR

A business buzzword with real meaning, collaboration is important whether you are farming in the Midwest, developing new software in Silicon Valley, or working in aerospace at the Johnson Space Center. Since the last Chair's Corner, collaboration has been on full display in human spaceflight.

A collaboration between Orbital and NASA with the Cygnus vehicle that launched September 18th saw to it that the vehicle safely docked to the International Space Station (ISS). After testing out

many functionalities for the first time in space, Cygnus attempted its first approach to ISS. The spacecraft made it to within about 15 kilometers, but encountered an issue with GPS readings between it and ISS. Cygnus safely backed off and the Orbital & NASA team went to work to fix the problem. After analysis and investigative work, a GPS timing issue was found and overcome. This led to a second approach to ISS, which successfully completed further test objectives before capture by the ISS Space Station Remote Manipulator System (SSRMS) and berthing to the ISS.

Further collaboration between NASA and other aerospace businesses culminated in two major project milestones. The first was with Sierra Nevada Corporation's Dream Chaser vehicle at Dryden Flight Research Center. They completed the first free flight test of Dream Chaser on Octo-

ber 26th. During the flight test glide portion, performance was nominal and the craft approached the runway right on target. However, as the craft lowered its landing gear, the left main gear did not deploy. This resulted in a rough landing. Damage was sustained to the vehicle. However, Sierra Nevada says that it is repairable. The landing gear on the vehicle tested is not the final design to be used on the vehicle. Flight data before the landing will be used to refine the vehicle. This collaboration allowed good flight data to be obtained and it found issues prior to a real flight, exactly the results one desires from a test.

The second collaboration was at Kennedy Space Center on October 28th, with Lockheed Martin and the Orion vehicle's avionics. The avionics systems were installed on the Orion Exploration Flight Test 1 (EFT-1) vehicle and powered on for the first time. The systems worked as expected, completing another step towards the actual flight test mission, targeted for the fall of 2014. The upcoming test will stress avionics, sensors, reaction control jets, and the thermal protection system at higher velocities than any other vehicle designed to carry humans since Apollo. This collaboration continues to build capabilities and the data from the flight test will be very valuable.

It is not just collaboration between NASA and companies but also between

NASA and other national space programs that continues to support human spaceflight activities, specifically the ISS. ESA's Automated Transfer Vehicle (ATV-4), named *Albert Einstein*, launched and docked with ISS in June 2013. Over the course of its mission it gave two delta-V boosts to the station (1.0 m/s and 1.45 m/s), provided supplies to those on board ISS, provided propellant to the Russian segment of the ISS, and when the *Albert Einstein* left ISS it took out the trash. This was a good mission to sustain the ISS and the people carrying out the science aboard it – accomplished through collaboration.

*Image credits: NASA.*

Further fruits of collaboration will soon include the launch of ISS Expedition 38 aboard a Soyuz launched from Baikonur Cosmodrome in Kazakhstan, continuing a partnership with Roscosmos. This launch will be a special one as it will be the first

time there have been nine humans in orbit since 2009 without a Space Shuttle docked to the ISS. In addition to rotating the crew of the ISS and maintaining six people aboard the space station, the crew of this Soyuz will have one American astronaut, one Russian Cosmonaut, and one Japanese astronaut – stressing the point of international collaboration and cooperation to push humanity farther than it has ever gone before. The ISS is a laboratory for learning how the body functions in space and how to work in space, and it is more than that. It is a beacon pointing to the future for all of humanity. It is a wonder built by dedication and collaboration.

This list of successful collaborations does not go into detail about the hard work and dedication that comes with any collaborative effort, but it shows the results of collaboration. It shows that if we harness each other's strengths, push through issues, and overcome obstacles that lie in our path, then together we can accomplish amazing feats. The challenge that is left to us is to continue collaborations, to grow them, and to improve them. The next time you hear the word *collaboration*, take a moment to reflect on its meaning, its past successes, and how might you harness it for a future success. A word that gets is done is *collaboration*.

From the Editor

# The Experimental Aviation Association (EAA) Chapter 12 (Houston)

DOUGLAS YAZELL, EDITOR

We omitted the EAA Chapter 12 page in this issue. Since we have some snapshots (from Saturday, October 26, 2013) of EAA airplanes from the Wings Over Houston airshow, we include some of those pictures here. For our usual EAA one-page article with meeting information for EAA chapters, please see our previous issue of Horizons and our next issue.


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*An archive for Horizons on a national AIAA website is here.*

*Submissions deadline: November 20, 2013, for the November/December 2013 issue (online by December 10, 2013).*

*We are late but we aim to get back on our usual bimonthly schedule by early 2014.*

***Advertising***
*Please contact us about rates.*

Shen Ge presents the solution to the chess puzzle on page 37 of our previous issue of Horizons:
1. Bb1 b2
2. Ra2 b3
3. Ra3 b4
4. Ra4 b5
5. Ra5 b6
6. Be4 mate

Notation: On each line, white moves first. An upper case letter is a piece (B for bishop and R for rook). A lower case letter followed by a number shows the destination. The upper case letter is omitted for pawns.

*Image credits: Douglas Yazell.*


*Above: Left to right are Section members Ellen Gillespie, Michael Frostad, and Clay Stangle. Our Section's new Extra-Vehicular Activity (EVA) technical committee chair Evelyn Miralles was there, too. See our Section's organization chart on a later page. They are standing under our Section's new shade-providing canopy. Next to that is the EAA canopy with their flag.*


# Second Public Symposium of the 100 Year Starship Sponsored by DARPA and NASA

Cover Story

WES KELLY, TRITON SYSTEMS, LLC, AND SHEN GE

For some of us, starships did not begin with Star Trek. A decade before, for example, Robert Heinlein's 1956 science fiction novel for youngsters, *Time for the Stars*, transposed to space a going-to-sea story lacking a "call me Ishmael" first line, but its style struck a Sinclair Lewis - Robert Lewis Stevenson mix. Originally the mission alternate for his brother, narrator Tom Bartlett becomes the space-faring communications link of an identical twin set; he provides telepathic communications to Earth-based brother Patrick. Pages into chapter one, before signing on to the interstellar torch ship *Lewis and Clark*, Tom relates how, when doing a school term paper, "…We got interested in the purposes of the Long Range Foundation. Its coat of arms reads, '*Bread Cast Upon the Waters*' and its charter reads, '*Dedicated to the Welfare of Our Descendants*.' …It wasn't enough for a project to be interesting to science or socially desirable; it also had to be so horribly expensive that no government and no other corporation would touch it."

Decades after first reading of torch ships headed out to the stars with twins page by page illustrating time dilation and Special Relativity, one can still wonder how much substance there was to the engineer-author's vehicular invention. Was it a dream he quickly transcribed to paper to sew into adolescent heads so they could be plagued by it as well and become engineers or scientists to follow it? What a STEM story success! Was the scenario the former naval officer described within the realm of possible: crewed ships heading out in all directions of the celestial sphere at 1-g acceleration up to near-light speed to search out and explore extra-solar planets? And do events now unfolding place another feather in the cap of a 20th century science fiction writer?

We probably know more about extra solar planets now than Heinlein knew about even Pluto back then; and we do have societal institutions actually examining the prospect of the flight. Plural should be stressed since there actually were other interstellar flight conferences this year, sponsored by the California Space Institute in San Diego ("Starship Century" in May) and the Starship ICARUS group of the British Interplanetary Society in Dallas back in August. In fact, this overseas cousin of the AIAA has for decades devoted its technical journal at least annually to "Interstellar Studies." Tau Zero Foundation and Centauri Dreams (the online link) also add to this effort.

Since the first DARPA sponsored Starship conference in Orlando in 2011, the downtown Houston Hyatt Regency hotel has hosted two more of the 100 Year Starship public symposia. Former astronaut Dr. Mae Jemison, the director of the non-profit 100 Year Starship (100YSS) foundation chaired ceremonies for this 19-22 September event which left the Earth behind in many ways, if not physically.

While all three conferences cited provide papers on transport solutions to star flight (in 100YSS program parlance, "Factors in Time and Distance Solutions"), the social science ("Becoming an Interstellar Civilization: Governing, Culture and Ethics"), biological aspects ("Life in Vivo and Vitro") and educational outreach possibilities of the starship mission were given more weight at the Houston event. As its subtitle suggests, "Pathways to the Stars, Footprints on Earth," stellar reach should make impressions where our feet are placed.

Yet since Horizons reports primarily "aeronautics and astronautics" and conference breadth is so wide and speculative, even metaphysical, a full relief map is difficult to provide, especially when it comes to the personal background of the many innovative thinkers in attendance. But prolonged interstellar flight no doubt demands design integration to include beside physical sciences and engineering, social and life sciences. If passenger frame of mind is crucial on a delayed or turbulent airline hub feeder hop, what are we to make of a century's flight duration? Thinkers with Ph. D.s or experience in diverse fields, some known widely and some known only to colleagues, applied themselves to this whole panorama. They were both imaginative - and stretched and open to more critical comment or reflection than we have space to provide here. Presenters at Houston have been featured at several events, sure enough, owing now to a world-wide, yet close-knit community concerned with interstellar transport. They arrived from all over the country and overseas, but Houston provided a significant segment of interstellar researchers and philosophers as well at 100YSS 2013.

**Welcome**

"No one shows a child the sky," Dr. Jemison observed, referring in opening to an old African proverb displayed prominently in the main auditorium. And, "Not everyone wants to go into space; but no one says we don't want to know what's out there. They don't say, just keep it to yourself. …Pursuing an extraordinary world tomorrow creates a better world today."

Coming to the 100YSS mission statement, Jemison said the foundation wants to foster innovation. Its purpose was not to build the starship itself but to pursue revolutionary knowledge and technology applicable to both Earth and space. To keep 100YSS going, Dr. Jemison used a favorite word: "We have to be audacious." Consequently the term showed up frequently in subsequent sessions, keeping faith with the organizer's goal.

Loretta Whitesides, co-founder with George Whitesides of the annual April "Yuri's Night" since 2001, followed Jemison as keynote speaker. While George currently heads Virgin Galactic, the space tourism concern, biologist Loretta. Whitesides' explorations include five dives to the Titanic with James Cam-

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## Cover Story

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eron's crew and over 75 parabolic micro-g flights. She had also worked as a life science contractor to NASA and the JPL. Ms. Whiteside and Dr. Jemison first became acquainted when the Stanford astronaut-alumna gave a commencement address at her alma mater and Loretta's graduation, an interesting example of how many 100YSS working relationships originated. Amid other hopes, Ms. Whitesides wished that 100YSS increased the influence of the Overview Effect experienced by many astronauts as they looked back on their home world Earth. In remarks following, Dr. Jemison confessed that her OE experience was sensed outward, an increased wonder at and curiosity about deeper space and the stars.

**"Factors in Time and Distance Solutions" –**
**Propulsion and Flight**

The British Interplanetary Society pioneered lunar mission planning studies just as it has with interstellar flights. It shifted to the stars after the 1969 Apollo lunar landing. But regarding "time and distance factors," we note that for every nautical mile between Earth and Moon (~206,815) there are as many astronomical units (AUs) to the parsec parallax distance ($180/\pi * 3600 = 206{,}265$ ). This is 3.26 light years or ~1 light year (63,115 AUs) short of Alpha Centauri. An AU is ~150 million kilometers or 80 million nautical (93 million statute) miles, making the nearest star ~100 million times further from Earth than the Moon and the Apollo landing site.

Dr. Eric Davis, an Austin-based astrophysicist, served as session moderator throughout. He and fellow speaker Marc Millis co-authored the AIAA survey text Frontiers of Propulsion Science. Millis would speak Saturday on "From Sci-fi to Scientific Method - A Case Study with Space Drives." Should there be a second Propulsion Science edition, one could imagine the authors culling through proceedings such as what follows.

Judging from 2013 and 2012 100YSS, *Time for the Stars* represents a band in the spectrum of interstellar study or speculation and the torch ship serves as a transport straw man. If a torch ship could draw sufficient energy from stores of water or liquid ammonia to accelerate off to Tau Ceti or Beta Hydrae like a long lived rocket, then was it a nuclear fusion powered rocket? Walking in on a presentation by well known Michigan-based nuclear fusion expert Terry Kammash, "Propulsion For Rapid Interstellar Travel" (would we select any other?), the answer was not readily apparent – save for what would happen when power densities were increased by orders of magnitude from the 10 watts/kilogram electric propulsion systems readily achieve today. Realms ~550 astronomical units (AUs) from the sun, he concluded, "would become accessible in a matter of decades with nuclear fission or fusion." Hundredths of a parsec? More about this distance milestone below.

Then perhaps to attain torch ship performance we need breakthrough propulsion efficiency attained from annihilation of matter and anti-matter? The next speaker, Pauli Laine from a Finland university answers his talk title question, "To the Stars with Current Technology?" with a review of two interstellar propulsion systems: 1), a combination of nuclear thermal rocket and nuclear electric propulsion assisted by a flyby of a giant planet; 2), a fission fragment rocket in combination with a solar sail, selecting the second as adequate "in principle" if "some suspended animation is employed." In which case neither is a torch ship solution. Amid the presentation the audience could hear a pleasant aria piercing through the screen wall separating conference rooms. More below about that as well.

Since even laser beams diverge over interstellar distances, Panamanian researcher C.J. Q. Cappiello in "The Laser Star Way: A Light Bridge to the Closest Stars," examines power relays systems between stars, plus the dynamics of station keeping. At least one advantage of transponders was clearing interstellar dust with which impact at near light speeds would be disastrous. Depending on how many way stations are needed, that's probably the good news.

NASA Johnson Space Center engineer and General Relativity researcher Dr. Sonny White presented more details of continuing work at the JSC Eagle Laboratory ("Warp Field Physics: an Update"), reported on previously in Horizons. This type approach side steps rocket derived technologies with space warp effects. Connections to earlier work by Miguel Alcubierre were reviewed and how economies of scale were achieved by shaping the field. Allowing that very exotic (negative) matter can be obtained, orders of magnitude less were now required, assuming negative matter "diminished" in absolute terms. Still, the layout of a warp-drive interstellar spacecraft was justified by field geometries and intensities plus mechanisms, inviting comparisons with Starship Enterprise layout. There were differences.

Dr. White's presentation, about double conference length, actually examined two types of drive systems: Alcubierre derived and the laboratory's quantum vacuum or Q-thruster. This is a device that has less in common with the Alcubierre theory than other experimental devices testing other physical hypotheses. Similar performance arguments could be made for a device known as a Mach thruster, often characterized as the Woodward Effect named for U of California - physicist James Woodward. While Woodward explains similar small observed forces with a GR derivation and the arguments of Ernst Mach on the origins of inertia, others, including Dr. White, seek to tap Zero Point Energy suggested by the Casimir Effect. In either case, if it can be scaled beyond trace effects in the laboratory, significance to star flight would be great. This type drive does not require exotic matter or even expelled mass (!), but sophisticated circuitry and capacitors to exploit a power supply. If the power gain is as projected, then trajectories for near term missions might include fast Mars missions. Dr. White supplied recent sample trajectories (Figure 1 and Table 1) for quick missions to Mars unimpeded by loads hundreds of tons of propellant. At last we see comparable performance to the torch ships of *Time for the Stars*.

After a lunch break, presentations took a different tack, starting with Marshall

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Barnes', "Challenges Outside of Proposed Models Based on General Relativity." Suffice to say that Mr. Barnes regretted a reluctance to pursue warp drive solutions outside the bounds of General Relativity theory; he was convinced that was the trail of the Holy Grail; though why Barnes prefers Kozyrev's explanation of gravity's effect on time without experimental proofs eludes us. Alvin Cantrell from the Marshall Spaceflight Center followed. He reported on gravitational sensors similar to the Cavendish device that established a measure of the gravitational constant. Could these devices be used for long range communication when gains sensed variations in their attraction?

If the last two papers sounded somewhat general in their reach for the stars, the next three were more particular.

Marshall Eubanks suggested asteroid resource search include search for exotic starship fuel sources in "Powering Starships with Compact Condensed Quark Matter." Should dark matter be composed of condensed superconducting quark material, admittedly a speculative matter, perhaps very ancient, rapidly rotating asteroids were locations to seek such deposits as sources of energy for the 100YSS or the proverbial torch ship. Examining the asteroid data set, the language and presentation was reminds us of papers presented to the Lunar and Planetary Science conference last March covered by Horizons earlier. When asked, the author reported he sometimes attended or contributed on asteroid studies.

Less speculative, but still a controversy, Jeff Lee's paper, "Temperature Inflation Considerations for Ultra-relativistic Subluminal Starships" adds another caveat against pressing too close to the speed of light. We were generally aware of the problems of collision with even dust motes at relativistic velocities in near interstellar vacuum. Cosmic background radiation is also blue shifted and more intense. Lee, a Canadian member of the ICARUS interstellar study group, provided estimates for leading edge temperatures. As the author himself noted, like many engineering controversies, this one boils down to which coordinate transformations are valid or should be invoked when intensities are calculated. General Relativity appears to be a mine field full of such, judging from GR correspondence groups' deliberations we have monitored. Just as with spacecraft re-entry, where surface or internal structures are at risk, Lee recommended speed limits at small fractions short of light velocity [c] before titanium structures would melt. Surface temperatures rise acutely in the region 0.9c< V< 0.9999c - even during coast. And we had thought interstellar transit would be extremely cold!

Michael Lammertin's paper on "Quantum Communications for Interstellar Travel," closed the Friday time and distance sessions. Examining "quantum entanglement" and teleportation, Lammertin provided a state of the art survey. Like the audience, Lammertin was intrigued by circumventing luminal velocities and signal attenuation, but viewed the prospects soberly.

**Table-1 Two Q Thruster Scenarios for 90-ton Spacecraft and 2 Megawatts Power**

| | A | B |
|---|---|---|
| Newtons / Kilowatt | 0.4 | 4 |
| Total Thrust (Newtons) | 800 | 8000 |
| Total mission (days) | 246 | 140 |
| Outbound (days) 66 | | 22 |
| Stay time (days) 70 | | 90 |
| Return leg (days) 110 | | 28 |

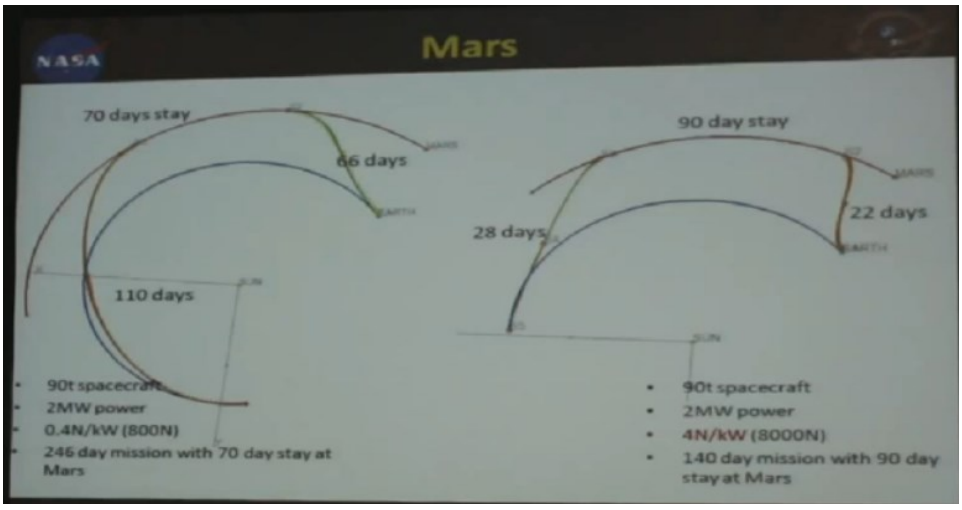


*Figure 1. Two Q-thruster scenarios for a 90-ton spacecraft and 2 megawatts of power.*

### "Factors in Time and Distance Solutions" – Intermediate Milestones and Devices

Einstein's 1916 GR Theory was first experimentally tested by the degree of light's bending by the sun for a near stellar occultation in May of 1919. The angle observed was about twice the classical prediction. More examples of bent light from deep space objects passing large gravitational fields have been observed since, but only recently has much consideration been given to the idea of exploiting gravitational lenses to create signal collecting or transmitting devices, e.g., dish antennas for signal reception or broadcast.

For one of us reporting (WK), one of the most remarkable featured devices of the 2013 100YSS was the solar gravitational lens observatory, receiver or transmitter. The idea's history stretches back several decades, but Italian astrophysicist Claudio Maccone probably dedicated more time

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## Cover Story

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and study than anyone else to the potentials of a focal lengths extending at least 551 astronomical units from the sun (see **Figure 2**) – or similar measurements from other stars. There is still much to be determined about light gathering, resolution and focal length as a function of wavelength, which would all affect spacecraft design for observation or transmitter purposes. If a spacecraft were to be sent to a star such as Alpha Centauri, then a tracking station and transmitter could very well be sent to the opposite celestial coordinates (e.g., right ascension declination) with respect to the sun to provide mission support. In the past detecting signals vs. natural processes from amid the stars has been directed SETI; in the future, if probes or spacecraft are launched to the stars, then the problem is communication without attenuation or distortion. Here is where the two authors make the case for the KLT vs. the more traditional Fast Fourier Transform tool. Co-Author Stephane Dumas of the Canadian chapter of the SETI institute presented "Interstellar Communication with Gravitational lens and the Karuhen-Loeve Transform (KLT)." A background presentation is available from the SETI institute (see **Links** below) summarizing Maccone's award winning 1996 text (**References**).

On the eve of the conference it was announced by the Jet Propulsion laboratory that Voyager 1 had finally exited the heliosphere boundary shock region of the solar wind's projection into interstellar space. Of course, this was a fluid medium of a very diffuse but charged nature. The extent and dynamic stability of this boundary has been a subject of continued debate. Jeffrey Nosanov in "Solar System Escape Architecture for Revolutionary Science: A NIAC Study" spoke of this development and pressed for wider exploration of this region with 150-kg spacecraft attached to 250 x 250 meter solar sails, transit time about 15 years. To place this endeavor in perspective, Voyager 1 (reported in another session) is a 722-kg space probe launched on 5 September 1977; circa 15 October 2013 its distance from Earth stood at 126 AUs, the farthest of any known man-made object. It was accelerated into interstellar space by successive Grand Tour planetary flybys coasting away at ~17 km/sec.

Remaining "time and distance" presentations concentrate on operational issues: Jeremy Straub from University of North Dakota examined forerunner robotic exploration prior to human missions in "An Exploration Strategy for an Interstellar Human Precursor Craft." The strategy boils down to autonomy in the face of lag times over light year distances. Similarly, Timothy Meehan from Saber Astronautics offered a company developed risk management and fault identification software tool to address interstellar spacecraft operations in "Reducing Operational Risk for Deep Space Missions through Predictive Modeling." Eray Ozkural of Bilkent University in Turkey surveyed the state of artificial intelligence. Orkuzal predicts, "around 2025, a laptop computer will have enough processing speed to simulate a human brain in real-time." With this expectation his paper outlined a mission design for a robotic expedition to Tau Ceti around 2040 - the *Lewis and Clark* torch ship first stop in Heinlein's *Time for the Stars*.

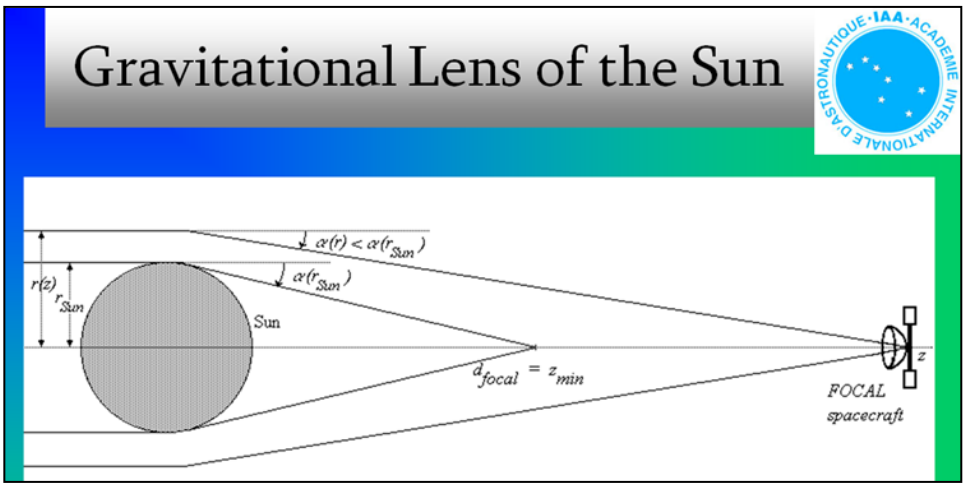


*Figure 2. Solar Gravitational Lens Geometry, Minimum Focal Length = 550 AU and FOCAL Spacecraft Position.*

**A Friday Night Science Fiction Evening**

Robert Heinlein's or Poul Anderson's stories were typical American s/f literature's efforts to offer plausible solutions to star flight generations ago. The social sciences tracks of 100YSS below probably owe more to the British heritage illustrated by Brian Aldiss, Arthur Clarke and Olaf Stapleton; the first, examining life on a millennia-long round trip to Tau Ceti; the last, contemplating sentient life's movement across planets and stars on a time scale similar to the stars' ages themselves. The *Journal of the British Interplanetary Society* (*BIPS*) Interstellar Studies series continues to explore that domain on a quantitative or theoretical basis unparalleled in this country.

But where in the spectrum has current science fiction evolved? We gained a glimpse Friday night (September 20th) via a panel discussion of current writers. The sampling included Mary Doria Russell, Jack McDevitt, Ken Scholes, and Karin Lowachee. Also participating were TV journalist Linda Lorelle, actor LeVar Burton (veteran of *Star Trek – the Next Generation*, but also of the PBS *Reading Rainbow* program) and Jason Batt. In the lively debate which followed, Dr. Russell fired the opening broadside, a 12-step self-help program self-introduction, "Hello, my name is Maria and I am a recovering academic…"

Dr. Russell, whose abandoned (?) field and career was "biological anthropology," said, after learning (perhaps from Howard Zinn's *People's History*) that Columbus was "not necessarily a hero," she decided to re-examine the terrestrial age of exploration in *The Sparrow*, her prize winning 1996 first novel of a voyage to Alpha Centauri in starship *Giordano Bruno*. As a given, with extraterrestrial contact Jesuit

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missionaries take the exploration initiative as they often did four centuries or so earlier. Unlike Zinn, her point of view is religious vs. Marxist; not an accusation against social systems, but the deeper question (like Job's?) of *why* do things go so awry. Another panelist, Ken Scholes, having attended a divinity school himself, shared Russell's focus: dealing with human zeal to spread civilization and faith, on this world today or other planets later. Both examine traditional beliefs on the larger cosmic canvas or else the imagined canvas a cosmic frontier inspires; they explore earlier adventures and replay them in hope of a different result, challenging explanations for suffering, inspired by grief, the neglected dimension of s/f as literature. Admittedly, for Russell starship *Giordano Bruno* was merely the bus, not where her book's truths would abide. Other panel writers addressed these concerns more obliquely– or else stressed continuity in the human condition. In Jack Devitt's words, Roman centurions looked forward to the latest model chariots, hence…

We hope that the conference will video stream this discussion someday.

Viewing of a 2013 science fiction film to the icy Jovian moon Europa followed (*The Europa Report*). Clearly, a kinship existed to the *2001: A Space Odyssey* from 1968, but in discussion that followed bio science session chair Dr. Obalisi submitted that despite the film's eye for detail, it was "The Blair Witch Hunt" in space. Like the V-2 of 1950s movies standing in for presumed larger vehicles, an Atlas V - like vehicle launched a crew of five or six astronauts to Europa to check for life under the ice. They found it, but to their own ruin turned every corner where the audience foresaw disaster. Too bad director and cast were not present as well to explain the motif of the deadpan end. However, discovering that the car was locked in a public garage several blocks away and it was raining, the night's philosophical ruminations came to an end.

**Education on Earth and in Flight**

Dan Hansen chaired the Friday sessions on Education which commenced with "Astrosociology in the Classroom," presented by Kathleen Toerpe from the Astrosociology Research Institute offering an introductory college course: a multidisciplinary and evidentiary approach to instruction covering the astrosocial dimension of space exploration.

Subsequently, two more presentations had similar messages about STEM education. Beside, adding "Art" to science, technology, engineering and mathematics teaching objectives, a case was also made for reaching out to young women students.

The next speaker connected to the parallel sessions on the same floor via the solo performance mentioned above (Debussy: *Nuit d'etoiles* sous tes voiles Sous ta brise et tes parfums; Triste lyre qui soupire Je reve ...). Opera singer and educator Adrienne Provenzano in "Getting All Hands on Deck: Using STEAM- Education Strategies to Include Girls and Women in Interstellar Space Exploration," cited STEM interest surveys showing 75% interest primary school girls, but descent to 20% STEM enrollments at college levels. Examples of The example of artistic pursuits of women astronauts, e.g., flute players Ellen Ochoa and Cady Coleman on the ISS argued for an integrated curriculum approach. "STEaM Power: The Ability to Create Beautiful Minds," by Seattle-based educators Matthew O'Laughlin and Whitney Martin seconded this view, "to show how art is the hook on which difficult concepts hang with ease. Those who learn to use science and art together are the ideal citizens of the future." For Paul Webber with "100YSS Education in Space: Are we ready?" robotics was the education gap, based on the implications of starship autonomy with or without crew.

Liverpool University (UK) researcher Matthew Bullock's "Interstellar Exploration and Colonisation of Exoplanets, Position and Projections" could very well have appeared in the *BIPS* journal with its particular brand of graphic formulation and Kardeshev civilization levels. The broad, galactic view of Olaf Stapleton was apparent. This meant more than simply putting a human footprint on a planetary surface.

As noted above, beside out of town and overseas contributors, 100YSS included local presenters. In the opening address, we were startled to hear Dr. Jemison call out, "…And we also have Frank Hughes here." "Everyone" knew Frank Hughes because in his years of working at astronaut training, beside Dr. Jemison, he had trained *all* of the astronauts. We asked him about this assertion before the evening's sci-fi panel, sitting in the lobby over drinks and reviewing the day's events and telling stories. "Yes and no." As Frank put it, he had arrived at JSC too late to work with John Glenn on his 1962 Mercury flight, but eventually checked him off before Glenn's second orbital mission in 1998 on the STS-95 Shuttle flight. Back in the *Time for the Stars* era, Frank built and fired model rockets in the Montana copper mining town where he grew up. Retired from the NASA JSC as chief of Flight Training since 1999, he now serves with the firm Tietronix as VP for educational and training products.

In "Grappling with 100YSS Psychosocial Problems," Dr. Hughes' basic point was that starship flight reversed most trends in recent human communications much more even than a flight to Mars or an asteroid would: "The near instant communications that humans expect to friends, family and colleagues will gradually dwindle until there is no possibility for immediate conversation anymore. If we reach just 1% light speed, the delay increases by 36 seconds every hour. In 24 hours, delay builds to 14.4 minutes... Communications with Earth will reduce to email and text communication and then to even less as delays mount. News of Earth can keep on coming each day but it will get more stale since the time it was sent will be further in the past. There will be effectively no two-way communications back to Earth that is not stilted and business-like. Over time, all the people you have left behind on Earth will have died as well as the original passengers on the space ship."

This was a fundamental psycho-social problem of crew-ship-mission design and integration.

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## Cover Story

*(Continued from page 9)*

**In Other Plenary Sessions**

In the "State of the Universe," chaired by astronomer and SETI pioneer Dr. Jill Tarter, a distinguished panel provided updates on astronomical developments tangential to interstellar flight. Dr. Adrian Tiplady reported on "South Africa's Square Kilometer Array (SKA)," a development in his homeland that would give the southern hemisphere as much or more radio spectrum astronomical coverage as in the north. Florida State University astrophysicist Hakeem Oluseyi provided the "Cosmology Dark Matter Update" and Ariel Anbar, a survey of "Astrobiology." Jeffrey Nasanov from the Voyager program at the Jet Propulsion Laboratory gave the "Voyager 1 Update." But once again, of local significance, Dr. David Black reported on "Exoplanets."

Many of our readers are probably aware that for decades Dr. Black directed the Lunar and Planetary Science Institute on Bay Area Blvd, the host institute for the annual Lunar and Planetary Science Conference, preparing for its forty fifth year. As early as the mid 1980s, before there were any definite finds, Dr. Black had been publishing reports on exoplanet formation and detection. "TOPS, Toward Other Planetary Systems," was an early survey of the state of knowledge about exo-planets and their detection, compiled by Dr. Black at the LPI.

The plan for the SKA in South Africa begins with 64 parabolic dish antennas known as the MEERcat. The SKA, however, will consist of an array of 1000 receivers. (Question for readers: How will 1000 receivers be spread over a square kilometer? Ten by ten clusters of ten?).

Similarly, in subsequent session titled "Trending Now," Dr. Jeff Kuhn described the "Colossus Telescope" for seeing exoplanets. (See **Figure 2**.) Dr. Ronke Olabisi, an aerospace engineer and medical doctor on the staff of Rutgers University described her life sciences work with crucial import to interstellar flight survival, "Growing Meat, Bones and Other Organics in the Lab." Dr. Armen Papazian described "Money Mechanics for Space" and Dr. Roy Marcus provided, "Fundamentals for Engineering Systems."

Colossus technology addresses the need to decrease the mirror weight per square meter and to provide dynamic mirror "phasing" to allow a large telescope structure that can be much less stiff (and less massive) than conventional structures. An effective 60-80 meter aperture resolution would be obtained by 60 independent off-axis 8m telescopes effectively merged into a telescope-interferometer. The primary consists of 60x8m off-axis parabolic primaries. The secondary structure is less than 5m in diameter with 60 independent 0.5m optics. Every primary is served by its own secondary bringing light into one Gregorian focus.

Dr. Ronke Olabisi obtained degrees in aerospace engineering from MIT and University of Michigan but found tissue engineering to be too fascinating to ignore. She explains that oxygen only diffuses 250 microns, meaning that all engineered tissue must be within 250 microns of each other or they die. Hence, currently grown tissue is very thin. There are ways around this. One way is to leach all the cells of an organ. You can then put in any cells you want in the container of the original organ. In reproduce bones, she encapsulates cells in hydrogels and grows them in a petri dish. Harvesting the cell for graph to a mouse bone growth can be observed. Attempts to grow meat substitutes could prove beneficial considering that the US cattle consume grain enough for 800 million people. Josh Schonwald, a food critic, tasted the first lab-grown beef burger on August 5, 2013. It did not taste good.

**Destination: Space**

As in the 2012 conference Joe Ritter from the University of Hawaii Institute for Astronomy chaired the Destination Session. The institute operates the Mauna Kea Observatory and understandably promotes advances in observing techniques. Dr. Ritter described some advanced ground based observatory systems for better resolution of extra-solar planets (e.g., characterizing their atmospheres). There were returns to and variations on these themes in 2013.

This year Ritter provided two more papers. In "Remote Sensing of Exoplanets and Combined Propulsion, Imaging and Power Generation Subsystems for Starships," Ritter reported a recent technology that could advance all five of the above:

*(Continued on page 11)*

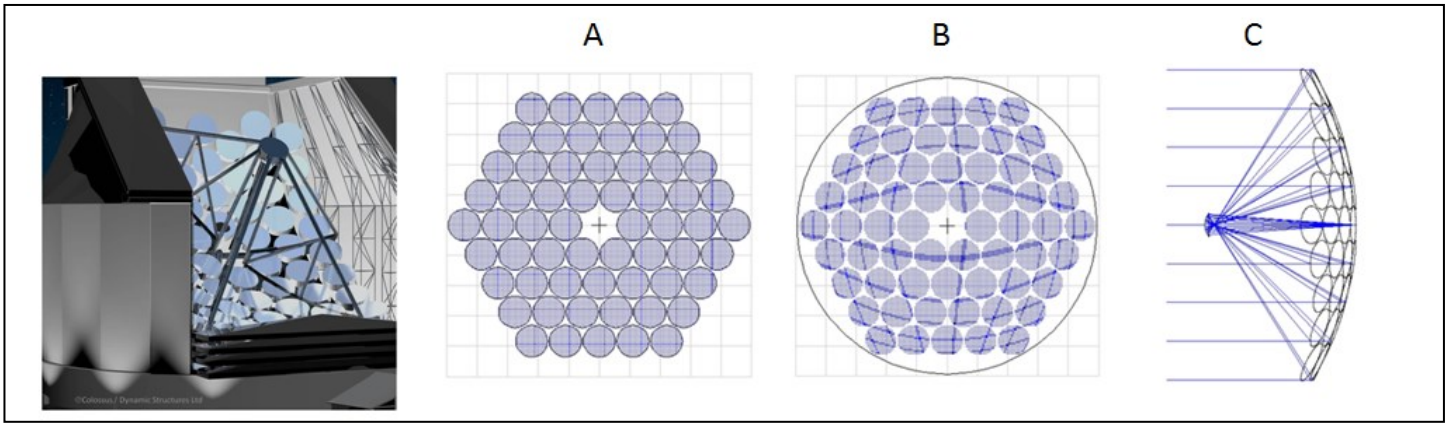


*Figure 3. Colossus Telescope: (A) Primary 8-m Mirrors, 74-m Aperture. (B) Secondary Mirrors within 5-m Structure. (C) Gregorian Telescope Focus.*

(Continued from page 10)

"low density photonic muscle polymer that allows shape nano-actuation using low power lasers."

In a second paper, time tagged photon intensity interferometry employed with inexpensive spacecraft constellations would enable long baseline astronomy and astrometry missions which could improve resolutions by a factor of a thousand (i.e., nano-arcsecond resolution).

In the 100YSS for 2012, several recently discovered exoplanet systems (e.g. near faint M Dwarf stars) were examined as possible starship destinations in this session. Margaret Turnbull in "Destinations to Inspire a Space-faring Generation" spoke to the issue at the back of the minds then and now: "If an attractive destination, or even a list of potentially attractive destinations, were known, the simple desire to go there could overwhelm almost any technical or mental resistance." The list of known worlds, now very numerous and widespread, was reviewed and evaluated once more.

In an earlier Horizons, we reported on William Bottke's LPI public lecture arguing for the widespread existence of unattached exoplanets. Marshall Eubanks, cites gravitational microlensing to similar effect in "Dark Earths - Initial Goals for Interstellar Exploration." With inferred population estimates, the nearest "dark Earth" could be within ~0.5 light year of the Solar System. Larger bodies, likely farther away. Further infra-red survey should tell whether we have a better luck of the draw. Promoters would be well advised to name these objects something like "Greenland."

Among the remaining presentations, Benjamin Solomon in "Empirical Evidence Suggests A Need For a Different Gravitational Theory" cites several investigators' observations of 13 inconsistencies in physical theories supportive of subspace concepts of spacecraft transport across space without expulsion of mass. Solomon, at least joins White and Woodward in search for the means towards this end; however, we did not view the presentation or locate further background. Michael Ziolo's presentations we will discuss together in another section.

## Becoming an Interstellar Civilization and Economics

We noted a tendency on opposite sides of the Atlantic to look at the starship studies through different lenses. Here in the States, we focus on spacecraft specifications or prospective destinations; elsewhere they contemplate what it all might someday mean. In several presentations civilization metrics on the "Kardashev" scale are applied. What in creation is that? A gross measure of a civilization's advancement, based on amounts of energy it is able to use. Three designated levels I, II, and III are indicated in **Table 2** below, and human civilization on Earth right now, for lack of an appropriate Roman numeral, is denoted as zero. A Type I civilization uses all available resources impinging on its home planet, Type II harnesses all the energy of its star, and Type III of its galaxy. First proposed in 1964 by Soviet astronomer Nikolai Kardashev, amendments have been proposed or else incorporated. For example, stars and planets come with radii and flux levels far above and below that of Earth or sun respectively. For example, Jupiter (10x wider than Earth) with its own radiant flux might be mistaken for a level I civilization if we are not satisfied with the giant world model of thermal equilibrium. A level I Earth would be "globally warmed" indeed if most of the power generated were strung out over a wide band around the sun. There might be other metrics to use beside simply power though, and perhaps with relief we can report that encounter of others with "power" has only been hypothetical thus far.

Michael Ziolo, a psychiatrist with the University of Liverpool (UK) is a BIS community member exploring such scenarios, as indicated by "Devising the 'Prime Radiant': A Strategy for Seeding the K0 →K3 Transition." Ziolo also examines dynamic models of world economy for the next 100 years (e.g., World3) and notes: "Permanent space habitation implies an evolutionary 'long jump' far greater than taken by our distant ancestors from sea to land," assuming we as a species are even so intent. The paradox or wonder of economic growth in a limited



resource world of has been examined since Malthus through the Club of Rome and its "Limits to Growth" publications on which the World3 program is based. Ziolo wonders if off-world strategies will win the game.

And speaking of Kardeshev levels, what about actually running into interstellar civilizations already established? In "Astrobiological Matrix" Ziolo suspects human spread into space makes indirect or direct detection or contact with advanced civilizations exponentially more likely. Conversely, less likely if we remain planet bound. Citing Stanislaw Lem's science fiction story "Fiasco" to illustrate how contact could go catastrophically wrong, he recommends more attention to developing a matrix of alien possibilities a priori, at least accounting for life forms based on elements C, H, O, N, P and S. Starting from these fundamentals, should we work our way toward alien psychology? But of course.

We wrote and revised this article amid the federal government shutdown and private investment deliberations over much more modest space ventures. With that introduction we turn to another facet of interstellar metamorphosis from caterpillar stage: interstellar civilization economics. Several speakers addressed this sundry matter, perhaps giving their takes on what Heinlein's Long Range Foundation should be like. At the federal level, energy expenditures per annum (i.e. power), figure into the overall budget deliberations in this fraction of K0 world civilization.

Perhaps a Kardeshev scale can be developed to describe interstellar civilization based on money? Dr. Armen Papazion began his talk contemplating the text on every US dollar: "This note is legal tender for all debts – public and private." Beside the problem of financing an expedition into a vast void like the Chinese did for decades in the 15th century, how do you make a monetary transaction in the vast depths of it. In Roman times, the Mediterranean basin, India and China all conducted trade; money was exchanged, but not

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## Cover Story

*(Continued from page 11)*

directly. Neither China nor Rome were able to reach each other with boatloads of coin. Our current day approach hardly even involves paper any more, but one wonders how you can beam and back a promissory note across light years of space.

In "Economies in a Stellar Civilization – Carrying a Bit of Earth to the Stars" economist Zubin Ray from India notes that value, property and trade, defined on Earth since pre-history really provide no precedent for a space based system with problems including very long time spans for exploitation focused gains and cords tied to Earth. Promotion of private entrepreneurship and investment into space exploration further complicates this equation, requiring "time bound generation value" and necessary socio-legal structures to encourage capital flow. Ray observes:

- ◊ Big corporations gain monopolies and exert strong control on market type, but with strong control, even if a venture is risky, it will still have access to funding.
- ◊ People in the West do not invest in the long-term; there's no multi-generation thinking. Returns must be within their lives. In India they invest across generations.
- ◊ Government tax credit can be an incentive. Fanny Mae allowed everyone to buy a house. Likewise, the government can support research for fifty years by offering reduced rate of return to investor. Like a bond or coupon, it can be recovered in 5, 10, or 20 years.
- ◊ Technology bubbles form from public enthusiasm, but bubble generation is hard to predict. A company that rides a bubble though can earn fabulous wealth. A successful company starts the bubble or ball rolling, but implosion, disillusionment, and crisis need to be watched for by all. "We don't want people to look at astronauts the same way they look at bankers today," Ray observed.

So where does all this leave us? What of the future for Earth, star travel and even 100YSS? In lieu of an Olympics style closing ceremony, we attended the Saturday evening dinner which did not feature a keynote address, but the performance of violinist Kenji Williams, accompanying artists and the video presentation Bella Gaia. Violinist, keyboard and vocalists accompanied a mix of intricate images from space, the wilderness and oceans of Earth and graphic images of human imprint on the planet. First came the Pacific NW coast from the track of the ISS; there followed hydrographic and varied spectral images from around the world. In heliocentric space we could see the Encased in the undulating jellyfish of its magnetosphere trailing away from the sun. At continental scales, we observed the dynamic but dissimilar circulatory cells of the Mediterranean, the Oceans and the Gulf, the wax and wane of snow cover over the Arctic and the Ozone Hole in the south. Measures of population, water and emissions by nation in bar charts rotated into view. "It was a lament," someone at the dais later summarized. Was hope more than 100 million times farther away than the Moon?

We shared a table with attendees to whom we were only briefly before introduced. One of us had asked a propulsion presenter about the use of an exotic fuel: an isotope of Americium for the nuclear fragment fission rocket. Was it nearly as difficult to obtain as say anti-matter? A third party pointed out that Americium was commonly used in smoke detectors, so… The exchange attracted the attention of the attendees from Washington State. As we awaited the performance, Kelvin Lynn demurred that he was not sure whether or not he should have presented a paper, but maybe next year. We asked, "Well, what is it that you do?" His card said he was the director of the Materials Research Institute. "I build and invent positron storage devices…"

Table 2. Kardashev Measurements for Stellar and Interstellar Civilizations – A Cosmic Perspective
Suggested in a paper by Russian Nikolai Kardeshev in 1964, measure civilizations by level of power available.

| Kardeshev Level/Type | Power (watts) | Equivalence or Example |
|---|---|---|
| "0" | $4x10^{12}$ | Current world power production |
| I | $10^{16}$ to $10^{17}$ | Solar insolation of Earth's surface |
| II | $4x10^{26}$ | Total solar radiation output (stars vary orders of magnitude) |
| III | $4x10^{37}$ | Total galactic radiation output |

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1. Millis, M., Davis, E., *Frontiers of Propulsion Science*, AIAA, 2009.
2. Maccone, C., *Deep Space Flight and Communications: Exploiting the Sun as a Gravitational Lens*, Praxis-Springer. 2009.
3. Black, D., TOPS – *Toward Other Planetary Systems*, Lunar and Planetary Science Institute, Houston, TX.


**Links**

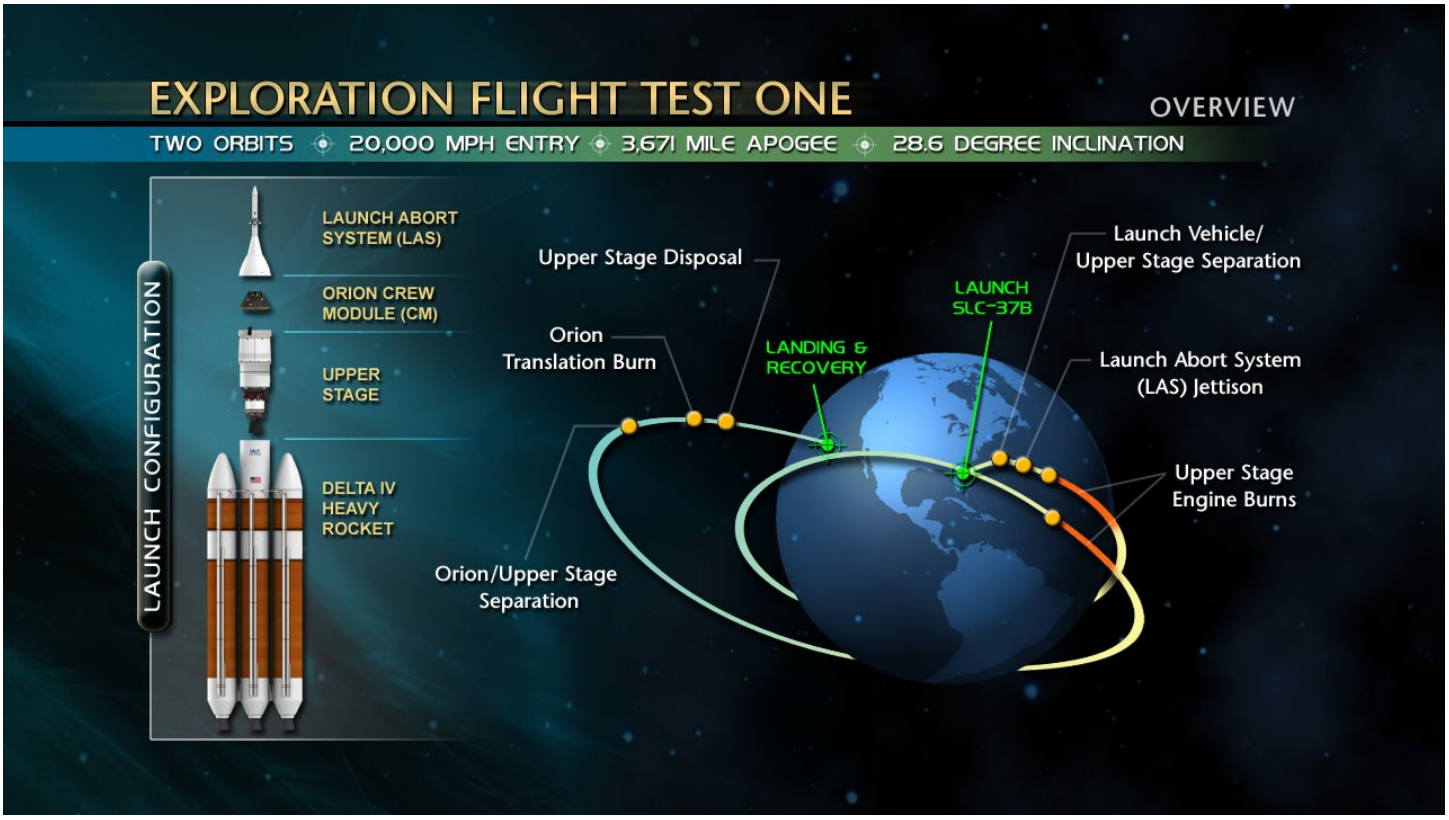
1. http://www.seti.org/seti-institute/weeky-lecture/deep-space-flight-and-communications-seti-klt-and-astronautics-2009
2. http://www.centauri-dreams.org
   Houston 100YSS coverage: http://www.centauri-dreams.org/?p=29122
3. Performance of Bella Gaia with Kenji Williams and accompanying artists
   The Baum Foundation, http://thebaumfoundation.org/environment/bella-gaia
   United Nations Environmental Program, http://vimeo.com/67499493

## Staying Informed

| Exploration Flight Test 1 | |
|---|---|
| Orbits completed | 2 (planned) |
| **Spacecraft properties** | |
| Spacecraft type | Orion MPCV |
| **Start of mission** | |
| Launch date | September 2014 [1] |
| Rocket | Delta IV Heavy |
| Launch site | Cape Canaveral SLC-37B |
| Contractor | United Launch Alliance |
| **End of mission** | |
| Landing site | Pacific Ocean |
| **Orbital parameters** | |
| Reference system | Geocentric |

*Above: Source: Wikipedia. Image credit: NASA.*

*Above: An artists' impression of the first Orion spacecraft in orbit attached to a Delta IV Upper Stage during Exploration Flight Test 1 (EFT-1). Image credit: NASA. Image source: Wikipedia and Flickr.*




*Above: Mission Summary. Image credit: NASA.*

Museum

1940 AIR TERMINAL MUSEUM

*This is a bimonthly column about the 1940 Air Terminal Museum, a 2008 addition to the list of AIAA Historic Aerospace Sites. The museum is restored and operated by the non-profit Houston Aeronautical Heritage Society.*

*1940 Air Terminal Museum*
*8325 Travelair Street*
*Houston, Texas 77061*
*(713) 454-1940*

# 1940 Air Terminal Museum at Hobby Airport An AIAA Historic Aerospace Site

DOUGLAS YAZELL, EDITOR

We reviewed pictures from three monthly Wings & Wheels events on the museum website to find a few great images for this issue of Horizons. The August 2013 Wings & Wheels theme was the Lone Star Lodestar Roundup. Two of the three photographs included here are aerial shots taken by museum volunteer Larry Orr. Museum volunteer Max Tribolet was the pilot.

Wings & Wheels is a monthly lunch-hour-centered celebration at the museum. It takes place on the third Sunday of most months. Classic car owners often accept the invitation to display the vehicles in front of the museum, and aircraft make a spectacular display behind the museum. The museum building itself is a unique sight inside and out. The displays and paintings inside the museum on the ground floor are worth the visit. And the lunch option is usually the popular Flaming Patties gourmet food truck.

This year's raffle airplane winner Allen Langford of Bynum, Texas, came to this event in August of 2013. The drawing was held during the July 2013 Wings & Wheels event. Museum volunteer Blair McFarlain join the winner to fly the airplane Waco, Texas, where hangar space had been secured. On the way to Waco they stopped at the famous Southern Flyer diner in Brenham, Texas.

Wings & Wheels visitors are no longer allowed on the roof of the first or second floor, nor in the control tower. Those visits will be allowed again one day once renovation restores the building to the state required by fire codes.

The old control tower is no longer in use for now, but the newer control tower is even further away from the runways. That's old school! They respect their elders at Hobby Airport!

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*Image credits: The 1940 Air Terminal Museum, Wings & Wheels event of August 2013.*

Opinion

# Climate Change and Local Responses

DOUGLAS YAZELL, EDITOR (ARTICLE #5 IN THIS BIMONTHLY SERIES)

**NATIONAL SCIENTIFIC SOCIETY REACTS TO IPCC REPORT RELEASE**

***REPORT REINFORCES NEED FOR ACTION TO ADDRESS CLIMATE CHANGE, SAYS AMERICAN GEOPHYSICAL UNION***

27 September 2013
WASHINGTON, DC—The following statement is attributable to American Geophysical Union (AGU) executive director/ CEO Christine McEntee:

"Today's release of the Intergovernmental Panel on Climate Change's (IPCC) Assessment 5, Working Group 1 report reinforces what the scientific community has known for some time now: Our climate is changing and human activity is a major influencer. The science is clear and the scientific community is in agreement.

Climate change is already threating our economic health, public safety, and national security. From issues of food security to energy availability, communities, cities, states, and regions across the U.S. and around the world are feeling the effects.

It is not too late to address the impacts of climate change, but the window for meaningful action continues to close. Lessening the negative outcomes will require rapid societal responses that are informed by science and that reflect the perspectives and commitment of all stakeholders, including international, national, regional, and local governments, the business community, the energy industry, scientific researchers, and many others."

The climate change position statement of the AGU:

***Human-induced climate change requires urgent action***

Humanity is the major influence on the global climate change observed over the past 50 years. Rapid societal responses can significantly lessen negative outcomes.

"Human activities are changing Earth's climate. At the global level, atmospheric concentrations of carbon dioxide and other heat-trapping greenhouse gases have increased sharply since the Industrial Revolution. Fossil fuel burning dominates this increase. Human-caused increases in greenhouse gases are responsible for most of the observed global average surface warming of roughly 0.8°C (1.5°F) over the past 140 years. Because natural processes cannot quickly remove some of these gases (notably carbon dioxide) from the atmosphere, our past, present, and future emissions will influence the climate system for millennia.

Extensive, independent observations confirm the reality of global warming. These observations show large-scale increases in air and sea temperatures, sea level, and atmospheric water vapor; they document decreases in the extent of mountain glaciers, snow cover, permafrost, and Arctic sea ice. These changes are broadly consistent with long-understood physics and predictions of how the climate system is expected to respond to human-caused increases in greenhouse gases. The changes are inconsistent with explanations of climate change that rely on known natural influences.

Climate models predict that global temperatures will continue to rise, with the amount of warming primarily determined by the level of emissions. Higher emissions of greenhouse gases will lead to larger warming, and greater risks to society and ecosystems. Some additional warming is unavoidable due to past emissions.

Climate change is not expected to be uniform over space or time. Deforestation, urbanization, and particulate pollution can have complex geographical, seasonal, and longer-term effects on temperature, precipitation, and cloud properties. In addition, human-induced climate change may alter atmospheric circulation, dislocating historical patterns of natural variability and storminess.

In the current climate, weather experienced at a given location or region varies from year to year; in a changing climate, both the nature of that variability and the basic patterns of weather experienced can change, sometimes in counterintuitive ways -- some areas may experience cooling, for instance. This raises no challenge to the reality of human-induced climate change.

Impacts harmful to society, including increased extremes of heat, precipitation, and coastal high water are currently being experienced, and are projected to increase. Other projected outcomes involve threats to public health, water availability, agricultural productivity (particularly in low-latitude developing countries), and coastal infrastructure, though some benefits may be seen at some times and places. Biodiversity loss is expected to accelerate due to both climate change and acidification of the oceans, which is a direct result of increasing carbon dioxide levels.

While important scientific uncertainties remain as to which particular impacts will be experienced where, no uncertainties are known that could make the impacts of climate change inconsequential. Furthermore, surprise outcomes, such as the unexpectedly rapid loss of Arctic summer sea ice, may entail even more dramatic changes than anticipated.

Actions that could diminish the threats posed by climate change to society and ecosystems include substantial emissions cuts to reduce the magnitude of climate change, as well as preparing for changes that are now unavoidable. The community of scientists has responsibilities to improve overall understanding of climate change and its impacts. Improvements will come from pursuing the research needed to understand climate change, working with stakeholders to identify relevant information, and conveying understanding clearly and accurately, both to decision makers and to the general public."

*Adopted by the American Geophysical Union December 2003; Revised and Reaffirmed December 2007, February 2012, August 2013.*

Astronomy

# The JSC Astronomical Society Building an Astronomer's Chair Complete with Sketch Desk and Red Lighting (Part 3 of 7)

JIM WESSEL, JSCAS EDUCATIONAL OUTREACH CHAIRMAN

**The JSC Astronomical Society (JSCAS)**
*www.jscas.net*

This article first appeared in the November 2010 issue of *Starscan*, the JSCAS newsletter.

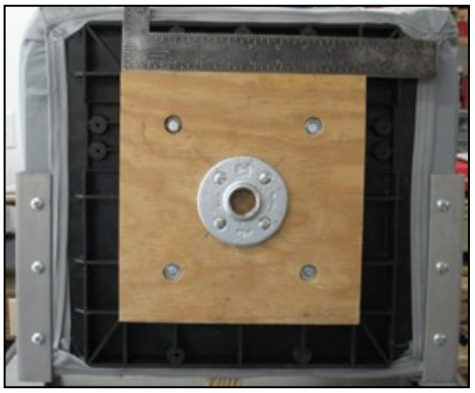
This time we will cover the seat attachment site, and the construction of the armrests and footrest.

**A place for everything, and everything in its place**

Since I elected to use a boat seat as the basis for my astronomer's stool, I feel it's important to discuss the design of the attachment site in detail. This is the 2nd of the two very important spots on the stool that needs to be particularly well made, and failure to do so could have injurious repercussions. We didn't take the seat apart to confirm, but we suspect that the internal screw threads where the retaining screws attach are made of plastic, and likely susceptible to either deforming under pressure, or completely ripping out if enough torque stress were to be applied. Needless to say, we intended this part of the construction to be a "one and done shot" with no re-dos. We were fortunate that this turned out to be the case in our build out. I don't know if boat seats are uniform in their location of screws on the underside of the chair, but I will say that the screws that came with the chair were not satisfactory for our purpose of creating an astronomer's stool, as they were just too short. The original screws were intended to penetrate and hold onto the thin metal "Lazy Susan" either on a johnboat type seat, or at the top of a fixed pedestal. In our case, the screws need to be long enough to hold the chair onto a nice thick piece of plywood (I used ¾" plywood). For the reader's information, the screws needed are going to vary dependent on the manufacturer's design of the boat seat (actually the internal screw housing [depth] inside the side), and your choice of plywood thickness, so plan accordingly. Here is an image of the plastic underside of the boat seat to give you an idea of a starting place for my build out:

If you will compare the previous picture with the following one, you will discern that we measured and cut the plywood square to exactly fit (mine was 9" x 9.5") onto a set of plastic 'ribs' on the underside of the seat. This was planned, and we thought that it would provide the maximum amount of stability (wood against the hard plastic) while minimizing the weight of the plywood. One of the post construction comments addresses this point in greater detail, later. The sizing of this particular piece of plywood is really dependent on the underside of the seat that you decide on. Obviously, we measured and drilled the holes to match the placement of the seat's retaining screws. Here I changed from the original machine to hex head screws, and they were countersunk. In the picture below, you can also see the original pencil marks that were used to determine the exact center of the four screws, which in turn, is the center of support for the seat. The 3/4" pipe floor flange was attached using T-nuts preinstalled on the back side of the plywood before mounting it to the seat bottom. Use of T-nuts prevents having to cut out spaces in the plastic bottom to accept standard nuts and washers.

The following picture shows the integrated unit, with the pipe going into the seat attachment site on the piece of plywood.



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## Astronomy

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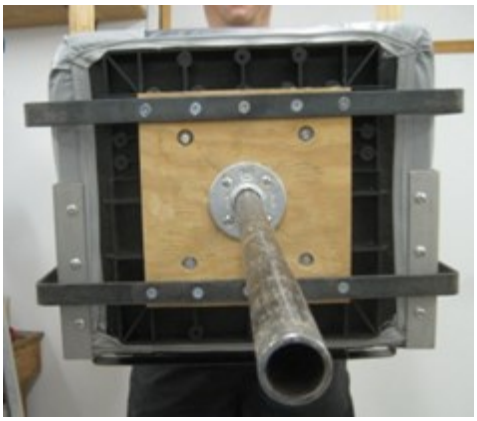
The second major use of this plywood square on the underside of the seat is as a place to attach desired armrests, since the boat seat did not come with them originally. In order to fabricate a reasonable set of armrests, we first needed to determine the optimum width for the supports (where my elbows would naturally rest in the lateral plane) and what height would be comfortable. We made this measurement by me simulating armrests on a scrap piece of plywood (it was wider than any conceivable width I might choose) and changing its height by stacking 2" x 4"s underneath it (all resting in my lap), then measuring both the height and the width from the attached ¾" plywood, via a side view. This or a similar measuring effort will reflect a personal preference for the eventual armrest positions that the reader needs to figure out for himself. Post construction, the right angle measurements of resultant width and height of the armrest supports for my chair are 19" and XX respectively.

I originally bought a pair of 1" x 1/8" metal flats which were bent by hammering in a vise to the desired shape for the armrest supports (see below). After loosely attaching the top wooden piece to the metal support and resting my arms' weight on them, we found that the supports were very susceptible to outward flexing with a minimal amount of weight or pressure. This was a critical design flaw and needed to be addressed immediately.

We countered this problem in two ways. The first was to get a pair of much heavier and harder to bend 3/16" x 1" x 4' steel flats for the arm supports, and the second was to plan on placing an even heavier 1/8" x 1.5" x 6' steel flat around the top of the two side supports and around the back rest of the chair. The addition of the 3 larger metal supports really solidified the rigidity of the armrests. As a result, the armrests now easily support my arms' weight without outward flex, and even better, they will handle the increased load of the sketch desk as well (its construction will be covered later in the description). However, this is not to say that the armrests alone will support my weight (they certainly won't). If I have to adjust my positioning in the chair I have to reach down outside the armrests to the seat itself and lift my weight through my arms pressing against the seat. To start attaching the armrest supports, the chair was inverted, the supports placed in their correct positions, and measurements were taken to evenly distribute the drilled locations for the screws (see following picture). We then countersunk the screw heads into the steel flats to ensure that there were no sharp edges to cut an unwary finger in the dark.

We decided on #8 3/4" flathead wood screws to attach the armrest supports to plywood on the underside of the chair. Pilot holes insured that the screws seated correctly and ended up flush with the surface of the metal without additional wood damage (see picture below). At this time, the top pieces of wood (which were already sanded, and notched to sit on top of the lateral supports) were permanently attached to the metal supports by four #8 1/2" screws, (predrilled to prevent splitting of the thin small pieces of wood), and again countersinking them for safety.



After the lateral armrests were complete, we started measuring the needed length of the top restraining steel flat. Determining where the two bends were to occur was challenging as the seat back needed to be accounted for in its fully upright position, and we did not make the final bend or cut on the steel flat until we were 100% sure they were both exactly correct. Four 1/4-20 x 1/2" screws and nuts were used to connect the overlapping pieces of metal, and any portion protruding past the nut was cut off and ground smooth. A side view and 3/4 view of this step are shown below.

*(Continued on page 19)*

*(Continued from page 18)*

The third and final use of the plywood attachment site under the chair was to support a hanging footrest. A footrest was not an original consideration in the design of the astronomer's stool, but rather something I found out that needed to be addressed when I sat in the chair when it was at full extension. When I was high up in the air, I realized that the weight of my legs was going to eventually crush down the front edge of the foam inside the seat, and cause an uncomfortable pressure point for the back of my upper legs. As a result, we had to brainstorm to think up a suitable method to account for this problem. We considered a wide metal loop, sort of like a stirrup, but noted that it would be a problem for disassembling the stool and putting it in the trunk of my car for transportation to a dark site. We also thought of a simple piece of rope, but found that it was not very comfortable for my legs or feet for long periods of time. So we settled on a combination of a stiff footrest and a flexible hanging system, all of which was attached to the underside of the chair. The following picture will help with the description of the attachment site build out as well as the two ends of the rope which holds the footrest.

As you can see, we drilled two holes through the front steel flat and the underlying plywood for the 2, #2 screw eyes that provide the points of attachment for the 2, "S" hooks at the ends of the piece of rope. The total length of rope necessary was determined by attaching one fixed (completed with a tied-on spring hook) end to the eye screw, the footrest was then placed under my feet, and the other end of the rope fed through the other eye screw – with the rope being pulled and adjusted to different lengths (equaling heights of the footrest) until a comfortable position was found. The rope was then cut and the second "S" was tied onto the free end. To prevent the footrest from sliding along the length of the rope, I placed the footrest at the optimal position, then opened the weave of the nylon and inserted a bolt through it, and then attached a washer on the backside. The same process was repeated for the rope at the other end of the footrest, and as a result, movement is minimal.

But let's not get ahead of ourselves, before you make the end connections on the rope you need to have the footrest in between, and that design process is outlined here. To make footrest, we took a scrap piece of 2" x 4" and visualized what would be the maximum width I would need for a comfortable placement of my feet. My measurement was found to be 18", and we took a 1/2" X 18" drill bit, and drilled through the center of the board lengthwise from both ends. This wasn't an easy task, as a long drill bit is prone to torque and curving along its length, and we eventually had to repeat the whole process a second time as the bit broke through the side of the board on the first attempt. Afterwards, we threaded a 4' section of nylon rope through the hole to get to the stage of construction shown in the picture below.

Since we had previously built out the supports for the pedestal we had a fair idea of where the hanging footrest would come into contact with the plywood supports for the pedestal. As you can imagine, a moveable 2" x 4" swinging into and hitting on the edge of a piece of plywood is going to cause considerable damage to both pieces of wood. We fixed this issue by putting ½" angle onto the four long corner edges of the footrest (similarly, the plywood had 3/8" channel put on its outside edges for its protection). You can get a better idea of the completed hanging footrest in the following picture.

Next Time: Construction of the supporting "legs" and "feet."

*(Continued on page 20)*

## Astronomy

*(Continued from page 19)*

*Below: Education and public outreach from the Lunar and Planetary Institute includes "Cosmic Explorations: A Speaker Series."*

http://www.lpi.usra.edu/education/lectures

### JSC Astronomical Society Calendar

**Upcoming Items from the JSCAS Calendar (Copied on October 12, 2013)**

*Our JSCAS meetings are held on the second Friday of every month at 7:30 P.M. in the auditorium of the USRA building (almost always at this location): 3600 Bay Area Blvd, at the SW corner of the intersection with Middlebrook Drive.*

**2013**

| | |
|---|---|
| November 8, 2013: | Dr. Stanley Love, NASA/JSC, *The Antarctic Search for Meteorites: Exploring an Ice Planet.* |
| November 9, 2013: | Family Space Days Star Party at LPI |
| December 13, 2013: | Winter Solstice Party |

**2014**

| | |
|---|---|
| January 10, 2014: | Bob Taylor, *2013 Astronomy Year in Review* |
| February 14, 2014: | Don Halter, TBA (To Be Announced) |
| March 14, 2014: | TBA (To Be Announced) |
| April 11, 2014: | Paul Maley, JSC Trip to Fort McKavett, April 24-27, Tentative |
| May 9, 2014: | Texas Star Party, May 25-June 1 |

# Space: Drawings, Fears, and the Dreams of Children

PHILIPPE MAIRET, 3AF MP

A while ago, in December of 2012, I suggested to my son Loup, when he was nine years old, that he create a drawing about space. I told him, "Loup, draw what you want," and I said, "Add a question or a sentence, and add your signature."

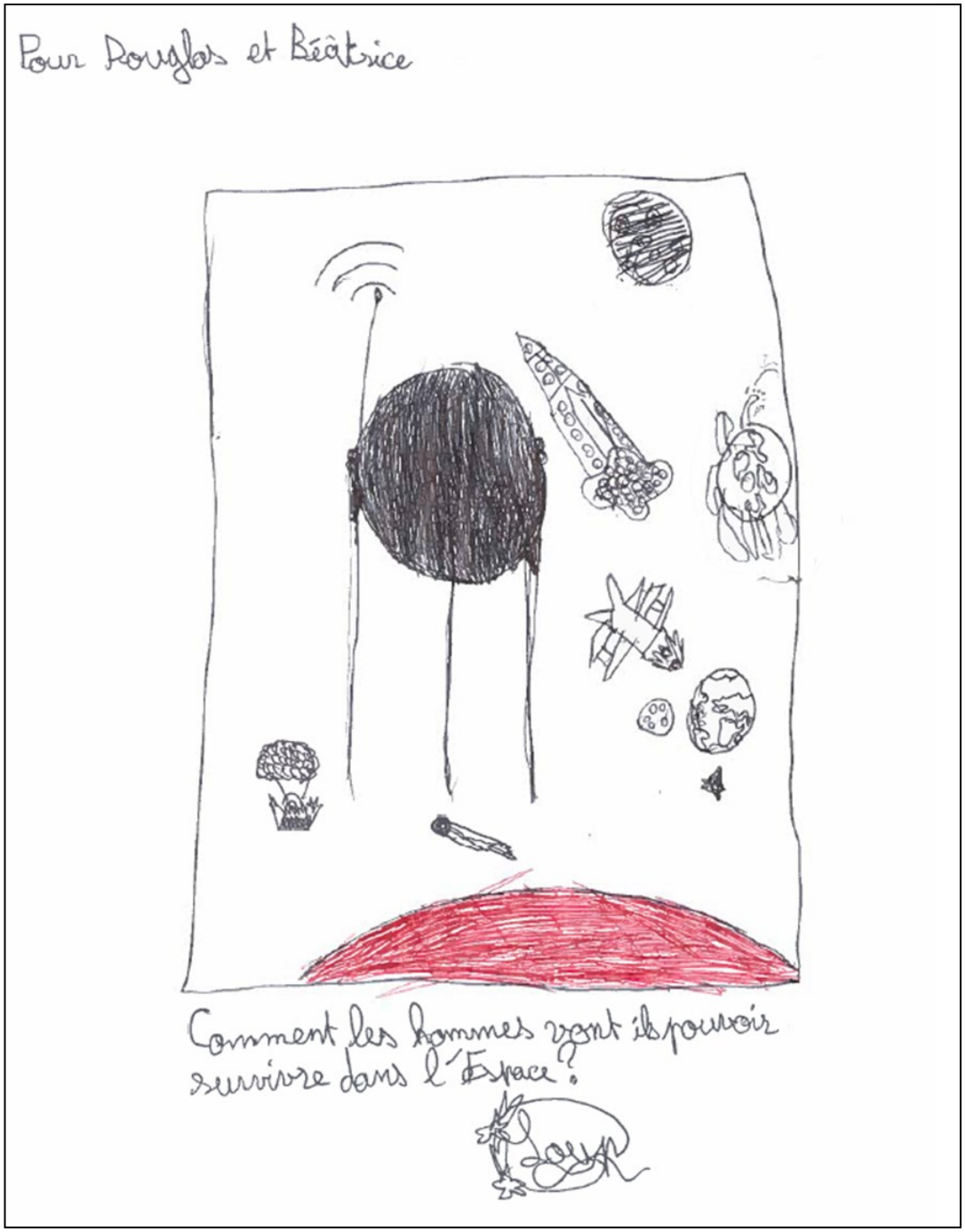
Children have a way of conceiving space which can vary from one to another. For some children, "Space is for escaping," such as in the Disney Pixar movie WALL-E. The characters flee in rockets to another planet to escape an ecological disaster on Earth. This was mentioned by a colleague recently in la Gazette #28, the newsletter of l'Association Aeronautique et Astronautique de France, Midi-Pyrenees (3AF MP) Chapter. Others, like Loup, ask themselves the question, "How will people be able to survive in space?"

Still others dream in their infancy of planets and the Moon. They sometimes draw them. Less common are those who draw comets and even asteroids. Children who want to become astronauts, cosmonauts, spationauts, or taikonauts are an older age.

*[AIAA Houston Section member and Chinese sister section contact person Marlo Graves tells us the Chinese prefer the word astronaut instead of taikonaut.]*

Although some children neither dream of space nor have nightmares about space, let us allow children the freedom to imagine the future of the Conquest of Space.

*[Editor's note: When he wrote this article, Philippe Mairet was not thinking about our Horizons reprints of the 1950s Collier's magazine series, Man Will Conquer Space Soon! I arranged the translation above so that the last words are, "Conquest of Space." This issue of Horizons presents the last of eight installments of this Collier's series. Mairet's writing about the conquest of space above is a nice coincidence.]*



Astronomy

# Comet ISON: Bang or Bust?

Dr. Patrick E. Rodi

Comet C/2012 S1 was discovered in September 2012 by Russian astronomers Vitali Nevski and Artyom Novichonok using data from the International Scientific Optical Network (ISON), and is commonly known as Comet ISON. This sun-grazing comet is predicted to reach perihelion on November 28, 2013 (Thanksgiving Day), when it will pass at a distance of only 730,000 miles above the star's surface (~2.7 solar radii from the center of the Sun). Based on its trajectory it is believed that this comet came from the Oort Cloud and has never passed by the Sun before. Therefore it could have a large quantity of fresh material to out gas. If true, this comet could produce a very bright tail that could possibly be visible during the day on Earth. As of late October, scientists believe that about 2.2 million pounds of gas are escaping the comet every day. Comet ISON was photographed on October 8, 2013 by Adam Block of the University of Arizona. His image is shown in Figure 1.

In early 2013, a light curve was generated to illustrate the comet's brightness with time. By extrapolating these data, a very bright comet was predicted. However, it has since exhibited a "slowdown event" in its rise in apparent brightness and is now only expected to reach an apparent magnitude of −3 to −5, or about the same brightness as Venus. This type of behavior has been exhibited by many other Oort cloud comets.

*Figure 1. Comet ISON photographed on October 8, 2013. Image credit: Adam Block, University of Arizona.*

Comet ISON is expected to appear the brightest around perihelion; however, it will be less than 1° of arc from the Sun at its closest, making it difficult to observe against the Sun's glare. The comet's surface temperature at perihelion is expected to approach 5,000° F. Additionally, it will be within the Sun's Roche radius (where the Sun's tidal forces first overpower the comet's self-attraction forces), meaning it might disintegrate. In December, it will be growing dimmer, but assuming that it remains intact, it will be visible from both hemispheres of Earth. After perihelion, its outbound trajectory will take it north on the celestial sphere, passing within two degrees of Polaris on 8 January, 2014. Earth will pass near the comet's path around January 14-15, 2014. Any residual comet dust could create a meteor shower.

In late September, Comet ISON passed by Mars and the High Resolution Imaging Science Experiment camera on NASA's Mars Reconnaissance Orbiter captured a number of photographs of the object, shown in Figure 2.

Additionally, a video showing observations from NASA's Deep Impact Mission is available at Space.com. NASA's pair of Solar TErrestrial RElations Observatory (STEREO) spacecraft will have a good view as the comet passes close to the sun. Illustrations showing the predicted path of the comet through the STEREO spacecrafts' fields of view are available at a NASA website.

Will Comet ISON be the "comet of the century," fizzle out, or disintegrate? No one is certain. But in the next few months, we will have a front row seat for the celestial show.

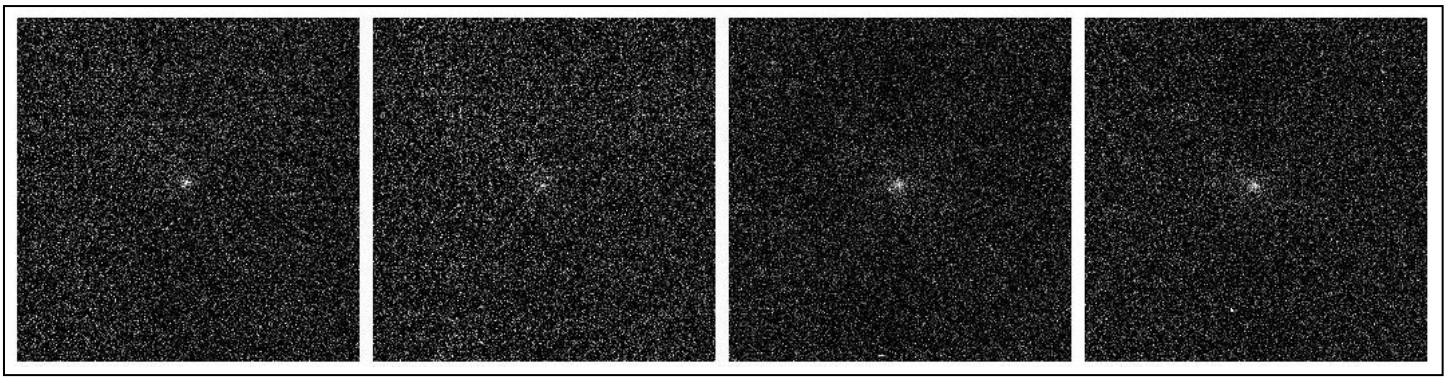


*Figure 2. Comet ISON photographed by the Mars Reconnaissance Orbiter on September 29, 2013. Image credit: NASA.*

# Address to AIAA Houston Section about the late James C. McLane, Jr., Part 2 of 6

JAMES C. MCLANE III

James C. McLane, Jr.
1923 - 2012

June 13, 2013

His years in the society were marked by many curious developments. But I am most proud of his efforts to establish a liaison, back in the early 1990's between the AIAA Houston Section and the Shanghai Astronautical Society, possibly China's closest technical match to the AIAA. I'll try to explain how this relationship came about.

The current restrictions on technical interfaces with foreigners are especially clear to those of us who got to experience the relatively open exchange of information and technology during the early days of NASA. Current limitations have made fraternal contacts with foreign entities more difficult than ever. The AIAA and many other technical associations have had to learn to function under strict rules regarding technology transfer to foreign countries. This has hindered efforts to foster international cooperation in human space flight. An exception has been NASA's special technical exchange relationship with the Russians which has enabled us to build the successful International Space Station. The Station is a great example of how technology exchanges can benefit the international community and serve the interest of the US at the same time. This US/Russian arrangement was pioneered by the Apollo Soyuz test project of the mid 1970's, a program that developed a trust between two countries who were at the time engaged in ruthless and inefficient competition. My father was very involved in Apollo Soyuz – but more about that later.

A brush with cancer convinced my Dad to retire early at the age of 60. He and my mother took up world travel. They went on a number of commercial tours to places like Europe and the Middle East. My father happened to be a member of the American Vacuum Society. This organization supported educational foreign trips under the "People to People" initiative, a program begun in the 1950's by President Eisenhower. These exchanges involved visiting host countries and meeting with people there who were in your own professions. In that capacity my parents were able to travel extensively in Russia, Japan and China where they met engineers and toured industrial and scientific facilities.

My folks really liked China, which at that time was definitely a "third world" country, but a place with great aspirations and enthusiasm, especially in regards to Space. Some Chinese engineers my father met invited him to return to lecture on space environment simulation. China at that time was so backward that my father's travel expenses were paid by a United Nations grant to developing nations. His lectures were patterned after a series that he had already presented at the University of Tennessee Space Institute. It took quite a while for the US State Department to approve the venture, but the trip was made and was very successful. By that time my father had become well acquainted with senior engineers in the Chinese space program and he thought it was a good time to explore a formal relationship between the AIAA and a parallel Chinese technical entity.

A sister section arrangement between the local AIAA section and the Shanghai Astronautical Society was the eventual result of that idea. The agreement resulted in exchanges of society newsletters and hosting of visitors by the society members in the respective countries. All together my parents made five trips to China, trips which included visits to rocket and satellite fabrication facilities and launch sites. I recall my dad said that one plant they visited made big boosters in one area and washing machines in another! There are probably some folks in this audience who traveled to China with my parents on trips hosted by the Chinese engineers.

The Chinese Sister Section relationship, as indeed many associations with foreign entities, became much more challenging after 911 and the increasing restrictions on information exchanges with foreigners imposed by ITAR rules that restrict sharing of technical, information.

*Above: Jim & Dorothy McLane and space scientists from the Shanghai Astronautical Society, on November 3, 1994, at the McLane home, 1702 Fairwind Road, Houston. The interpreter is Kylin Lee. Image credits: James C. McLane III.*

Calendar

**All calendar items are subject to change without notice.**

**Section council meetings (email secretary2013[at]aiaahouston.org)**

Time: 5:30 - 6:30 PM usually
Day: First Tuesday of most months except for holidays.
Location: NASA/JSC Gilruth Center is often used. The room varies.

**Upcoming Section events**

Audiobook in work by Ted Kenny, NASA/JSC, Chair, AIAA Houston Section History technical committee, *Suddenly Tomorrow Came, A History of JSC*. The author of this 1993 book is Henry C. Dethloff. See that web page for author information and a short bio.

**2013 Conferences www.aiaa.org (Events link)**

3 - 7 November 2013, Ribeirao Preto, 22nd International Congress of Mechanical Engineering – COBEM 2013
5 - 7 November 2013, Frankfurt, 8th International Conference Supply on the Wings

**2014 Conferences www.aiaa.org (Events link)**

13 - 17 January 2014, National Harbor, Maryland, 16th AIAA Non-Deterministic Approaches Conference
13 - 17 January 2014, National Harbor, Maryland, 22nd AIAA/ASME/AHS Adaptive Structures Conference
13 - 17 January 2014, National Harbor, Maryland, 32nd ASME Wind Energy Symposium
13 - 17 January 2014, National Harbor, Maryland, 52nd AIAA Aerospace Sciences Meeting
13 - 17 January 2014, National Harbor, Maryland, 55th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference
13 - 17 January 2014, National Harbor, Maryland, 7th Symposium on Space Resource Utilization
13 - 17 January 2014, National Harbor, Maryland, AIAA Atmospheric Flight Mechanics Conference
13 - 17 January 2014, National Harbor, Maryland, AIAA Guidance, Navigation, and Control Conference
13 - 17 January 2014, National Harbor, Maryland, AIAA Modeling and Simulation Technologies Conference
13 - 17 January 2014, National Harbor, Maryland, AIAA Science and Technology Forum and Exposition (SciTech2014)
13 - 17 January 2014, National Harbor, Maryland, AIAA Spacecraft Structures Conference (formerly the AIAA Gossamer Systems Forum)
26 - 30 January 2014, Santa Fe, New Mexico, 24th AAS/AIAA Space Flight Mechanics Meeting
27 - 30 January 2014, Colorado Springs, Colorado, Annual Reliability and Maintainability Symposium (RAMS) 2014
2 - 6 February 2014, Atlanta, Georgia, American Meteorological Society Annual Meeting
1 - 8 March 2014, Big Sky, Montana, 2014 IEEE Aerospace Conference
24 - 26 March 2014, Lille, France, 49th International Symposium of Applied Aerodynamics
30 April 2014, Washington, DC, 2014 Aerospace Spotlight Awards Gala
5 - 9 May 2014, Pasadena, California, SpaceOps 2014
26 - 28 May 2014, St. Petersburg, Russia, the 21st St. Petersburg International Conference on Integrated Navigation Systems
5 June 2014, Williamsburg, Virginia, 2014 Aerospace Today and Tomorrow
16 - 20 June 2014, Atlanta, Georgia, 11th AIAA/ASME Joint Thermophysics and Heat Transfer Conference

# Automated Transfer Vehicle Mission Control Center (ATV-CC)



EUROPEAN SPACE AGENCY WEBSITE

## ATV CONTROL CENTRE

The main function of the Automated Transfer Vehicle Control Centre (ATV-CC) is to operate Automated Transfer Vehicles (ATV).

In the elegant, modern 'Fermat Building' of the Toulouse space centre, the French space agency CNES, under a contract signed with ESA in 2003, developed and operates, a complex space control centre specialised in handling ATV missions in orbit.

Under the authority of ESA, ATV-CC is responsible for the preparation and validation of the monitoring and control tools used by the 30 mission control staff during the flight. The Control Centre is also responsible for carrying out the programmed mission plans and, if needed, to implement any changes.

ATV-CC Flight Control Room

Additionally the Centre is in charge of the orbitography, the localisation of ATV and monitoring its approach to the International Space Station. This is a challenging task, requiring a very high degree of technical skill.

Among the different flight control and piloting capabilities, ATV-CC also directs the undocking of ATV from the International Space Station. The Control Centre can command an operation to keep ATV in the vicinity of the International Space Station for up to eight weeks and, if needed, even perform a re-docking.

An ATV mission requires complex interactions and shared responsibilities between space organisations dispersed throughout the world.

Team at work in the ATV Control Centre

ATV-CC works with the Guiana Space Centre, in charge of launch and deployment of ATVs. For rendezvous, docking and departure, ATV-CC works in close coordination with the Mission Control Centres in Moscow and Houston.

All ATV ground control commands are issued from Toulouse. For example, in case of a major malfunction during the rendezvous, ATV-CC, as well as the Space Station crew, can initiate the Collision Avoidance Manoeuvre to move the 20-tonne spaceship away from the Station before attempting another rendezvous the next day.

To allow continuous coordination with the other control centres and to remain in constant contact with ATV during a mission ATV-CC relies on the Interconnection Ground Subnetwork, which is based at the German Space Operations Centre, at Oberpfaffenhofen in Germany. ATV-CC is directly linked to the Columbus Control Centre, which also plays the role of the central node of the communications network with ESA's partners.

Last update: 4 June 2013

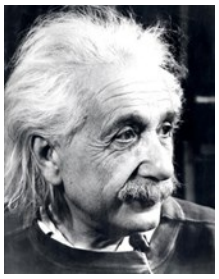
***Above: ATV Control Centre is housed in the CNES Fermat Building in Toulouse***
*Fermat Building at the Toulouse Space Centre houses the Automated Transfer Vehicle Control Centre (ATV-CC). The French space agency, CNES, was responsible for the development of the Control Centre, and prepares, coordinates and supports all ATV operations on behalf of ESA. Copyright: CNES.*

***Above: ESA mission controllers on console***
*Released: 16/02/2011 4:38 pm. Copyright: CNES/S. Girard, 2011. ESA mission controllers on console at ATV-CC on 15 February 2011, during the first launch attempt for ATV Johannes Kepler. Foreground: Jean Christophe Ronnet; background: Jean Michel Bois.*

***Above: ATV-CC during Ariane launch attempt 15 February 2011***
*Released: 16/02/2011 4:38 pm. Copyright: CNES/S. Girard, 2011.*

## Section News


*Image credits: ESA.*



From AIAA Daily Launch, October 28, 2013

**ATV-4 Spacecraft To Undock From ISS Today.** Russia's RIA Novosti (RUS) (10/28) reports the ESA's ATV-4 cargo spacecraft is expected to undock from the ISS today. It will then be five days before it is sent into the atmosphere to burn up. According to the article, the spacecraft will be positioned so the ISS astronauts can observe what takes place in order to gather information that "might be useful for calibrating future reentries." Jean-Michel Bois, head of the ATV operations team in Europe, said this was a "fitting end" for the vehicle.



## *Association Aéronautique et Astronautique de France (3AF)*

***Sister Section of AIAA Houston Section since 2007***
***Jumelée avec AIAA Houston Section depuis 2007***

3AF Association Aéronautique Astronautique de France — **Midi-Pyrénées**

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(F. Renard, accountant)

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**Vice-President for Space**
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- Youth committee: B.Tarrade
- Programme planning: O. Marty/ Y.Roncin
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  - ISAE: J.Huet
  - IPSA: ( B.Tarrade)
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- Light Aviation & Derived Machines: J.L. Chanel
- Environment : (D.Collin: TBC)
- Exploration and Observation of Space: M. Rieugnié

## Boeing Completes Mission Control Center Interface Test

Section News

*Sept 13, 2013, Rebecca Regan, John F. Kennedy Space Center*

For the first time, the Mission Control Center (MCC) at NASA's Johnson Space Center in Houston has tested communications with a commercial, crew-capable spacecraft, as The Boeing Company conducted an interface test between the MCC and software planned for the company's CST-100 spacecraft.

Boeing has partnered with NASA to develop a fully integrated crew transportation system, with its CST-100 spacecraft and United Launch Alliance Atlas V rocket, in partnership with NASA's Commercial Crew Program (CCP). New commercial spaceflight capabilities being developed by NASA partners through commercial crew initiatives could eventually provide services to transport astronauts to and from the International Space Station, launching from U.S. soil.

*Image credits: Boeing (artist concepts).*

# *The American Institute of Aeronautics and Astronautics (AIAA)*

AIAA Houston Section
Since 1962

*P.O. Box 57524*
*Webster, TX 77598*

*Executive Council*
*July 01, 2013 - June 30, 2014*

www.aiaahouston.org

*Downloaded October 29, 2013*

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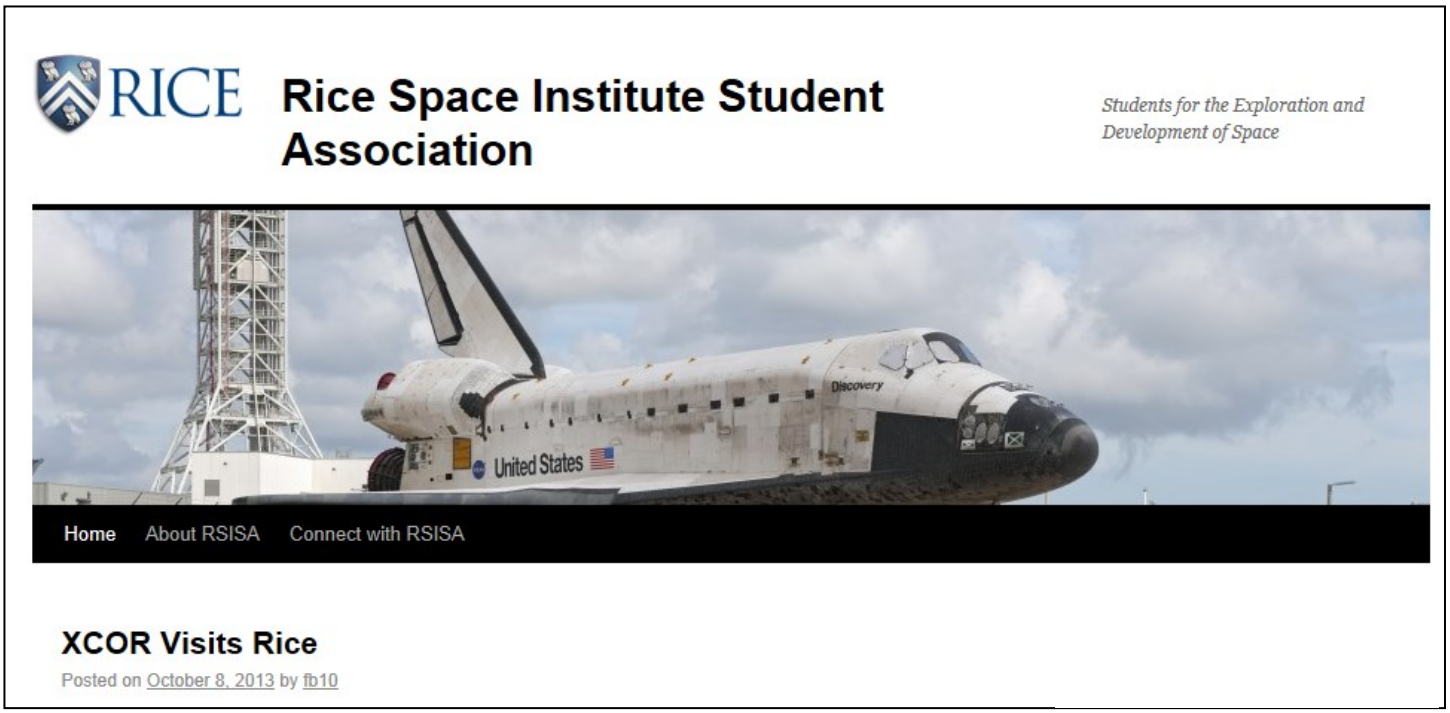
**International Space Activities Committee**
Ludmila Dmitriev-Odier / USA
832-524-6307 (w)

*Updated August 14, 2013 , Executive Council Voting Members (20) are identified by:*

## Student Section News

Rice University AIAA Student Section Advisor:
Professor Andrew Meade, *meade[at]rice.edu*
*713-348-5880, www.ruf.rice.edu/~meade/*


*Above: Image credit: Rice University.*




*Above: The Rice Space Institute Student Association (RSISA) is not associated with AIAA, but we have similar interests. The RSISA and the image above were noticed by Horizons team members on Monday, October 28, 2013. The date of the XCOR visit is not specified.*


*Above: Image credit: Rice University.*

**Student Section News**
Please send inputs to Dr. Gary Turner, our College and Co-Op Chair. His e-mail address is: *collegecoop2012[at]aiaahouston.org*
His backup for this task is Editor Douglas Yazell: *editor2012[at]aiaahouston.org*. Our Section's web page lists the related websites. We publish most bimonthly issues at www.aiaahouston.org by the last day of each even-numbered month, and the submissions deadline is three weeks earlier. The November / December issue is an exception. It is published by December 10, not December 31.

The Texas A&M University AIAA student section started work on its web site for the new year as of August 10, 2012:
http://stuorg-sites.tamu.edu/~aiaa/
Faculty advisor: Professor John E. Hurtado, *jehurtado[at]tamu.edu*, 979-845-1659.

## Student Section News

*The student section is not associated with climate change studies, but climate change is a subject of interest for AIAA and NASA.*

| | |
|---|---|
| **Facebook** | American Institute of Aeronautics and Astronautics: Texas A&M Chapter |
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### Student Section News

Please send inputs to Dr. Gary Turner, our College and Co-Op Chair. His e-mail address is: *collegecoop2013[at]aiaahouston.org*
His backup for this task is Editor Douglas Yazell: *editor2013[at]aiaahouston.org*. Our Section's web page lists the related websites.
We publish most bimonthly issues at www.aiaahouston.org by the last day of each even-numbered month. The submissions deadline is three weeks earlier. The November / December issue is an exception. It is published by December 10, not December 31.

## Experts on Climate Change

Texas A&M University TAMU Times article
September 26, 2013, adapted from the press release

The College of Geosciences at Texas A&M University has experts who can answer media inquiries about the science of climate change, especially as it relates to the upcoming United Nations Intergovernmental Panel on Climate Change (IPCC) report.

The IPCC, specifically its Working Group I that evaluates the physical science of climate change, will present its Fifth Assessment Report Summary for Policymakers September 27, 2013, in Stockholm, Sweden.

While the report is unlikely to contain much new information regarding the well understood basics of planetary warming such as greenhouse gases and greenhouse heating, ocean acidification, or sea level rise, it is likely to convey a message of increased scientific certainty of how humans have affected global climate, and the steadily increasing risks to societies under current global business-as-usual CO2 emissions scenarios.

A persistent gap remains between the scientific consensus on global warming and the public's perception of these science results. The science results say Earth is warming, this warming is dominated by human greenhouse gas emissions, and continued unmitigated emissions will have significant adverse societal impacts. Thus, accurate reporting to the public is an important service. Geosciences faculty can work with media in assessing the IPCC report and the science, policy and public perception of climate change.

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## Collier's 1952-54

# Man Will Conquer Space Soon! (1952-54)

DOUGLAS YAZELL, EDITOR

***The Horizons Collier's Team***

*Douglas Yazell, Editor*
*Scott Lowther, Aerospace Projects Review (APR)*
*Dr. Albert A. Jackson IV*
*Ron Miller, Black Cat Studios*
*Melvin Schuetz, bonestell.com*
*Frederick Ira Ordway III*
*John Sisson, Dreams of Space*
*Arthur M. Dula*
*Shirazi Jaleel-Khan*

*Quite a few more people make these articles possible, including the Horizons team listed on page 2. Thanks to all involved!*

Thanks to a great team of volunteers, this issue of Horizons presents the last of the eight installments in this famous Collier's series of space articles from 1952 to 1954, *Man Will Conquer Space Soon!* This issue of Horizons is the eighth consecutive bimonthly issue used for this project. It was a big job, but we get more out of this volunteer work than we put into it.

Since Horizons is archived on two websites, these page-by-page, high-resolution reprints will always be available. The AIAA Houston Section website is www.aiaahouston.org/newslettter. Horizons is free for anyone to download at this

*(Continued on page 31)*

| | "Man Will Conquer Space Soon!" in 8 Issues of the Weekly Magazine Collier's 1952-54 | Cover Image | Page Count |
|---|---|---|---|
| **1** | March 22, 1952: Man Will Conquer Space Soon!<br>What are we Waiting For? pp. 22-23, The Editors<br>Crossing the Last Frontier, pp. 24-29, 72, 74, Dr. Wernher von Braun<br>A Station in Space, pp. 30-31, Willy Ley<br>The Heavens Open, pp. 32-33, Dr. Fred L. Whipple<br>This Side of Infinity, pg. 34, Dr. Joseph Kaplan<br>Can We Survive In Space? Pp. 35, 65-67, Dr. Heinz Haber<br>Who Owns the Universe? Pp. 36, 70-71, Oscar Schachter<br>Space Quiz Around the Editor's Desk, pp. 38-39 | Yes | 25 |
| **2** | October 18, 1952: Man on the Moon<br>Man on the Moon, p. 51, The Editors<br>The Journey, pp. 52-58, 60, Dr. Wernher von Braun<br>Inside the Moon Ship, pg. 56, Willy Ley | Yes | 11 |
| **3** | October 25, 1952: More About Man on the Moon<br>The Exploration, pp. 38-40, 44-48, Dr. Fred Whipple & Dr. Wernher von Braun<br>Inside the Lunar Base, pg. 46, Willy Ley | No | 10 |
| **4** | February 28, 1953: World's First Space Suit<br>Man's Survival in Space, 10 Contributors & 3 Artists, edited by Cornelius Ryan<br>pp. 40-41<br>Picking the Men, pp. 42-48 | Yes | 10 |
| **5** | March 7, 1953: More About (Continuing) Man's Survival in Space<br>Testing the Men, pp. 56-63 | No | 8 |
| **6** | March 14, 1953: How Man Will Meet Emergency in Space Travel<br>Concluding Man's Survival in Space: Emergency! pp. 38-44 | Yes | 9 |
| **7** | June 27, 1953: The Baby Space Station: First Step in the Conquest of Space<br>Baby Space Station, pp. 33-35, 40, Dr. Wernher von Braun with Cornelius Ryan | Yes | 6 |
| **8** | April 30, 1954: Can We Get to Mars? / Is There Life on Mars?<br>Is There Life on Mars? pg. 21, Dr. Fred L. Whipple<br>Can We Get to Mars? pp. 22-29, Dr. Wernher von Braun with Cornelius Ryan | Yes | 10 |

This issue

*Above: Man Will Conquer Space Soon!, a series of articles from 1952 to 1954, from the weekly magazine Collier's.*
*Source for most of the table: Wikipedia, Man Will Conquer Space Soon!, an article first written by John Sisson.*

*(Continued from page 30)*

address. The AIAA national website for a Horizons archive is specified in the Editor's column on page four of every recent issue of Horizons. A username and password are probably required.

Wernher von Braun was a great American whose talents were on display as he led this Collier's team of writers, artists and editors. John Sisson (creator of the *Dreams of Space* blog) showed us that advertisement for this Collier's series, an advertisement saying that if we build that Earth-orbiting space station, "*We can guarantee peace—forever!*" I doubt that von Braun wrote that. It was probably written by an employee of the weekly magazine Collier's.

AIAA Houston Section member Dr. Albert A. Jackson IV wrote about this Collier's series in Horizons in 1992 for the 50th anniversary and in 2002 for the 60th anniversary. For the 70th anniversary, he was part of this Horizons Collier's team. Al is also a Fellow of the British Interplanetary Society and an AIAA Associate Fellow.

Horizons started this Collier's reprint series in our July / August 2012 issue. The NASA human space program suffered a cancellation of its Moon-centric *Moon, Mars and Beyond* Constellation program in February of 2010, though the Orion crew capsule was revived in April of 2010. A NASA manager speaking at an AIAA Houston Section event explained about some troubles with Orion, including the units system to be used, English or metric. He explained that commercial companies were willing to change from English to metric units as long as NASA was willing to pay for the cost of that change. DARPA and NASA/Ames created the 100 Year Starship (100YSS) program, and its first public symposium took place in Orlando, Florida, in September and October of 2011. The winning team is led by space shuttle astronaut Mae Jemison. The monetary award for 100YSS is a one-time sum which probably could not last for one year, much less 100 years, but 100YSS is doing very well so far.

## Collier's 1952-54

There are many visions available now for our world's human space programs. NASA is proposing exciting missions for its human space program, such as the current Asteroid Retrieval Mission (ARM).

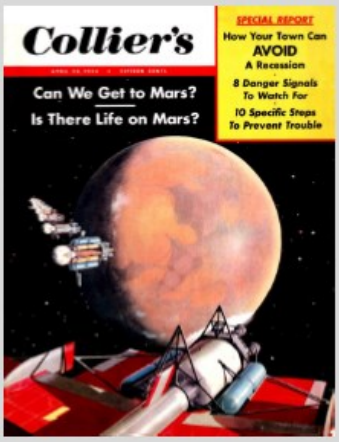
The Collier's series serves as an unforgettable example of *dreams of space* with one's feet firmly planted in reality.



Issue 3 of 8:
The cover image
is not related to
*Man Will Conquer*
*Space Soon!*


Issue 5 of 8:
The cover image
is not related to
*Man Will Conquer*
*Space Soon!*

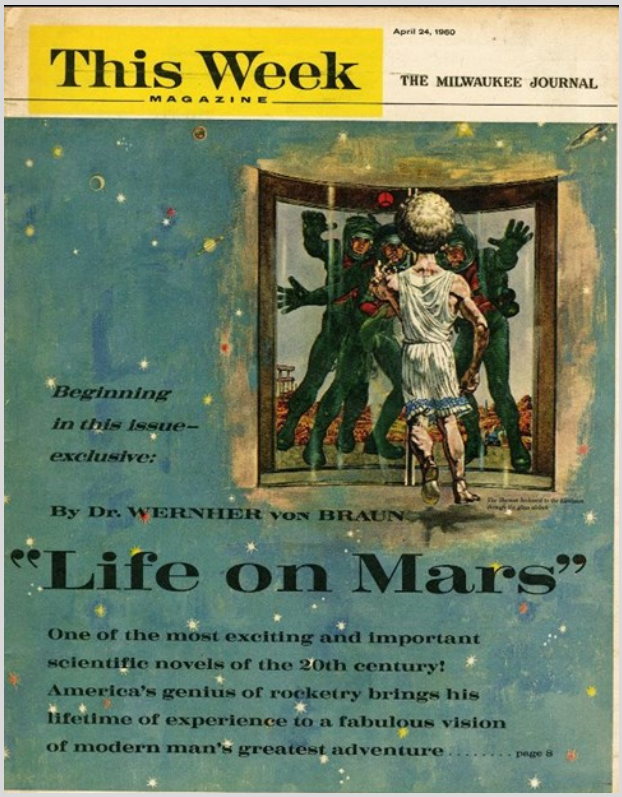


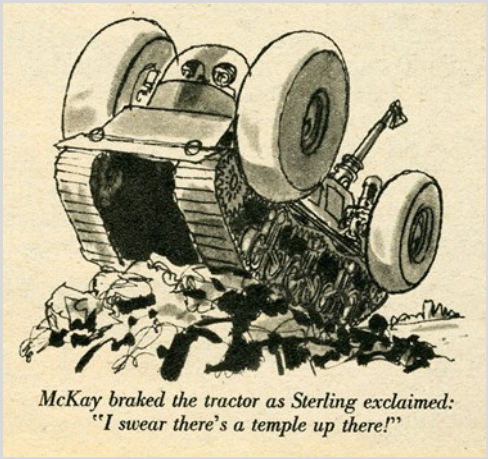


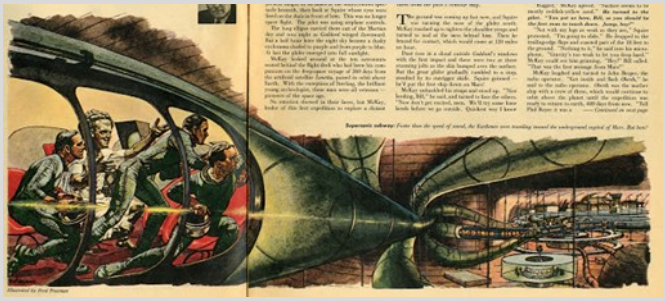

*Above: Image credits: Scott Lowther, with help from other Horizons Collier's team members.*

## *Dreams of Space*
## *Books & Ephemera*

***Non-Fiction Children's Books about Space Flight from 1945 to 1975***
*http://dreamsofspace.blogspot.com/*





*McKay braked the tractor as Sterling exclaimed: "I swear there's a temple up there!"*



# Collier's

APRIL 30, 1954 • FIFTEEN CENTS

## Can We Get to Mars?

## Is There Life on Mars?

**SPECIAL REPORT**

**How Your Town Can AVOID A Recession**

***8 Danger Signals To Watch For***

***10 Specific Steps To Prevent Trouble***

# Collier's

APRIL 30, 1954

PUBLISHED BY THE CROWELL-COLLIER PUBLISHING CO.

CLARENCE E. STOUCH
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## SPECIAL



## SHORT STORIES



## SERIAL



## FEATURES



## THE COVER . . Chesley Bonestell

From an orbit around Mars, the first visitors from the earth prepare to land on the most intriguing of our neighbor planets. The winged rocket in the foreground is preparing for the descent; the ships that remain, all cargo carriers, will stay in the orbit. When will this visit occur—and what will it uncover? Leading scientists give the answers in a special nine-page report, starting on page 21

The characters in all stories and serials in this magazine are purely imaginary. No reference or allusion to any living person is intended.

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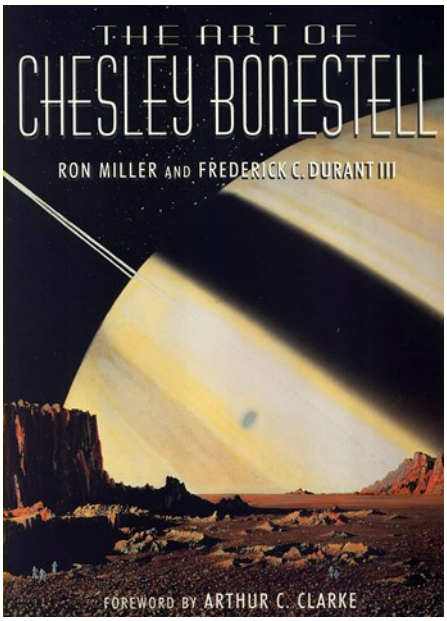



Award winner Ron Miller & Black Cat Studios

*Ron Miller, winner of the 2002 Hugo Award (World Science Fiction Society) for Best Related Work: The Art of Chesley Bonestell*

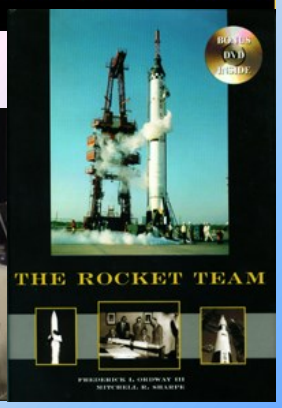
## The Chesley Bonestell Archives of Melvin H. Schuetz


www.bonestell.com

*A former satellite controller in the U.S. Air Force and private industry, Melvin H. Schuetz has researched and collected publications from around the world containing Bonestell's art for more than four decades. His book, A Chesley Bonestell Space Art Chronology, is a unique reference bibliography containing detailed listings of over 750 publications which have included examples of Bonestell's space art.*

**Space scientist and well-known author of visionary books on spaceflight. Ordway was in charge of space systems information at the Marshall Space Flight Center from 1960 to 1963 and before that performed a similar function for the Army Ballistic Missile Agency. For many years he was a professor at the University of Alabama's School of Graduate Studies and Research. However, his greatest contribution has been to the popularization of space travel through dozens of books that he has authored or coauthored. He was also technical consultant to the film 2001: A Space Odyssey and owns a large collection of original paintings depicting astronautical themes. Ordway was educated at Harvard and completed several years of graduate study at the University of Paris and other universities in Europe.**

www.cgpublishing.com


**Frederick Ira Ordway III**

*Co-Author with Mitchell R. Sharpe of The Rocket Team*

## *Dreams of Space, Books & Ephemera*

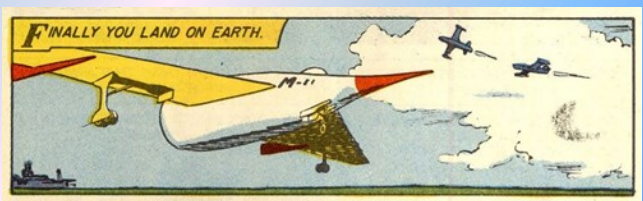
***Non-Fiction Children's Books about Space Flight from 1945 to 1975***

http://dreamsofspace.blogspot.com/

Classics Illustrated were comic books intended to educate as well as entertain. They often were fictional "classic" books in comic book form such as Moby Dick. They also had a special series called "The World around Us." These were non-fiction comic books about topics of interest.

Classics Illustrated. Illustrated by Gerald McCann, Sam Glanzman and John Tartaglione. The Illustrated Story of Space (80 pages), 26 cm, softcover.

Contains illustrated stories on training for space, the first rocket to the Moon, the history and use of the rocket, the launch of Vanguard 1 and the construction of a space station. "The World Around Us" (#5) January 1959.



## Afterword about the Collier's Spaceflight Series

By Dr. A. A. Jackson, October 30, 2013

Before the 1952-1954 Collier's series was finished, there appeared the book, *Across the Space Frontier*, Ryan, Cornelius, (Ed.); Kaplan, Joseph; von Braun, Wernher; Ley, Willy; Whipple, Fred L.; Haber, Heinz; Schacter, Oscar, illustrated by Chesley Bonestell, Fred Freeman, Rolf Klep, published by The Viking Press, 1952. And the book, *Conquest of the Moon*, Wernher von Braun, Willey Ley, Fred Whipple, illustrated by Chesley Bonestell, Fred Freeman, Rolf Klep, publisher: Viking Press, 1953.

These books were dynamite to my 13-year-old mind. I still have my copies of the first printings.

Only many years later (like 50 years later) did it occur to me that the Viking Press series was quite subpar. The books are of fair to middling manufacture. Especially in that the paintings and illustrations are all on plain paper. Bonestell art demands enameled paper. The books are interesting because they contain some expansion and elaboration of the prose material in the Collier's series.

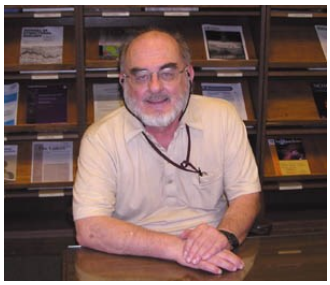
Then came, *The Exploration of Mars*, Ley, Willy; Wernher Von Braun, published by Viking, 1956 (a much better-manufactured book).

But! I wondered what became of *Can We Get to Mars? / Is There Life on Mars?* Collier's (1954). *The Mars Project* by von Braun was written in 1948. A shortened version was published in German in 1952 and in English in 1953 and was the motivation for Cornelius Ryan's Collier's series. The 1954 Collier's issue, which was first popular realization of the 1948 manuscript, never appeared as a book. In 2005 *The Mars Project* version that contained von Braun's novel did appear, alas without von Braun's excellent popularization in the 1954 issue of Collier's. With the Walt Disney television series in 1955, von Braun had changed his mind about the Mars Expedition and scaled it back.

With my complete collection (eight issues of the magazine from that two-year period) of the Collier's spaceflight series, I thought, for about 20 years, why?! Why didn't anyone ever publish the whole Collier's series? So much is missing is missing from the Viking Press books… some of Bonestell's paintings, a bunch of Fred Freeman's illustrations and paintings. Also never reprinted in book form: most of the exposition in the issues about spacesuits, simulation instruction and emergency training using the escape capsules and space medicine.

Books covering the rest of the material were never produced. Here we have, thanks to Douglas Yazell and his efforts, we have the complete series, reprinted page by page using high resolution. *[Thanks also go to our volunteers in Houston, around the USA, and around the world.]* Special thanks go to Scott Lowther for his work, including supplying most the original magazine issues, and Art Dula for work relating to the copyright status of the Collier's series.

The Collier's spaceflight series was unique and influential, and now, finally, accessible on the Web.



*Dr. A. A. Jackson, Visiting Scientist at the Lunar and Planetary Institute (LPI). Image credit: LPI.*

GILLOON AGENCY

Wernher von Braun, Ryan

# COLLIER'S CREDITS..

THE name Dr. Hubertus Strughold will ring a bell with readers who recall our symposium on Man's Survival in Space (Collier's, February 28, 1953), of which the doctor, head of the Department of Space Medicine at Randolph Field, Texas, was a member. We Credit him now because Dr. Wernher von Braun and staffer Cornelius Ryan found much relevant information in Dr. Strughold's book, The Green and Red Planet (University of New Mexico Press), when our writing team tackled the discussion of a 355,000,000-mile journey to Mars.

Dr. Strughold's thesis is perhaps more easily assimilated than Dr. Wernher von Braun's authoritative volume, The Mars Project (University of Illinois Press), because it does not contain such formulas as Dr. von Braun's

$$\dot{v} = \frac{F_1 + A_{s1}(p_{s1} - p_a) - c_D \cdot A_1 v^2 \gamma / 2g_0}{1/g_0 \,(W_{s1} - W_1 \cdot t)} - g_0 \cos\vartheta \quad (4.1)$$

for "the ascent track" of a space ship. But friend Wernher's scientific books are not particularly intended for your library or ours, and anyway that's where "Connie" Ryan comes in—to give you the facts in nontechnical verbiage.

The Mars story begins on page 21 and will comprise part of the third book on space travel that Cornelius Ryan has edited since Collier's began to explore the subject two years ago.

★ ★ ★

EFFORTS to improve American schooling long ago became a permanent agendum on our editorial calendar, which is why, when we were casting about for a quick and comparatively inexpensive answer to the current shortage of schoolroom facilities, we consulted The Architects Collaborative, of Cambridge, Massachusetts. This eight-member partnership is inspired by seventy-year-old Walter Gropius, whose architectural achievements cover every kind of service and design man can dream about. Well equipped by experience and imagination, the Collaboratives co-operated with Collier's in detailing the plans for the modern school plant we sponsor in this issue.

Credits to the hard-working team (identified below)—and a special one for Mr. Gropius for having recently received in Brazil the Grand Prix International d'Architecture (Premio São Paulo) from the hands of President Getulio Vargas in the presence of the diplomatic corps.

★ ★ ★

SPEAKING of schools, we have proud and selfish reasons for mentioning a Creditable new magazine called Omnibus. Vol. 1, No. 1 of this fat (53-page) periodical, jammed with articles, stories, drawings and advertisements, was produced on a duplicating machine by sixth-grade students in Oceanlake, Oregon. Preliminary work on the project included a thorough study of seven leading magazines by the editors, who finally "decided to use Collier's as a model because it has so many different kinds of features." The youthful staff regretted the lack of a Letters department, but explained logically that it was their first issue and no mail was at hand. Typical Omnibus cartoon: on the sidewalk one flea asks another, "Shall we walk or take a dog?" The last (editorial) page Omnibusly warned: "Let Collier's look to their laurels . . . There's only room at the top for one and we won't quit until we are there!" Respectful note to the Omnibus staff: Confronted by this spirit of competition, we shall indeed do as you advise. P.S. Perhaps this item will find a place in your indubitably now flourishing Letters column.

—GURNEY WILLIAMS

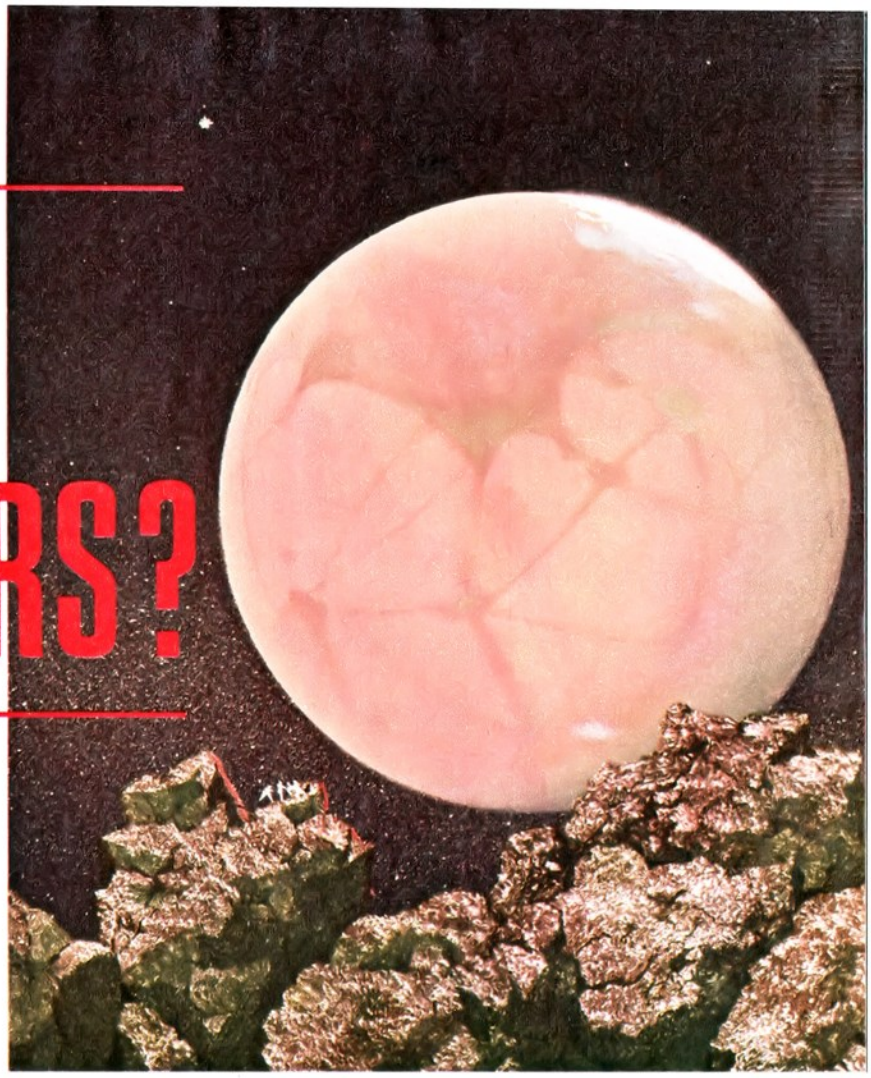
SAMUEL ROSENBERG

**The designers of the Collier's school included this architectural team: Benjamin Thompson, Sarah Harkness, Norman Fletcher, Chester Nagel, Walter Gropius, Jean B. Fletcher, John C. Harkness, Louis A. McMillen**

**Collier's for April 30, 1954**

*Collier's, April 30, 1954*

# IS THERE LIFE ON MARS?



By Dr. FRED L. WHIPPLE

*Chairman, Department of Astronomy, Harvard University*

**Astronomers—planning to give the great red planet its closest scrutiny in history this summer—are nearer than ever before to answering the most fascinating question of all**

ON JULY 2d, the planet Mars, swinging through its lopsided orbit around the sun, will be closer to the earth than at any time since 1941. All over the world, scientists will train batteries of telescopes and cameras on the big red sphere in history's greatest effort to unravel some of the mystery surrounding this most intriguing of the planets.

Next to Venus, Mars is our closest planetary neighbor. Even so, it will be 40,000,000 miles away as it passes by this summer (compared to 250,000,000 miles at its farthest point from the earth); on the most powerful of telescopes it will look no larger than a coffee saucer. Still, it will be close enough to provide astronomers important facts about its size, atmosphere and surface conditions—and the possibility that some kind of life exists there.

We already know a great deal.

Mars's diameter is roughly half the size of the earth. The Martian day is 24 hours, 37 minutes long, but its year is nearly twice as long as ours—670 Martian days. During daylight hours, the temperature on Mars shoots into the eighties, but at night a numbing cold grips the planet: the temperature drops suddenly to 95 below zero, Fahrenheit.

There is no evidence of oxygen in Mars's thin blue atmosphere. Moreover, its atmospheric pressure is so low that an earth man couldn't survive without a pressurized suit. If life of any kind does exist on Mars it must be extremely rugged.

Through the telescope, astronomers can clearly see Mars's great reddish deserts, blue-tinted cloud formations and—especially conspicuous—its distinctive polar caps.

The Martian polar caps cover about 4,000,000 square miles in the wintertime—an area roughly half the size of the North American continent. But as they melt in spring, strange blue-green areas develop near their retreating edges. Some months later these color patches, now covering great areas of the planet's surface, turn brownish. Finally in the deep of Martian winter they're a dark chocolate color. Do these seasonal color variations indicate some sort of plant or vegetable life? That's one of the riddles we'd like to solve.

There's another big question mark: Mars's so-called canals. Although most modern astronomers have long since discounted the once popular theory that the faint tracings seen by some on Mars are actually a network of waterways (and, therefore, perhaps constructed by intelligent beings), we still don't know what they are—or if they exist at all.

The "canals" have had a controversial history. They were first reported in 1877 by an Italian astronomer named Giovanni Schiaparelli who said he had seen delicate lines tracing a gridlike pattern over vast areas of the planet. He called them *canali*—"canals" or "channels."

Since Schiaparelli, many astronomers (especially Dr. Percival Lowell, who established an observatory for the primary purpose of studying Mars) have reported observing the delicate veinlike lines. Others, just as keen-sighted, have spent years studying the Martian face without once seeing the disputed markings.

This year we may get an opportunity to clear up the canal confusion once and for all. An American team, sponsored jointly by the National Geographic Society and Lowell Observatory, will photograph Mars from Bloemfontein, South Africa, where Mars will appear almost directly overhead nightly during early July. The U.S. team, using new photographic techniques and the latest in fast film emulsions, expects to get the most detailed photographs of the planet yet obtained.

But great as the 1954 Mars observation program promises to be, it's only the curtain raiser for 1956, when Mars will approach to within 35,000,000 miles of the earth. Not for another 15 years, in 1971, will it be so close again.

When all the findings have been evaluated we may be able to make some intelligent guesses as to the possibility of life on Mars. Chances are that bacteria are the only type of animal life which could exist in the planet's oxygenless atmosphere. There also may be some sort of tough, primitive plant life—perhaps lichens or mosses which produce their own oxygen and water. Such plants might explain the changing colors of the Martian seasons.

There's one other possibility.

How can we say with absolute certainty that there isn't a *different* form of life existing on Mars—a kind of life that we know nothing about? We can't. There's only one way to find out for sure what is on Mars—and that's to go there. ▲▲▲



**Rocket expert Dr. Wernher von Braun discusses the problems of a trip to Mars on the pages that follow**

Near wheel-shaped space station 1,000 miles from the earth, built especially for assembly of the Mars expedition, weightless workers put together

# *Can We Get to MARS?*

By DR. WERNHER von BRAUN with CORNELIUS RYAN

Chief, Guided Missile Development Division, Redstone Arsenal, Huntsville, Alabama

**Man's trail-blazing journey to Mars will be a breath-taking experience—with problems to match**


CHESLEY BONESTELL

**the 10 rocket ships required for the flight. Three of the huge space craft have torpedo noses which convert to planes for landing on the planet**

THE first men who set out for Mars had better make sure they leave everything at home in apple-pie order. They won't get back to earth for more than two and a half years.

The difficulties of a trip to Mars are formidable. The outbound journey, following a huge arc 355,000,000 miles long, will take eight months—even with rocket ships that travel many thousands of miles an hour. For more than a year, the explorers will have to live on the great red planet, waiting for it to swing into a favorable position for the return trip. Another eight months will pass before the 70 members of the pioneer expedition set foot on earth again. All during that time, they will be exposed to a multitude of dangers and strains, some of them impossible to foresee on the basis of today's knowledge.

Will man ever go to Mars? I am sure he will—but it will be a century or more before he's ready. In that time scientists and engineers will learn more about the physical and mental rigors of interplanetary flight—and about the unknown dangers of life on another planet. Some of that information may become available within the next 25 years or so, through the erection of a space station above the earth (where telescope viewings will not be blurred by the earth's atmosphere) and through the subsequent exploration of the moon, as described in previous issues of Collier's.

Even now science can detail the technical requirements for a Mars expedition down to the last ton of fuel. Our knowledge of the laws governing the solar system—so accurate that astronomers can predict an eclipse of the sun to within a fraction of a second—enables scientists to determine exactly the speed a space ship must have to reach Mars, the course that will intercept the planet's orbit at exactly the right moment, the methods to be used for the landing, take-off and other maneu-

vering. We know, from these calculations, that we already have chemical rocket fuels adequate for the trip.

Better propellants are almost certain to emerge during the next 100 years. In fact, scientific advances will undoubtedly make obsolete many of the engineering concepts on which this article, and the accompanying illustrations, are based. Nevertheless, it's possible to discuss the problems of a flight to Mars in terms of what is known today. We can assume, for example, that such an expedition will involve about 70 scientists and crew members. A force that size would require a flotilla of 10 massive space ships, each weighing more than 4,000 tons—not only because there's safety in numbers, but because of the tons of fuel, scientific equipment, rations, oxygen, water and the like necessary for the trip and for a stay of about 31 months away from earth.

All that information can be computed scientifically. But science can't apply a slide rule to man; he's the unknown quantity, the weak spot that makes a Mars expedition a project for the far distant, rather than the immediate, future. The 70 explorers will endure hazards and stresses the like of which no men before them have ever known. Some of these hardships must be eased—or at least better understood—before the long voyage becomes practical.

For months at a time, during the actual period of travel, the expedition members will be weightless. Can the human body stand prolonged weightlessness? The crews of rocket ships plying between the ground and the earth's space station about 1,000 miles away will soon grow accustomed to the absence of gravity—but they will experience this odd sensation for no more than a few hours at a time. Prolonged weightlessness will be a different story.

Over a period of months in outer space, muscles accustomed to fighting the pull of gravity could shrink from disuse—just as do the muscles of people who are bedridden or encased in plaster casts for a long time. The members of a Mars expedition might be seriously handicapped by such a disability. Faced with a rigorous work schedule on the unexplored planet, they will have to be strong and fit upon arrival.

The problem will have to be solved aboard the space vehicles. Some sort of elaborate spring exercisers may be the answer. Or perhaps synthetic gravity could be produced aboard the rocket ships by designing them to rotate as they coast through space, creating enough centrifugal force to act as a substitute for gravity.

Far worse than the risk of atrophied muscles is the hazard of cosmic rays. An overdose of these deep-penetrating atomic particles, which act like the invisible radiation of an atomic-bomb burst, can cause blindness, cell damage and possibly cancer.

Scientists have measured the intensity of cosmic radiation close to the earth. They have learned that the rays dissipate harmlessly in our atmosphere. They also have deduced that man can safely venture as far as the moon without risking an overdose of radiation. But that's a comparatively brief trip. What will happen to men who are exposed to the rays for months on end? There is no material that offers practical protection against cosmic rays—practical, that is, for space travel. Space engineers could provide a barrier by making the cabin walls of lead several feet thick—but that would add hundreds of tons to the weight of the space vehicle. A more realistic plan might be to surround the cabin with the fuel tanks, thus providing the added safeguard of a two- or three-foot thickness of liquid.

The best bet would seem to be a reliance on man's ingenuity: by the time an expedition from the earth is ready to take off for Mars, perhaps in the mid-2000s, it is quite likely that researchers will have perfected a drug which will enable men to endure radiation for comparatively long periods. Unmanned rockets, equipped with instruments which send information back to earth, probably will blaze the first trail to our sister planet, helping to clear up many mysteries of the journey.

FRED FREEMAN

### Small Meteors Could Do Little Damage

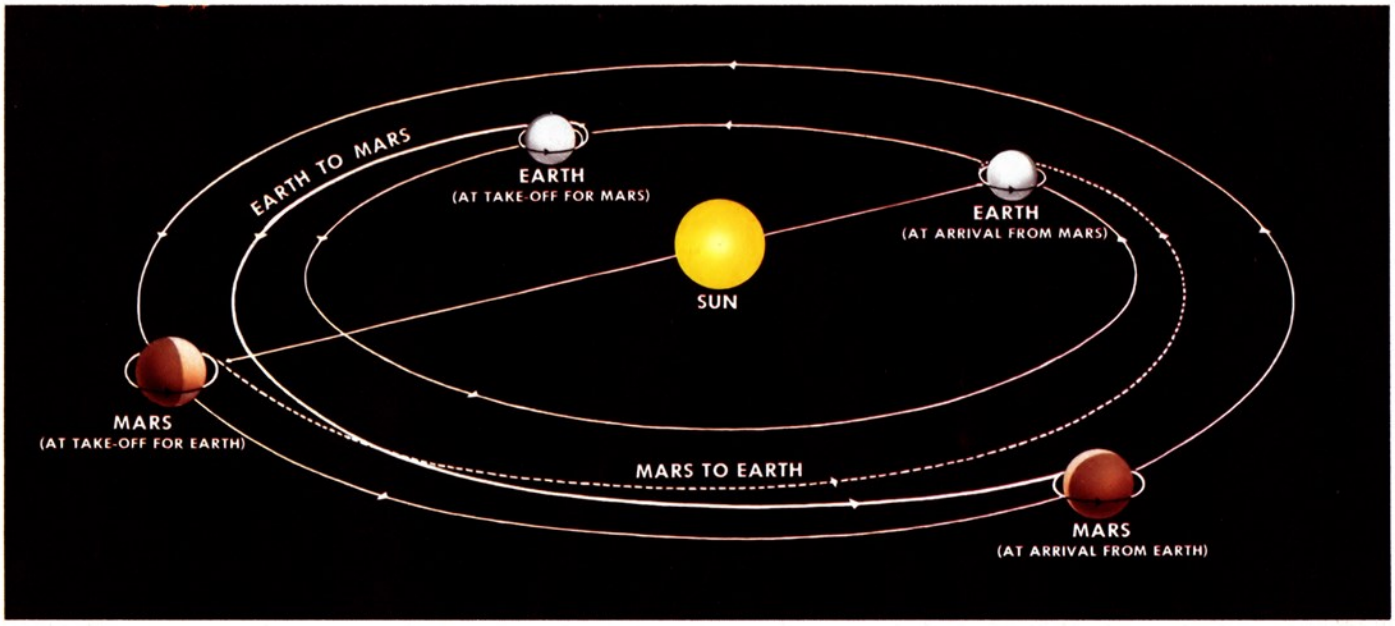
Meteors, for example. Many billions of these tiny bullets, most of them about the size of a grain of sand, speed wildly through space at speeds of more than 150,000 miles an hour. For short trips, we can protect space ships from these lightning-fast pellets by covering all vital areas—fuel tanks, rocket motors, cargo bins, cabins and the like—with light metal outer shields called meteor bumpers. The tiny meteors will explode against this outer shell, leaving the inner skin of the ship—and the occupants—unharmed.

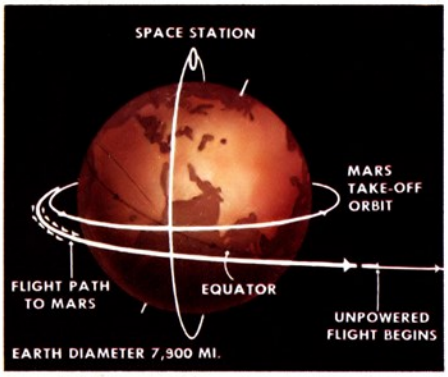
But in the 16 months of space travel required for a visit to Mars, much larger projectiles might be encountered. Scientists know that the density of large meteors is greater near the red planet than it is around the earth. If, by some chance, a rock the size of a baseball should plow through the thin shell of one of the rocket ships it could do terrible damage—especially if it struck a large, solid object inside. A meteor that size, traveling at terrific speed, could explode with the force of 100 pounds of TNT. In the cabin of a space vehicle, such an explosion would cause tremendous destruction.

Fortunately, meteors that size will be extremely rare, even near Mars.

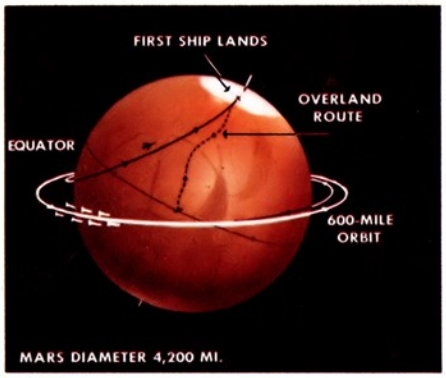
Dime-sized chunks are more likely to be encountered. They will be a danger, too, although not so bad as the larger rocks. They'll rip through the bumper and skin like machine-gun bullets. If they strike anything solid, they'll explode with some force. If not, they'll leave through the other side of the ship—but even then they may cause trouble. Holes will have to be plugged to maintain cabin pressure. The shock wave created by the meteors' extreme speed may hurt the ship's occupants: there will be a deafening report and a blinding flash; the friction created by their passage through the cabin atmosphere will create enough heat to singe the

**Illustration shows how the landing planes are assembled in 600-mile Martian orbit. Pointed noses are removed from three of 10 ships that made trip from earth; wings and landing gear are fitted to them. Cutaway of plane in the foreground shows personnel, tractors in ship**




**Top diagram shows positions of earth and Mars at times of arrival and departure, and routes followed in both directions. Drawing at left depicts take-off maneuver from an orbit 1,000 miles above earth's equator (note polar orbit of original earth space station, which might be built within next 15 or 20 years). Mars vehicles cut power 5,700 miles from the earth and coast rest of the way through space. At right, fleet of 10 rocket ships approaches to within about 600 miles of Mars, establishes itself in orbit and launches first of three landing planes toward Martian polar area for snow landing. After landing, advance party abandons plane and travels on tractors 4,000 miles to equator, where it prepares a landing strip for expedition members in other planes**




ROLF KLEP

eyebrows of a man standing close by. And, of course, a person in the direct path of a pebble-sized meteor could be severely injured. A fragile piece of machinery could be destroyed, and it's even possible that the entire rocket ship would have to be abandoned after sustaining one or more hits by space projectiles that size (astronomers estimate that one out of 10 ships on a 16-month voyage might be damaged badly, although even that is unlikely).

If one of the Mars-bound vehicles does suffer serious damage, the incident needn't be disastrous. In a pinch, a disabled space vehicle can be abandoned easily. All of the ships will carry small self-propelled craft—space taxis—which are easily built and easily maneuvered. They will be fully pressurized, and will be used for routine trips between the ships of the convoy, as well as for emergencies. If for some reason the space taxis aren't available to the occupants of a damaged ship, they will be able to don pressurized suits and step calmly out into space. Individual rocket guns, manually operated, will enable each of them to make his way to the nearest space ship in the convoy. Space-suited explorers will have no difficulty traveling between ships. There's no air to impede motion, no gravitational pull and no sense of speed. When they leave their ship the men will have to overcome only their own inertia. They'll be traveling through the solar system at more than 70,000 miles an hour, but they will be no more aware of it than we on earth are aware that every molecule of our bodies is moving at a speed of 66,600 miles an hour around the sun.

Science ultimately will solve the problems posed by cosmic rays, meteors and the other natural phenomena of space. But man will still face one great hazard: himself.

Man must breathe. He must guard himself against a great variety of illnesses and ailments. He must be entertained. And he must be protected from many psychological hazards, some of them still obscure.

How will science provide a synthetic atmosphere within the space-ship cabins and Martian dwellings for two and a half years? When men are locked into a confined, airtight area for only a few days or weeks oxygen can be replenished, and exhaled carbon dioxide and other impurities extracted, without difficulty. Submarine engineers solved the problem long ago. But a conventional submarine surfaces after a brief submersion and blows out its stale air. High-altitude pressurized aircraft have mechanisms which automatically introduce fresh air and expel contaminated air.

There's no breathable air in space or on Mars; the men who visit the red planet will have to carry with them enough oxygen to last many months.

### When Men Live Too Close Together

During that time they will live, work and perform all bodily functions within the cramped confines of a rocket-ship cabin or a pressurized—and probably mobile—Martian dwelling. (I believe the first men to visit Mars will take along inflatable, spherical cabins, perhaps 30 feet across, which can be mounted atop tractor chassis.) Even with plenty of oxygen, the atmosphere in those living quarters is sure to pose a problem.

Within the small cabins, the expedition members will wash, perform personal functions, sweat, cough, cook, create garbage. Every one of those activities will feed poisons into the synthetic air—just as they do within the earth's atmosphere.

No less than 29 toxic agents are generated during the daily routine of the average American household. Some of them are body wastes, others come from cooking. When you fry an egg, the burned fat releases a potent irritant called acrolein. Its effect is negligible on earth because the amount is so small that it's almost instantly dissipated in the air. But that microscopic quantity of acrolein in the personnel quarters of a Mars expedition could prove dangerous; unless there was some way to remove it from the atmosphere it would be circulated again and again through the air-conditioning system.

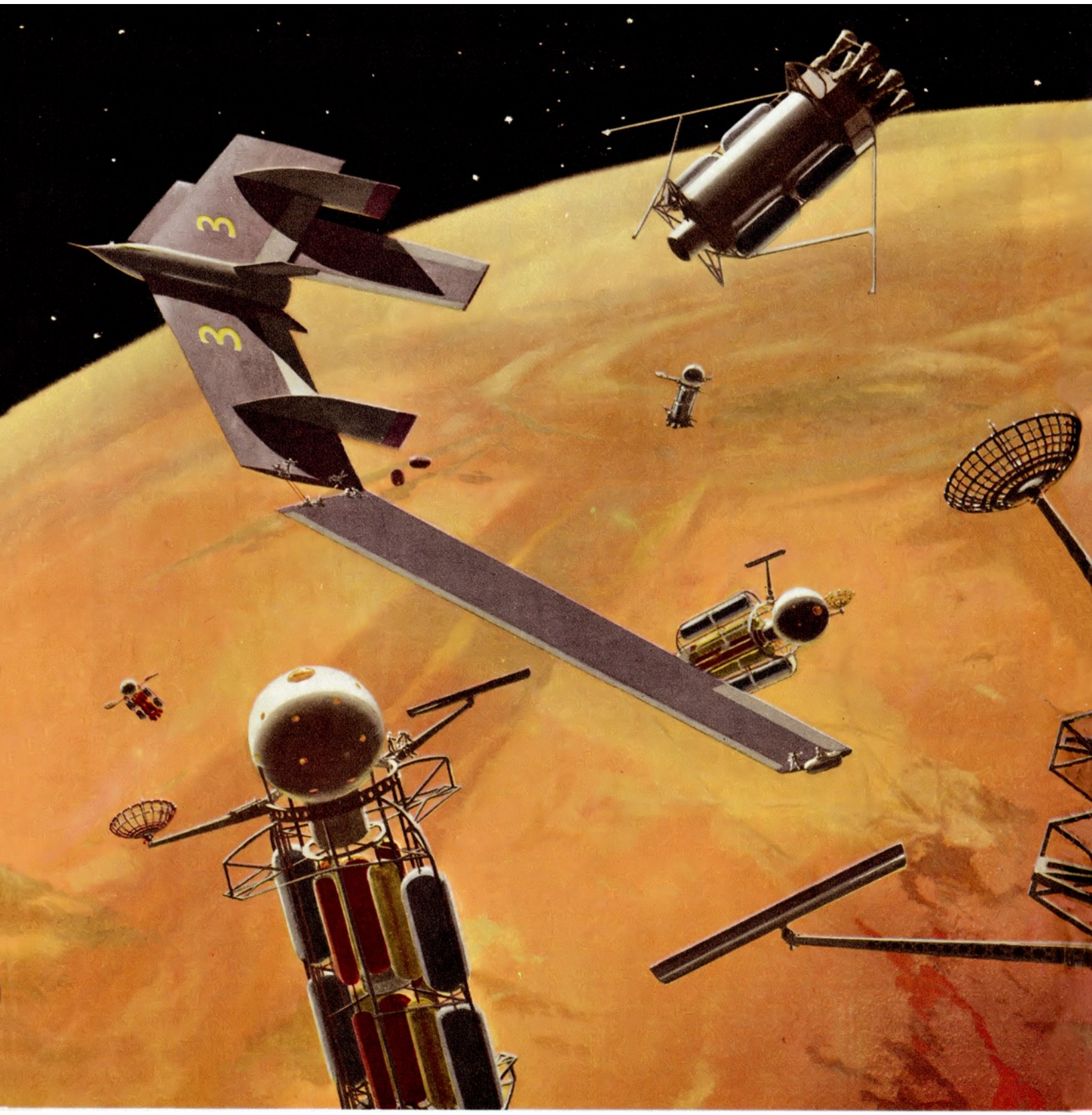
Besides the poisons resulting from cooking and the like, the engineering equipment—lubricants, hydraulic fluids, plastics, the metals in the vehicles—will give off vapors which could contaminate the atmosphere.

What can be done about this problem? No one has all the answers right now, but there's little doubt that by using chemical filters, and by cooling and washing the air as it passes through the air-conditioning apparatus, the synthetic atmosphere can be made safe to live in.

Besides removing the impurities from the man-made air, it may be necessary to add a few. Man has lived so long with the impurities in the earth's atmosphere that no one knows whether he can exist without them. By the time of the Mars expedition, the scientists may decide to add traces of dust, smoke and oil to the synthetic air—and possibly iodine and salt as well.

I am convinced that we have, or will acquire, the basic knowledge to solve all the physical problems of a flight to Mars. But how about the psychological problem? Can a man retain his sanity while cooped up with many other men in a crowded area, perhaps twice the length of your living room, for more than thirty months?

Share a small room with a dozen people completely cut off from the outside world. In a few weeks the irritations begin to pile up. At the end of



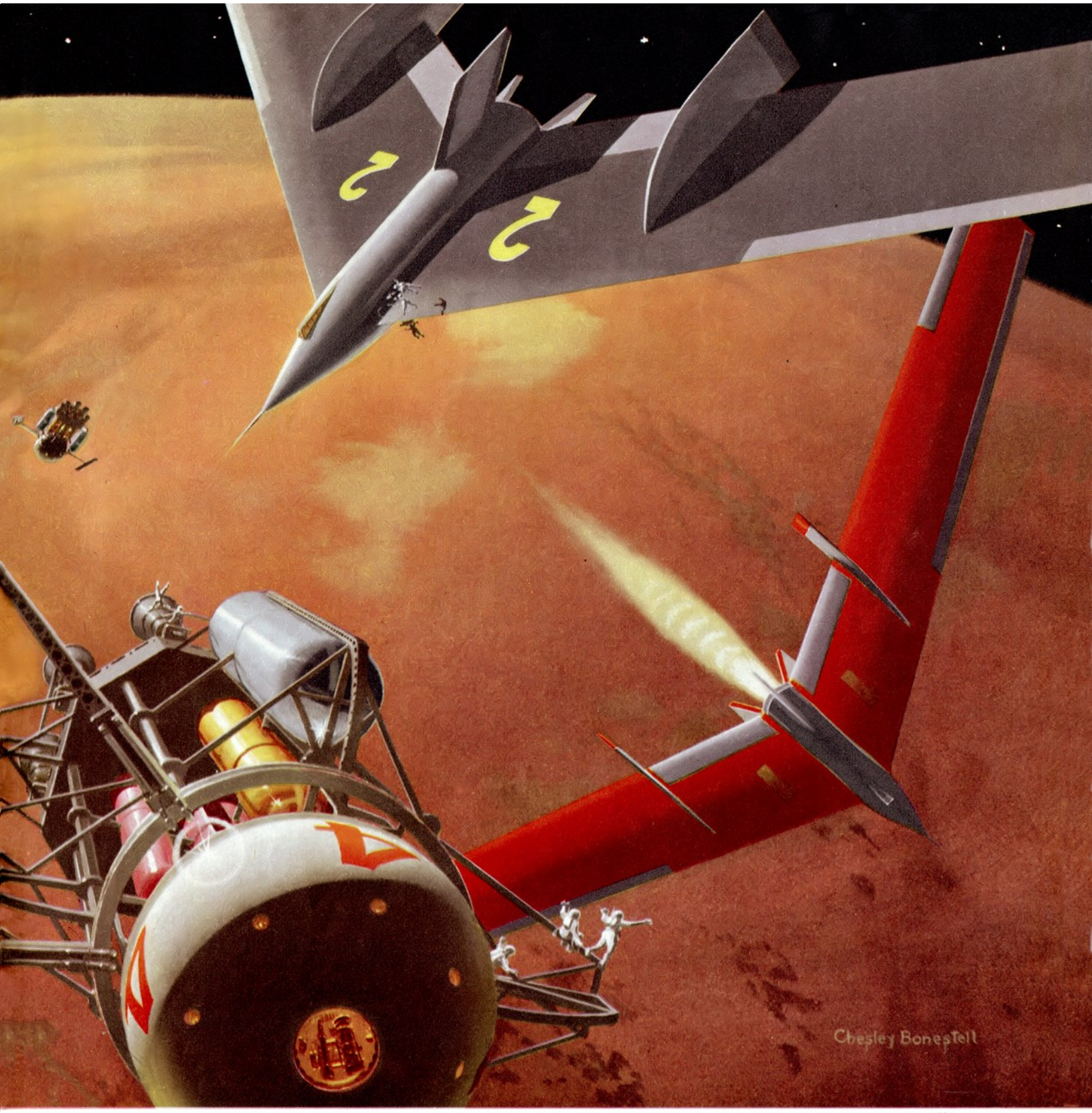
**The first landing party takes off for Mars. Two other landing planes will wait until runway is prepared for them, and the remaining seven ships**

a few months, particularly if the occupants of the room are chosen haphazardly, someone is likely to go berserk. Little mannerisms—the way a man cracks his knuckles, blows his nose, the way he grins, talks or gestures—create tension and hatred which could lead to murder.

Imagine yourself in a space ship millions of miles from earth. You see the same people every day. The earth, with all it means to you, is just another bright star in the heavens; you aren't sure you'll ever get back to it. Every noise about the rocket ship suggests a breakdown, every crash a meteor collision. If somebody does crack, you can't call off the expedition and return to earth. You'll have to take him with you.

The psychological problem probably will be at its worst during the two eight-month travel periods. On Mars, there will be plenty to do, plenty to see. To be sure, there will be certain problems on the planet, too. There will be considerable confinement. The scenery is likely to be grindingly monotonous. The threat of danger from some unknown source will hang over the explorers constantly. So will the knowledge that an extremely complicated process, subject to possible breakdown, will be required to get them started on their way back home. Still, Columbus' crew at sea faced much the same problems the explorers will face on Mars; the fifteenth-century sailors felt the psychological tension, but no one went mad.

But Columbus traveled only ten weeks to reach America; certainly his men would never have stood an eight-month voyage. The travelers to Mars will




CHESLEY BONESTELL

**will stay in 600-mile orbit. Arms on cargo ships hold screenlike dish antennas (for communication), trough-shaped solar mirrors (for power)**

have to, and psychologists undoubtedly will make careful plans to keep up the morale of the voyagers.

The fleet will be in constant radio communication with the earth (there probably will be no television transmission, owing to the great distance). Radio programs will help relieve the boredom, but it's possible that the broadcasts will be censored before transmission; there's no way of telling how a man might react, say, to the news that his home town was the center of a flood disaster. Knowing would do him no good—and it might cause him to crack.

Besides radio broadcasts, each ship will be able to receive (and send) radio pictures. There also will be films which can be circulated among the space ships. Reading matter will probably be carried in the form of microfilms to save space. These activities—plus frequent intership visiting, lectures and crew rotations—will help to relieve the monotony.

There is another possibility, seemingly fantastic, but worth mentioning briefly because experimentation already has indicated it may be practical. The nonworking members of a Mars expedition may actually hibernate during part of the long voyage. French doctors have induced a kind of artificial hibernation in certain patients for short periods, in connection with operations for which they will need all their strength (Collier's, December 11, 1953—Medicine's New Offensive Against Shock, by J. D. Ratcliff). The process involves a lowering of the body temperature, and the subsequent slowing down of all the normal physical processes. On a Mars expedition, such a procedure, over a longer

period, would solve much of the psychological problem, would cut sharply into the amount of food required for the trip, and would, if successful, leave the expedition members in superb physical condition for the ordeal of exploring the planet.

Certainly if a Mars expedition were planned for the next 10 or 15 years no one would seriously consider hibernation as a solution for any of the problems of the trip. But we're talking of a voyage to be made 100 years from now; I believe that if the French experiments bear fruit, hibernation may actually be considered at that time.

Finally, there has been one engineering development which may also simplify both the psychological and physical problems of a Mars voyage. Scientists are on the track of a new fuel, useful only in the vacuum of space, which would be so economical that it would make possible far greater speeds for space journeys. It could be used to shorten the travel time, or to lighten the load of each space ship, or both. Obviously, a four- or six-month Mars flight would create far fewer psychological hazards than a trip lasting eight months.

In any case, it seems certain that the members of an expedition to Mars will have to be selected with great care. Scientists estimate that only one person in every 6,000 will be qualified, physically, mentally and emotionally, for routine space flight. But can 70 men be found who will have those qualities—and also the scientific background necessary to explore Mars? I'm sure of it.

One day a century or so from now, a fleet of rocket ships will take off for Mars. The trip could be made with 10 ships launched from an orbit, about 1,000 miles out in space, that girdles our globe at its equator. (It would take tremendous power and vast quantities of fuel to leave directly from the earth. Launching a Mars voyage from an orbit about 1,000 miles out, far from the earth's gravitational pull, will require relatively little fuel.) The Mars-bound vehicles, assembled in the orbit, will look like bulky bundles of girders, with propellant tanks hung on the outside and great passenger cabins perched on top. Three of them will have torpedo-shaped noses and massive wings—dismantled, but strapped to their sides for future use. Those bullet noses will be detached and will serve as landing craft, the only vehicles that will actually land on the neighbor planet. When the 10 ships are 5,700 miles from the earth, they will cut off their rocket motors; from there on, they will coast unpowered toward Mars.

After eight months they will swing into an orbit around Mars, about 600 miles up, and adjust speed to keep from hurtling into space again. The expedition will take this intermediate step, instead of proceeding directly to Mars, for two main reasons: first, the ships (except for the three detachable torpedo-shaped noses) will lack the streamlining required for flight in the Martian atmosphere; second, it will be more economical to avoid carrying all the fuel needed for the return to earth (which now comprises the bulk of the cargo) all the way down to Mars and then back up again.

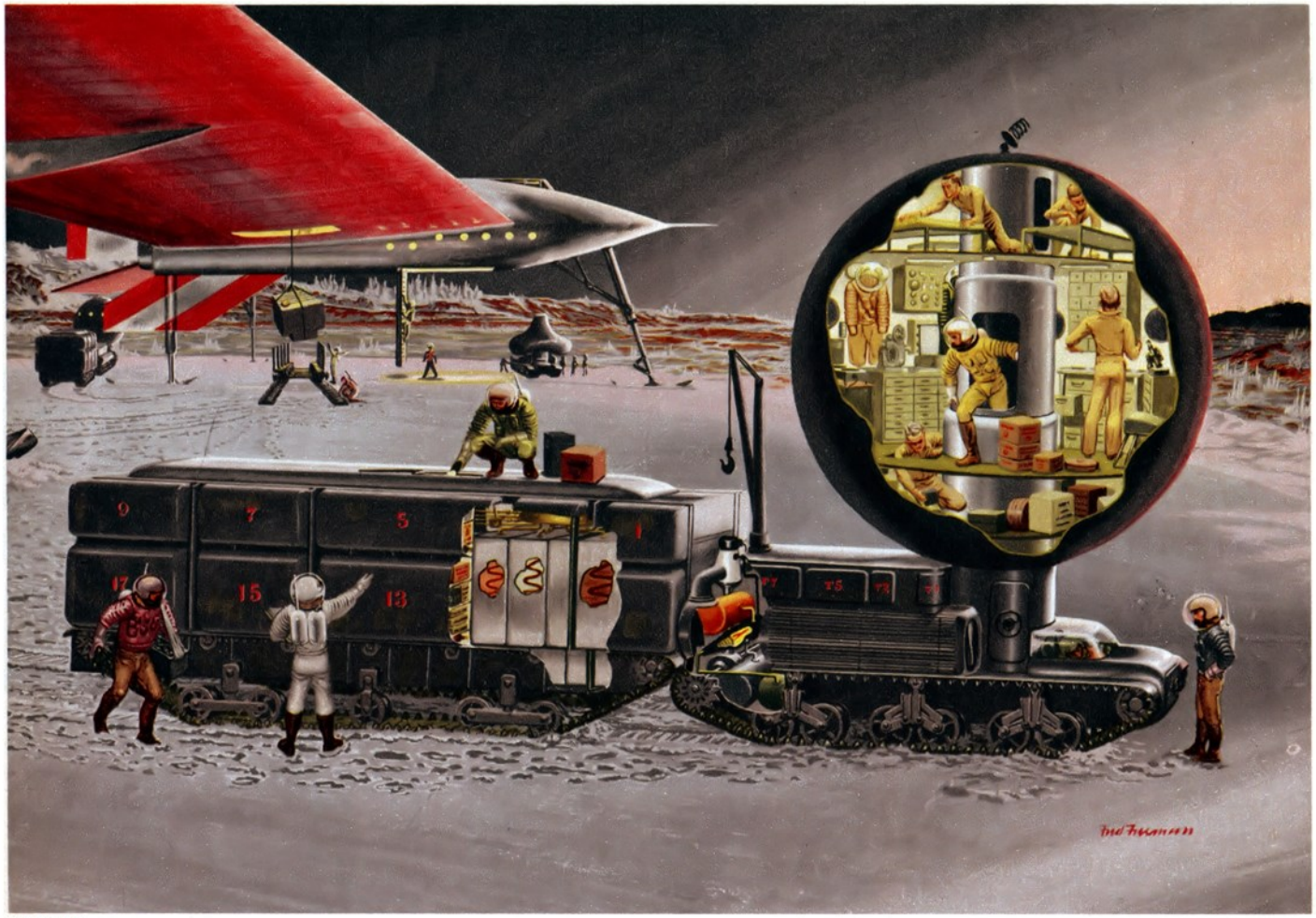
Upon reaching the 600-mile orbit—and after some exploratory probings of Mars's atmosphere with unmanned rockets—the first of the three landing craft will be assembled. The torpedo nose will be unhooked, to become the fuselage of a rocket plane. The wings and a set of landing skis will be attached, and the plane launched toward the surface of Mars.

The landing of the first plane will be made on the planet's snow-covered polar cap—the only spot where there is any reasonable certainty of finding a smooth surface. Once down, the pioneer landing party will unload its tractors and supplies, inflate its balloonlike living quarters, and start on a 4,000-mile overland journey to the Martian equator, where the expedition's main base will be set up (it is the most livable part of the planet—well within the area that scientists want most to investigate). At the equator, the advance party will construct a landing strip for the other two rocket planes. (The first landing craft will be abandoned at the pole.)

In all, the expedition will remain on the planet 15 months. That's a long time—but it still will be too short to learn all that science would like to know about Mars.

When, at last, Mars and the earth begin to swing toward each other in the heavens, and it's time to go back, the two ships that landed on the equator will be stripped of their wings and landing gear, set on their tails and, at the proper moment, rocketed back to the 600-mile orbit on the first leg of the return journey.

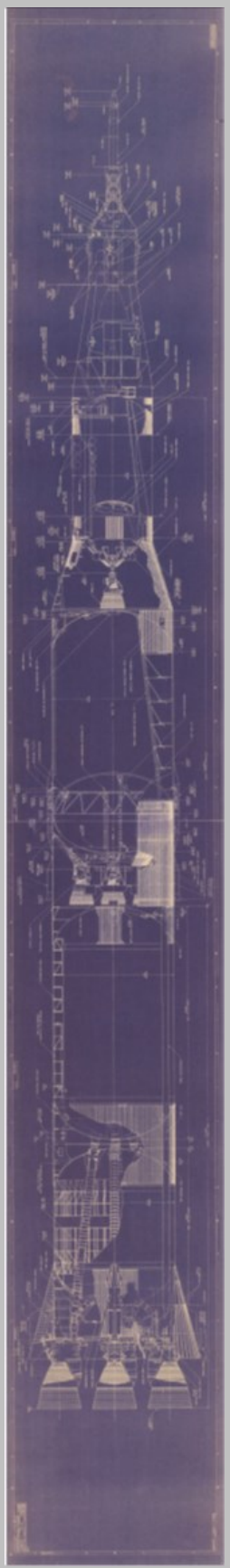
What curious information will these first explorers carry back from Mars? Nobody knows—and it's extremely doubtful that anyone now living will ever know. All that can be said with certainty today is this: the trip can be made, and will be made . . . someday. ▲▲▲



FRED FREEMAN

**Advance party, after landing on Martian snow in ski-equipped plane, prepares for trip to equator. Men live in inflatable, pressurized spheres mounted on tractors, enter and leave through air locks in the central column. Sphere on tractor at rear center is just being blown up. Cutaway of tractor, foreground, shows closed-circuit engine, run by hydrogen peroxide, oil. Trailer cutaway shows fuel supply, cargo**

After 15-month exploration, the Mars expedition prepares for return flight to earth. Two landing planes are set on tails, with wings and landing gear removed. They will rocket back to the 600-mile orbit on first leg of journey



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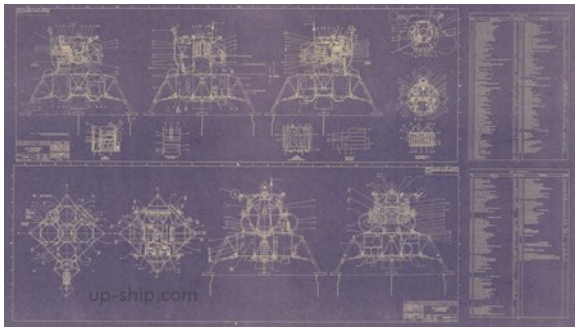


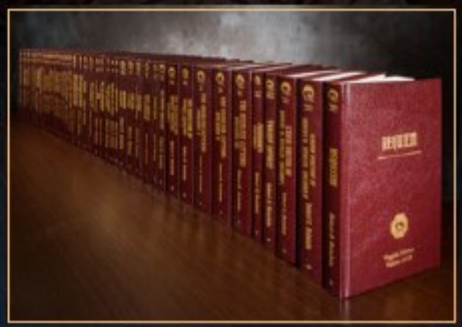


**Exerpt from "Ray Guns and Rocketships"**
*first published in 1952*

It was suggested that I comment on the writing of science fiction for children. I am not sure just how to do this as I am not sure that I have written any sciene fiction for children. It is true that I have a group of books which are catalogued as being intended for "boys of ten and older"—but I have found that this list is read by adults as well as by boys (and girls!) and that my books intended for adults are read by my younger readers as well as by adults. Science fiction is quite ambivalent in this respect. A book so juvenile that it will insult the intelligence of adults is quite likely to insult the intelligence of the kids.

When I was a child myself I used to get quite annoyed at authors who "wrote down." When I was first asked to do a book intended for kids I swore a solemn oath that I would never "write down"—it is better by far that a child should fail to grasp some portion of a story than it is to patronize him. So I believe and my experience seems to bear me out. In my own work I make just two minor distinctions between copy intended nominally for adults and copy intended nominally for not-yet-adults. In the boys' list I place a little less emphasis on boy-meets-girl and a little more emphasis on unadulterated science—but these are matters of slight emphasis only. On the first point I am obeying a taboo set up by adults, it being my own recollection that kids get interested in boy-meets-girl at a very tender age. On my second point it is my recollection and my more recent observation that kids are more interested in "how" and "why" than their parents usually are. The kids really want to know how the spaceship operates; the adults frequently don't care—so I try to give the kids enough detail in matters technological to satisfy them without giving so much that it will bore an adult. In any case a science fiction story should be a story first of all; it is not intended to replace science text books.

But most especially in writing for kids the science in it should be valid. When they spot an error they are not likely to forgive it.

In many ways science fiction belongs to the kids. They know that "it hasn't happened yet"—but they believe that it will happen. They expect to grow up to build space ships, to pilot them. They still believe in change and they are undismayed by the wonderful and terrifying future we have in front of us. If an adult enjoys science fiction, it is almost a guarantee that he has managed to carry over a youthful point of view, a mind not yet calcified, a belief in change and the future. It is for the youngster and for this adult who still has something of youth about him that we write.

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2

**Exerpt from "All You Zombies"**

*First published in The Magazine of Fantasy and Science Fiction (March 1959)*

2217 TIME ZONE V (EST) 7 Nov 1970 NYC—"Pop's Place": I was polishing a brandy snifter when the Unmarried Mother came in. I noted the time—10.17 p.m. zone five or eastern time November 7th, 1970. Temporal agents always notice time & date; we must.

The Unmarried Mother was a man twenty-five years old, no taller than I am, immature features and a touchy temper. I didn't like his looks—I never had—but he was a lad I was here to recruit, he was my boy. I gave him my best barkeep's smile.

Maybe I'm too critical. He wasn't swish; his nickname came from what he always said when some nosy type asked him his line: "I'm an unmarried mother." If he felt less than murderous he would add: "—at four cents a word. I write confession stories."

If he felt nasty, he would wait for somebody to make something of it. He had a lethal style of in-fighting, like a female cop—one reason I wanted him. Not the only one.

He had a load on and his face showed that he despised people more than usual. Silently I poured a double shot of Old Underwear and left the bottle. He drank, poured another.

I wiped the bar top. "How's the 'Unmarried Mother' racket?"

His fingers tightened on the glass and he seemed about to throw it at me; I felt for the sap under the bar. In temporal manipulation you try to figure everything, but there are so many factors that you never take needless risks.

*Continued on page 4.*

## The Virginia Edition

**The Virginia Edition** represents authoritative texts for all of Robert Heinlein's published fiction and nonfiction, newly typeset, whenever possible from the editions put in final form by Heinlein's own hand. In other cases, the definitive texts are represented by editions restored to their intended state, in publications overseen directly by Virginia Heinlein after her husband's passing. Mrs. Heinlein's role in perpetuating her husband's work and legacy was at all times crucial, both during and after the writing. It is truly fitting that her name be remembered in close connection with his.


*Robert Heinlein and Virginia Gerstenfeld late fall 1947. Permission by Robert A. and Virginia Heinlein Prize Trust.*

3

I saw him relax that tiny amount they teach you to watch for in the Bureau's training school. "Sorry," I said. "Just asking, 'How's business?' Make it 'How's the weather?' "
He looked sour. "Business is okay. I write 'em, they print 'em, I eat."
I poured myself one, leaned toward him. "Matter of fact," I said, "you write a nice stick—I've sampled a few. You have an amazingly sure touch with the woman's angle."
It was a slip I had to risk; he never admitted what pen-names he used. But he was boiled enough to pick up only the last. " 'Woman's angle!' " he repeated with a snort. "Yeah, I know the woman's angle. I should."
"So?" I said doubtfully. "Sisters?"
"No. You wouldn't believe me if I told you."
"Now, now," I answered mildly, "bartenders and psychiatrists learn that nothing is stranger than the truth. Why, son, if you heard the stories I do-well, you'd make yourself rich. Incredible."
"You don't know what 'incredible' means!"
"So? Nothing astonishes me. I've always heard worse."
He snorted again. "Want to bet the rest of the bottle?"
"I'll bet a full bottle." I placed one on the bar.
"Well—" I signaled my other bartender to handle the trade. We were at the far end, a single-stool space that I kept private by loading the bar top by it with jars of pickled eggs and other clutter. A few were at the other end watching the fights and somebody was playing the juke box—private as a bed where we were. "Okay," he began, "to start with, I'm a bastard."

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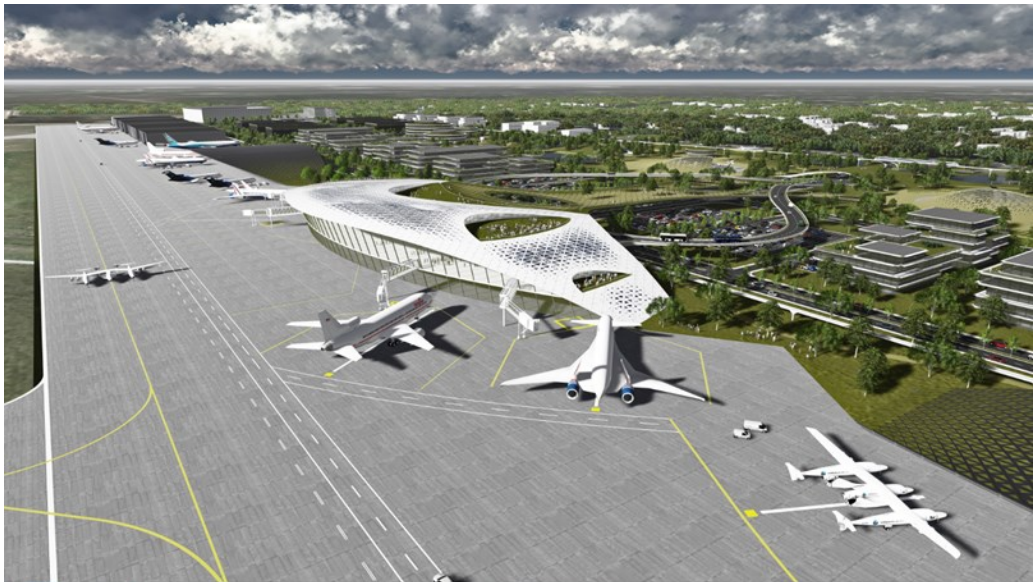
Right:
The **Houston Airport System** unveils part of its vision for the future of Ellington Airport with these conceptual renderings of a possible Spaceport. These drawings capture various elements of the overall project including a terminal facility, aviation museum and the accompanying aerospace industries that would most certainly arrive should Houston become home to the nation's ninth licensed Spaceport.



Dear Friends:

We are very proud of the fine work spaceport planning and design work accomplished by two of our Sasakawa International Center for Space Architecture (SICSA) graduates, Sam Ximenes (Class of 1987) and Nejc Trost (Class of 2013). We are also grateful for the broad positive recognition of their achievements by the Houston Airport System, by the regional aerospace community, and by the University of Houston (UH) Cullen College of Engineering which is featuring their contribution in the story below.

"UH Space Architects Help Design Houston's Proposed Spaceport," UH Cullen College of Engineering
http://www.egr.uh.edu/news/201310/uh-space-architects-help-design-houston%E2%80%99s-proposed-spaceport

This story can also be found on the College's Aerospace Engineering homepage:
http://aerospace.egr.uh.edu/

A gallery of spaceport design images created by our space architects can be accessed at
http://www.fly2houston.com/SpaceportGallery

An overall spaceport proposal video presentation sponsored and hosted by the Houston Airport System can be viewed at
http://www.youtube.com/watch?v=FQGRT8BeVDU

Another recent College of Engineering feature article story about SICSA/Space Architecture can be seen at
http://egr.uh.edu/news/201309/shooting-stars-uhs-larry-bell-discusses-space-architecture

Yes, space vision and commitment is active and well in Space City and at our fine Tier One university. Together, we are committed to converting lofty dreams to realities.

*Professor Larry Bell, Founding Director, University of Houston, Sasakawa International Center for Space Architecture (SICSA)*

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