Horizons

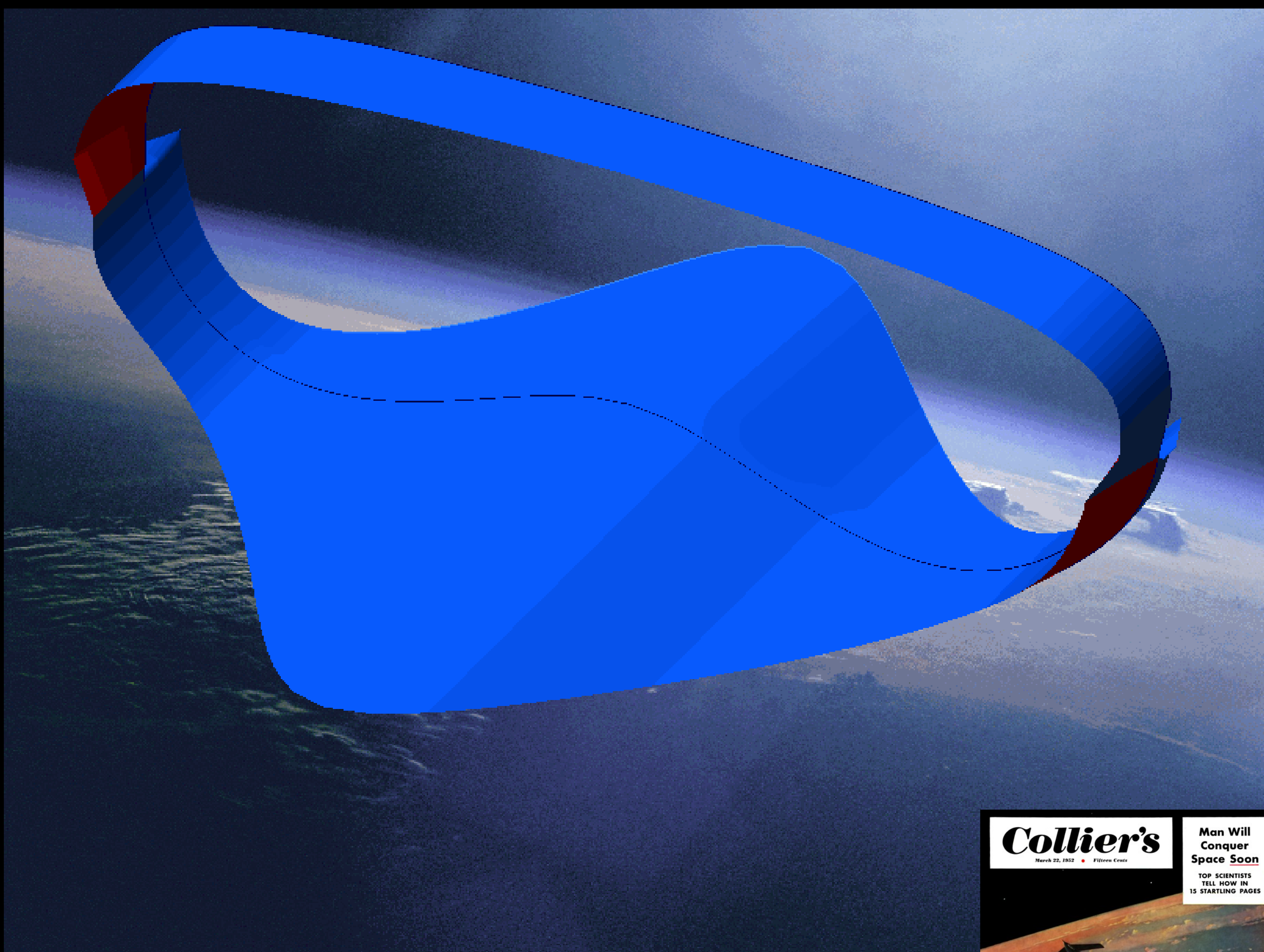
Volume 38
Issue 1

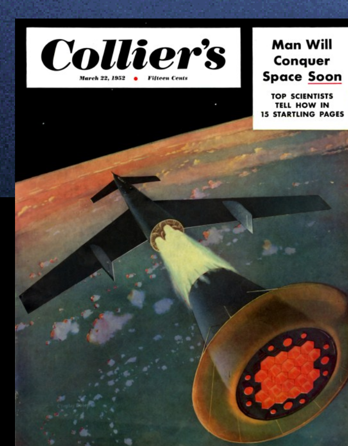
The Newsletter of AIAA Houston Section
The American Institute of Aeronautics and Astronautics

July / August 2012
www.aiaahouston.org

Ring Wing Waveriders

Dr. Patrick Rodi





Also, Starting in this Issue!

***Man Will Conquer Space Soon!* (Collier's 1952-54)**

July / August 2012
Horizons, Newsletter of AIAA Houston Section

Horizons is a bimonthly publication of the Houston Section of The American Institute of Aeronautics and Astronautics.

Douglas Yazell, *Editor*
Editing team: Dr. Steven E. Everett, Ellen Gillespie, Shen Ge, Don Kulba, Alan Simon
Regular contributors: Dr. Steven E. Everett, Don Kulba, Philippe Mairet, Alan Simon, Scott Lowther
Contributors this issue: Patrick Rodi, Shen Ge, Ted Kenny, Dr. Albert A. Jackson IV

T A B L E   O F   C O N T E N T S

From the Chair 3
From the Editor 4
Cover Story: Ring Wing Waveriders, Dr. Patrick Rodi 5
Ellington Field Joint Reserve Base, Colonel Jack “Stitch” Daniel 9
The 1940 Air Terminal Museum at Hobby Airport 13
Annual Honors & Awards Dinner, Robonaut 2 by Dr. J.D. Yamokoski 14
The European Space Agency Awards Two Studies to EADS Astrium 16
Europe’s First Lunar Lander by 2018 17
The 100 Year Starship 2012 Public Symposium in Houston Sept. 13-16 18
Scientific Preparatory Academy for Cosmic Explorers Inaugural Event 20
Suddenly Tomorrow Came... A History of JSC, the Audiobook 22
The Experimental Aircraft Association (EAA) Chapter 12 (Houston) 23
Current Events & Staying Informed 24
Calendar 26
Cranium Cruncher by Dr. Steven E. Everett 27
Section News 28
Recent Conference Papers by Section Members 32
Man Will Conquer Space Soon! Reprinting Collier’s from 1952-54 42
The Collier’s Series Backstory, Dr. Albert A. Jackson IV 45
Man Will Conquer Space Soon! Collier’s, March 22, 1952, the First Articles 46
The Back Cover: Attendees at the Leadership Retreat, August 15, 2012 76

Horizons and AIAA Houston Section Web Site
AIAA National Communications Award Winner

2004 2005 2006 2007

Cover: Waverider image by Dr. Patrick Rodi. This table of contents page uses part of Vincent van Gogh’s 1889 painting The Starry Night (Wikipedia).

Kicking Off Our 2012-2013 Year

DANIEL NOBLES, CHAIR

chair2012@aiaahouston.org
(Daniel A. Nobles)

Links:

https://people.nasa.gov

http://phone.jsc.nasa.gov/cgi-isis/phone/phone.cgi

As we look to the future of human spaceflight in Houston we must look around and ask ourselves, "Why do we do it?" Do we remain here because we have nowhere else to go in a down economy? The oil business is booming, and Houston is growing as a result. Are the layoffs over? Probably not. Why do we stay? I see our situation as the solid foundation for a glorious future. We're now significantly leaner than we were, but we lost some amazing engineers. We did not lose them all. We remain. The International Space Station (ISS) is complete, open for business and business is good. We have significant scientific programs running twenty-four hours a day on orbit, with Robonaut2 watching guard. Thanks largely to Houston, the United States of America enjoys a continuous presence in space (since October of 2000). AIAA Houston Section is now entering its 51st year. Why do most of us remain when most of us could make more money somewhere else?

I stay because I have pride in this work. I am making a difference for not just the USA, but for mankind. I stay for the thrill of watching astronauts strap themselves into rockets that hurl fragile men and women into the chasm of space using highly explosive gases and chemicals. It is the rumble of the engines, the white cloud of the shock wave and the thrill of the work. We are fortunate to work as professionals in human spaceflight, supporting NASA and making the American public proud. I stay for the excellence, the intellect and the drive of our team spirit.

Why run the exact same stress calculation on varying wall thicknesses of pipe every single day in the oil and gas industry once we have calculated the bending moments on the ISS truss due to longeron shadowing? Why would someone want to prescribe pills to the general public once they have felt the adrenaline of watching a man climb outside the hatch in a spacesuit while you watch his heartbeat race at the adrenaline of the moment that he looks down at that blue sphere, and you can call to the flight director and confirm that the crew is doing well? Why would you want to flip switches on a panel of a chemical plant, when you can flip switches that fire engines on the space station? Why would you want to train airline flight attendants how to properly stow a tray when you can train astronauts on how to operate a toilet in space? Why would you want to sweep floors at a factory, once you have had your mop bucket bumped by a tall robot wheeling itself down a hallway on a modified Segway?

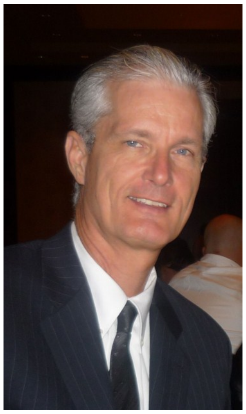
We cannot get enough of it; we are hooked. Though we lost many great engineers, I will no longer whine about the folks we have lost. Instead I will focus on doing my best. I will learn more, work smarter and refocus on things that matter. Astronauts will be launching on commercial spacecraft in the next few years and I want to be here to see it. We must not become demoralized. As long as some form of human spaceflight center remains here in Houston, your AIAA Houston Section will be here. We, who remain, will be in a wonderful position to climb the ladder once we rebuild on the solid foundation of technical competence.

As our former chairman Steve King once wrote, "*Technical competence* in our world of human spaceflight is a major tenet allowing missions to be performed successfully and their crews returned safely home. It will also be required to meet the known and unforeseen challenges in implementing the President's Vision for Space Exploration and exploiting untold opportunities that will likely follow. Over the years I have seen less importance placed within many organizations on keeping one's technical skills sharp. In-house training courses, conference paper presentation, or working on an advanced degree after hours fell by the wayside. This can be attributed to many factors such as budget pressures, contract changes, workforce reductions, or limited thought put into career planning." *(AIAA Houston Horizons, September / October 2005, page 4.)* Mr. King went on to talk about the new NASA Administrator's commitment to technical excellence. That NASA Administrator is now the AIAA President, serving over 35,000 members and 90 corporate members. Although none of us knew the extent of the changes we were to face since then, our focus on those technical skills is still appropriate.

The AIAA Houston Section must focus on providing a better product to our members. We must build vibrant technical committees, advertise our Annual Technical Symposium (ATS) better and find a larger ATS venue. We must hold more technical dinner meetings on a more regular basis. We must better engage our young professionals through more networking opportunities. We must ensure our workforce is adequately trained and their skills remain current. We must make ourselves more relevant in meeting the goals and needs of our profession at NASA Johnson Space Center and in our student sections. We will be part of the solution. We will maintain our skills and retune AIAA Houston Section to maintain our proper place in our NASA community. The new 45-person council welcomes your assistance, and we look forward to a great year. If you have suggestions, please e-mail me. You can also find [me](#) on the NASA global personnel [directory](#), or swing by my desk in building 7. Thank you for your support of AIAA Houston Section.

Daniel A. Nobles

From the Editor



E-mail:
editor2012[at]aiaahouston.org

www.aiaahouston.org

For a Horizons archive on a national AIAA web site click here.

Submissions deadline: October 10, 2012, for the September / October 2012 issue, to be published by October 31, 2012.

Correction: Yvonne Vigue-Rodi was spelled wrong on page 16 of our May / June 2012 issue. That has now been corrected, but most readers downloaded that issue before we made the correction.

Links:

Horizons archive:
https://info.aiaa.org/Regions/SC/Houston/Newsletters/Forms/AllItems.aspx

AIAA branding & logos manual
https://www.aiaa.org/Secondary.aspx?id=4967

Man Will Conquer Space Soon!

DOUGLAS YAZELL, EDITOR

We started a new logo design for a recent dinner meeting. Alan Sisson and Michael Frostad helped, and Irene Chan followed up by implementing these suggestions. Sara Bluestone, AIAA branding & logos, along with her colleagues, contributed their expertise. We noticed in the AIAA branding & logos manual that her help is available.

Our two final designs are shown on this page. We suggest that both logos become official logos of AIAA Houston Section. Users can choose the one they prefer.

We will show these logos to our council as soon as possible. If they are accepted, we can proceed to create a letterhead. Irene already created one more version of both logos, using black in place of most of the blue. That is a "reversed out" version described in the branding & logos manual.

Dr. Patrick E. Rodi was a presenter at ATS 2012, our Annual Technical Symposium of May 18, 2012. He presented a few recent Waverider papers at AIAA national conferences. We thank Dr. Rodi for this issue's cover story.

In this issue we start reprinting *Man Will Conquer Space Soon!*, a series of 1952-54 articles in the weekly magazine Collier's. The first issue was dated March 22, 1952 and contained about 25 pages and six articles. All of those 25 pages are reprinted in this issue of Horizons. The next several issues of Horizons will continue reprinting the series. The total page count is at least 89 pages.

We will see you again here in two months!

AIAA Houston Section
Since 1962

AIAA Houston Section
Since 1962

Right: Please enjoy their quarterly newsletter: www.astronauts4hire.org.

Ring Wing Waveriders

Cover Story

DR. PATRICK RODI

The Dream

Imagine a time when air transport to the farthest points on the planet will only take a few hours. This has been a dream for hypersonic vehicle designers for decades. While much progress has been made, the dream is still not a reality. Around the world teams of researchers, engineers and designers work in groups or individually to advance the state-of-the-art. As part of this effort, the pursuit of high lift-to-drag ratio (L/D) supersonic/hypersonic configurations has been underway for decades. By taking advantage of the hyperbolic nature of the inviscid flowfield, vehicle performance can be greatly increased. One such utilization of this approach is the waverider family of vehicles. Waveriders effectively increase the lift generated from a vehicle moving through the air, at Mach numbers greater than one, by riding the shock wave that the vehicle itself has created.

Waveriders were first proposed by Professor Terence Nonweiler of the Queen's University of Belfast. His initial concept was to employ planes of two-dimensional wedge flows to define a vehicle. Since then, various approaches have been developed to generate waverider geometries. For example, by tracing streamlines through the axisymmetric flowfield around cones the Conical Waverider Method was developed. However, the L/D ratios for such conical waveriders were rather poor. Additionally, the volumetric efficiency was poor, internal packaging was a challenge, and the greatest L/D ratios were obtained at low values of lift coefficient. In order to increase the L/D of waveriders at useful lift coefficients, the Osculating Cones Method was developed. This approach permits a more general definition of the shock wave shape and produced vehicles with a significant improvement in L/D. A recent evolution of waverider generation is the Osculating Flowfield Method (OFWR). Similar to the Osculating Cones Method, the Osculating Flowfield Method uses a series of planes that are created normal to the local shock wave shape defined at the trailing edge of the waverider geometry. While the Osculating Cones Method uses a conical flowfield on each plane, the new method employs a generalized flowfield such as generated by "power law" bodies.

In both methods, the procedure used to generate the waverider geometry begins by prescribing the upper surface trace and the shock wave trace on the baseplane of the vehicle. The zero radius (i.e. sharp) leading edge of the waverider is then found by determining the intersection point between each osculating plane and the upper surface, at the shock angle generated by the local flowfield on that osculating plane. With the leading edge defined, the waverider lower surface can be created by tracing streamlines from the leading edge point within each osculating plane. In general, waveriders created with the Osculating Flowfield Method have superior L/D performance over those created using the Osculating Cones Method, and demonstrate better packaging efficiency.

The OFWR method was developed while I worked at Lockheed Martin (LM) Skunk Works, an intensely innovative environment with a long history of producing revolutionary vehicles. It demonstrates patience by going through many poor ideas to find one good idea. While locked in a major competition for a USAF hypersonic vehicle contract I was looking for an aerodynamic discriminator to help our proposal and conceived of the OFWR method. While only an evolutionary improvement over existing approaches, the performance advantages ob-

(Continued on page 6)

From page 35:

Dr. Rodi recently presented these papers at the June 2012 AIAA conference in New Orleans:

Preliminary Ramjet/ Scramjet Integration with Vehicles Using Osculating Flowfield Waverider Forebodies
Patrick Rodi Lockheed Martin Corporation, Houston, TX, AIAA-2012-3223

Non-Symmetric Waverider Star Bodies for Aerodynamic Moment Generation
Patrick Rodi Lockheed Martin Corporation, Houston, TX, AIAA-2012-3222

High Lift-to-Drag Ratio Waveriders for Missions in the Martian Atmosphere
Patrick Rodi Lockheed Martin Corporation, Houston, TX; George Bennett, Hamilton Sundstrand, Houston, TX, AIAA-2012-3221

Cover Story

Dr. Patrick E. Rodi is the Aero-Sciences Lead for Lockheed Martin-Houston for the Orion Multi-Purpose Crew Vehicle. Patrick earned his B.S. degree from The University of Florida, and his M.S. and Ph.D. degrees from The Center for Hypersonic Training and Research at The University of Texas at Austin, as a NASA-Ames Graduate Student Research Fellow. Following college, he was a National Research Council Post-Doctoral Research Associate assigned to NASA-Langley to study ramjet/scramjet inlets. Patrick has worked for Boeing, McDonnell-Douglas, and joined Lockheed Martin Skunk Works in 1996 to work in high speed aerodynamics and aero-thermodynamics on a number of programs such as X-33 and FALCON. In 2007, he returned to Texas to work on the Orion Crew Exploration Vehicle. Dr. Rodi is an Associate Fellow of the AIAA and has authored 30 papers on hypersonics, grid generation and optimization.

(Continued from page 5)

served with the new designs were noteworthy and LM won the contract. Since then the OFWR method has been applied to a wide variety of missions over a range of conditions.

By definition, the flowfield around a waverider, at the design conditions, is known. This information is assumed during the geometry generation process, and can be extremely useful in engine integration. When using an air-breathing propulsion system, such as a Supersonic Combustion RAMJET (SCRAMJET), correctly locating the cowl of the engine is important for obtaining maximum performance. Ideally, a “shock-on-lip” condition is desired so that all of the air directly ahead of the engine that has been processed by the fore body is digested and used for propulsion. During vehicle design using the OFWR method the shock wave shape is known, at least in an inviscid sense, and the engine components can be optimally located with respect to the shock wave. Additionally, the flowfield properties are also known, making propulsion cycle analysis easily performed during the early phases of conceptual design and optimization. This is a significant advantage waveriders hold over other types of hypersonic vehicles that would require Euler or Navier-Stokes analysis to reach a similar level of flowfield understanding.

The Concept

Often technical advancements are made by simply combining two or more existing ideas. The combination may be far more powerful than each idea individually. The Ring Wing Waverider (RWWR) design concept is such a combination that has yielded interesting and fruitful results.

Ring Wing vehicles offer a number of potential performance advantages. Ring Wings achieve low drag by reducing the induced drag component. This is especially true at lower speeds when the lift coefficient is relatively high. By avoiding wing tips, downstream running vortices are minimized and the induced drag is reduced. Ring Wing vehicles are much like a bi-plane aircraft in that they can generate a lot of lift for a given planform, without using high lift coefficients. This is especially beneficial for large scale vehicle applications where space on taxiways, and around passenger gates and hangers, is at a premium. At transonic and low supersonic Mach numbers, Ring Wing vehicles have been designed with improved area distributions for reduced wave drag, and could potentially generate favorable interference between the wings to further reduce drag. For vehicles operating in the supersonic regime, the sonic boom footprint can have a major impact on utility be reducing or eliminating overland routes and/or flight times-of-day. Ring Wing vehicles have been designed with tailored lift and volume distributions to reduce the sonic boom footprint. As the Mach number increases further, the sonic boom footprint becomes less of an issue as a typical hypersonic vehicle’s altitude is so great that any waves generated will largely dissipate before reaching the ground.

Combining the Ring Wing concept with the OFWR generation method has been interesting and enlightening. For my first attempt, a simple circular shock wave trace was employed on the baseline. The resulting “Circular” vehicle definitely qualified as a Ring Wing, but with the circular shock wave pattern flow was compressed by the vehicle and pushed out in all directions. (See the far left illustration in Figure 1, showing the shock wave trace as a thin black line and the body frontal area as a grey region.)

(Continued on page 7)

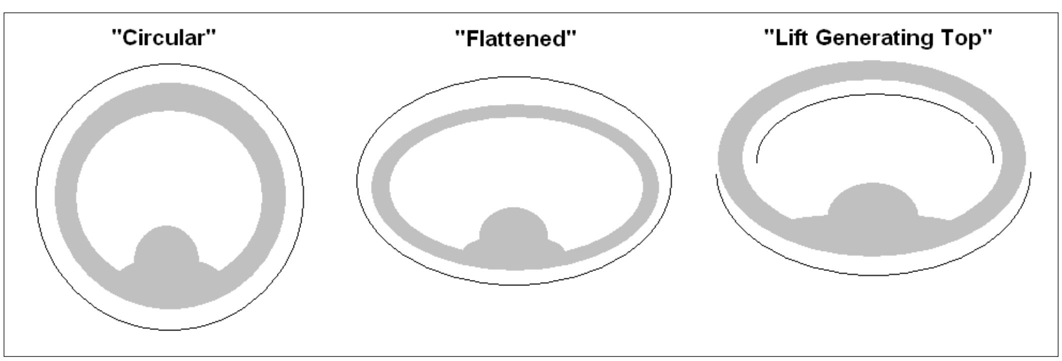


Figure 1. Front Views, showing vehicle (gray) and shock wave trace (black line). Image credit: Dr. Patrick Rodi.

Cover Story

(Continued from page 6)

Only by extending the local chord length on the bottom of the vehicle could I generate net positive lift and create a fuselage volume for packaging. Also, with so much flow compression occurring in all directions and little net lift generated, the L/D was poor.

I then tried to elongate the vehicle regions that could generate useful lift. To accomplish this, an elliptical shock wave trace was used which produced a "Flattened" shape. Again, the local chord was lengthened on the body to generate net lift. (An illustration of this geometry is shown in the center sketch of Figure 1.) This approach reduced the amount of flow being pushed sideways. The L/D improved, but the upper wing wasn't generating lift.

In order to generate lift on the top wing, I generated two separate waveriders. The first was for the top wing with compression on the lower surface. The second was for the bottom wing/fuselage, again with compression on the lower surface. A transition region was added to blend these two vehicles together. The result is illustrated in the sketch on the far right in Figure 1, and is known as the "Lift Generating Top" vehicle. This approach worked well and generated vehicles with a good L/D ratio at useful lift coefficients.

To the basic waverider forebody, a boat tail geometry was added to the lower section. The function for this aft body close-out could vary around the vehicle. For example, behind the fuselage region it could act as the nozzle for a SCRAMJET engine, and on the sides the close-out could function to reduce drag and be a prime location to include control surfaces such as rudders. For this iteration, a blunt close-out was added on the upper section. The resulting vehicle is shown in Figure 2.

The Future

Experimental testing of the RWWR concept is beginning this summer with Rutgers University conducting a wind tunnel test to quantify aerodynamic performance at low speeds. A number of geometries will be evaluated in their subsonic facility. Rutgers University is using rapid prototyping methods to quickly produce the wind tunnel models of the configurations

(Continued on page 8)

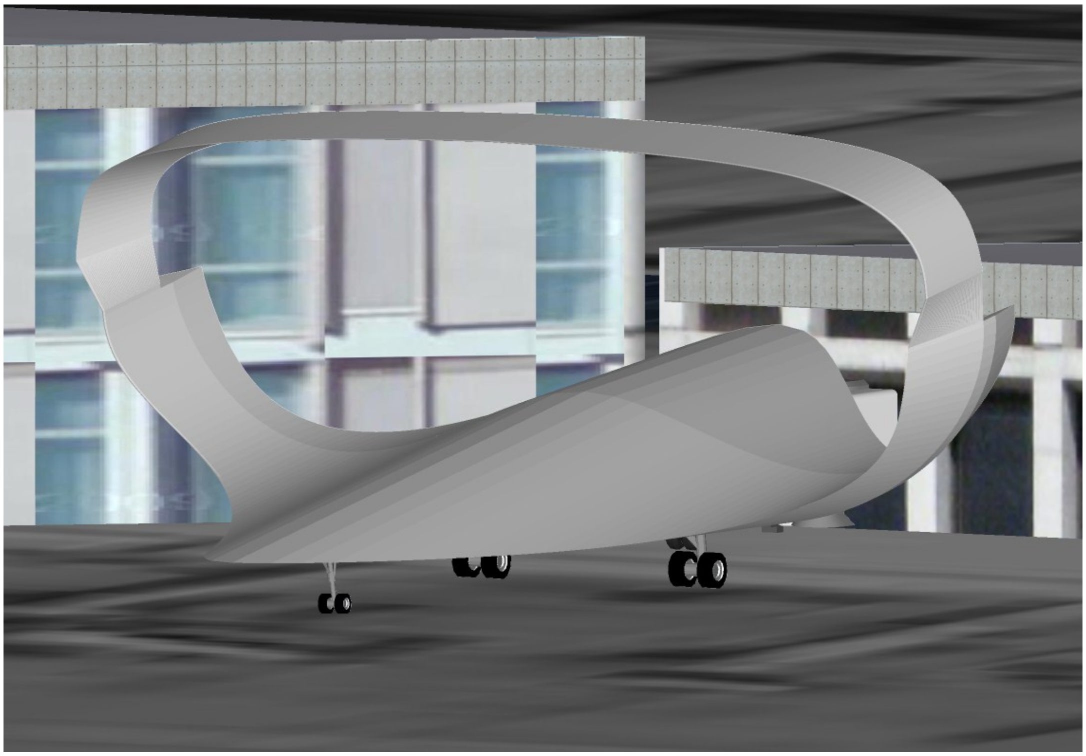
Figure 2. A Ring Wing Waverider (RWWR) vehicle. Image credit: Dr. Patrick Rodi.

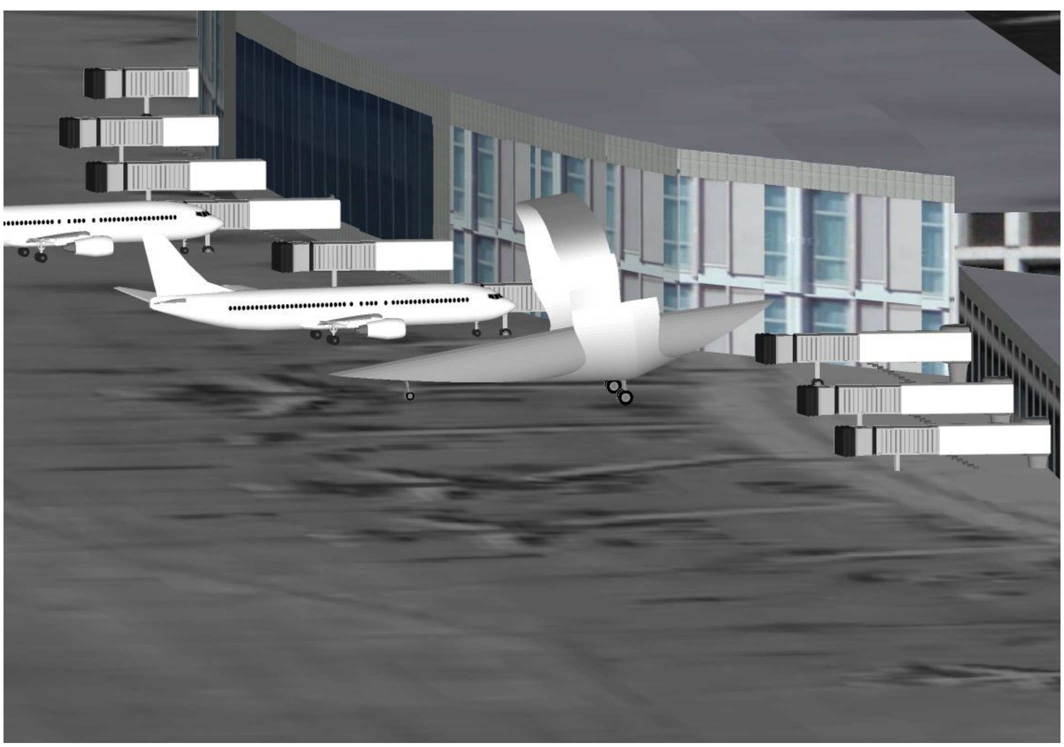
Cover Story

presented at this year's AIAA Houston Section Annual Technical Symposium (ATS 2012).

Intrinsic to the RWWR concept are a long run of leading edge length and a large expanse of wetted surface area. While these two attributes are often detrimental to the aerodynamic and/or aerothermodynamic performance of a hypersonic vehicle, there exist new technologies that can utilize these features. In recent years the field of thermal-to-electrical energy conversion has attempted to improve efficiencies by recovering lost heat in a variety of applications such as from automotive engine exhaust systems and from the skins of high speed aircraft. Such a technology can exploit the inherent features of RWWR configurations. How these two technologies will work in combination remains to be explored.

Further afield, optimization of RWWR concepts has just begun. Hopefully, the dream of hypersonic transports flying people and cargo around the planet will someday be realized. Maybe those vehicles will be Ring Wing Waveriders such as the RWWR airliner shown in Figures 3 and 4, parked on the ramp at Austin-Bergstrom Airport.





Figures 3 and 4. A Ring Wing Waverider (RWWR) Airliner at Austin-Bergstrom Airport. Image credits: Dr. Patrick Rodi.

See page 27 for news and images of the Boeing X-51A (also known as the X-51A WaveRider).

Ellington Field Joint Reserve Base

News

DOUGLAS YAZELL, EDITOR

Colonel Jack “Stitch” Daniel, Commander of Houston’s Ellington Field Joint Reserve Base (JRB) made a presentation at a Bay Area Houston Economic Partnership (BAHEP) meeting on May 16, 2012. Bob Payne (BAHEP) made the charts (a PDF file) available, and MSgt Dale Hanson explained in a brief phone call that this newsletter article based on those charts is acceptable.

Tenants, populations and needs are three main areas addressed by this presentation. Populations are addressed by the table on this page, providing details about numbers of personnel and economic impact. Needs are addressed in a list of challenges on one chart:

- Fiscal Year 2013 budget (budget control act $492B, sequester $1.2T, readiness-hollow force)
- Base Realignment and Closure (BRAC) “201?” [year]
- FAA approval to fly Remotely Piloted Aircraft (RPAs) in the National Air Space (NAS)
- JRB status
- Joint small arms range
- Joint security funding
- Fitness center
- Running track
- Base exchange (BX)/ commissary
- Joint dining facility
- Joint medical facility
- Billeting complex

The JRB (seven or eight tenants) and the US Air Force (USAF, five tenants) are located in separate but adjacent areas at Ellington Field, with the latter listed as AFRC (Air Force Reserve Center?).

The five AFRC tenants are:

- The 75th Battle Training Command Division, US Army Reserve (mission: pre-deployment battalion and higher battle command training, capabilities: interoperable and integrated training)
- The 1-149th Attack Reconnaissance Battalion, Texas Army National Guard (mission: detects the enemy and provides lethal fires,

(Continued on page 10)

Ellington Field JRB				
Unit	Full Time	Part Time	Total Personnel	Economic Impact
147th RW	309	615	924	$84
1-149th ARB	120	450	570	$22.5
USCG	91	90	181	$8.3
138th FW Det 1	34	0	34	$2
75th BCTD	109	600	709	$13.3
USNR	30	957	987	$11.1
1-23rd Marines	44	400	440	$7.5
Grand Total	737	3112	3845	$148.7

-Dollar amounts are in millions
-Current as of Jan 2012

News

(Continued from page 9)

enabling US Forces to freely maneuver and take the battlefield initiative, capabilities: nine aerial weapons teams for continuous combat operations)

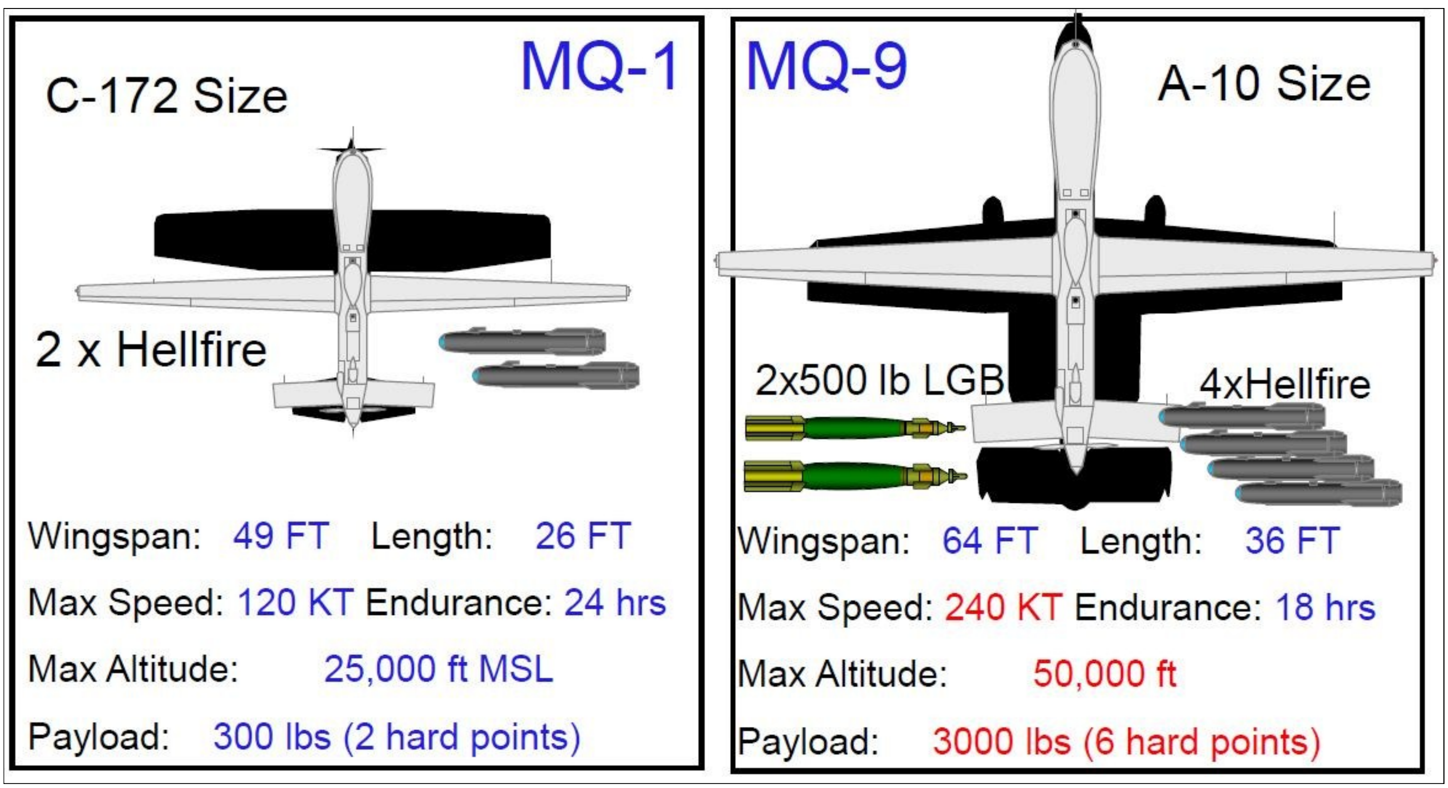
- The 451st Civil Affairs Battalion, USAR (US Army Reserve)
- The Navy Operational Support Center, US Navy Reserve (USNR), mission: provide mission-capable units and individuals to the Navy-Marine Corps teams in peace and war, capabilities: train and equip units for contingency operations.
- The 1 Battalion 23rd Marines, US Marine Corps Reserves (USMCR), mission: inspects and assists command functions: executes community relations tasks to maintain a continuous state of mobilization/ deployment readiness, capabilities: battalion staff, a headquarters and service company, three infantry companies and five dispersed weapons companies

Seven listed Ellington Field JRB tenants are:

- The 147th Reconnaissance Wing, Texas Air National Guard (TXANG), mission: federal– provides combat support to multiple commands, state– disaster response and border protection, capabilities: MQ-1B Predator, air support operations squadron, RC-26 counter drug, needs: FAA approval to fly in National Air Space (NAS), JRB status ("purple money").
- The 136th Signals Battalion, Texas Army Reserve National Guard (TXARNG)
- Houston Army Aviation Support Facility, Texas Army Reserve National Guard (TXARNG)
- The US Coast Guard, Department of Homeland Security (DHS), mission: defend the nation's maritime borders and save those in peril, capabilities: 3 MH-65C helicopters, needs: main hanger heating, ventilation and air conditioning (HVAC) and roof repairs.
- The 138th Fighter Wind Detachment (Det) 1, Oklahoma Air National Guard (OKANG), mission: provides rapid and lethal aerospace defense and air sovereignty assets in response to hostile actions against North America, capabilities: armed F-16CM Fighting Falcons, needs: military construction (MILCON) in three areas.
- Civil Air Patrol, US Air Force Auxiliary, mission:

(Continued on page 11)

Below: MQ-1 Predator and MQ-9 Reaper



(Continued from page 10)

aerospace education and cadet programs (engineering, science, aircraft maintenance and aerospace medicine) and emergency services (search & rescue, disaster relief, humanitarian services, Air Force support and counterdrug).

- Texas State Guard, Texas Military Forces, mission: provide mission-capable airmen as a force multiplier for the Texas Air National Guard to enable homeland security and Defense Support to Civil Authorities (DSCA) missions, capabilities: shelter management and Point of Distribution (PoD) management, provide emergency management during natural or man-made disasters, 147th Reconnaissance Wing support and force multiplier, needs: continued facilities support at Ellington Field JRB.

An introduction to the MQ-1 Predator and the MQ-9 Reaper begins with a 1945 VJ Day quote, one man's vision, from General Hap Arnold, USAAF: "We have just won a war with a lot of heroes flying around in planes. *The next war may be fought by airplanes with no men in them at all*… Take everything you've learned about aviation in war, throw it out the window, and let's go to work on tomorrow's aviation. *It will be different from anything the world has ever seen.*"

A chart for the Predator systems shows a ground data terminal (GDT), a satellite Earth terminal subsystem (SETS), an operations center, and two ground control stations (GCS), along with four aircraft, with about fifty personnel in the foreground.

(Continued on page 12)

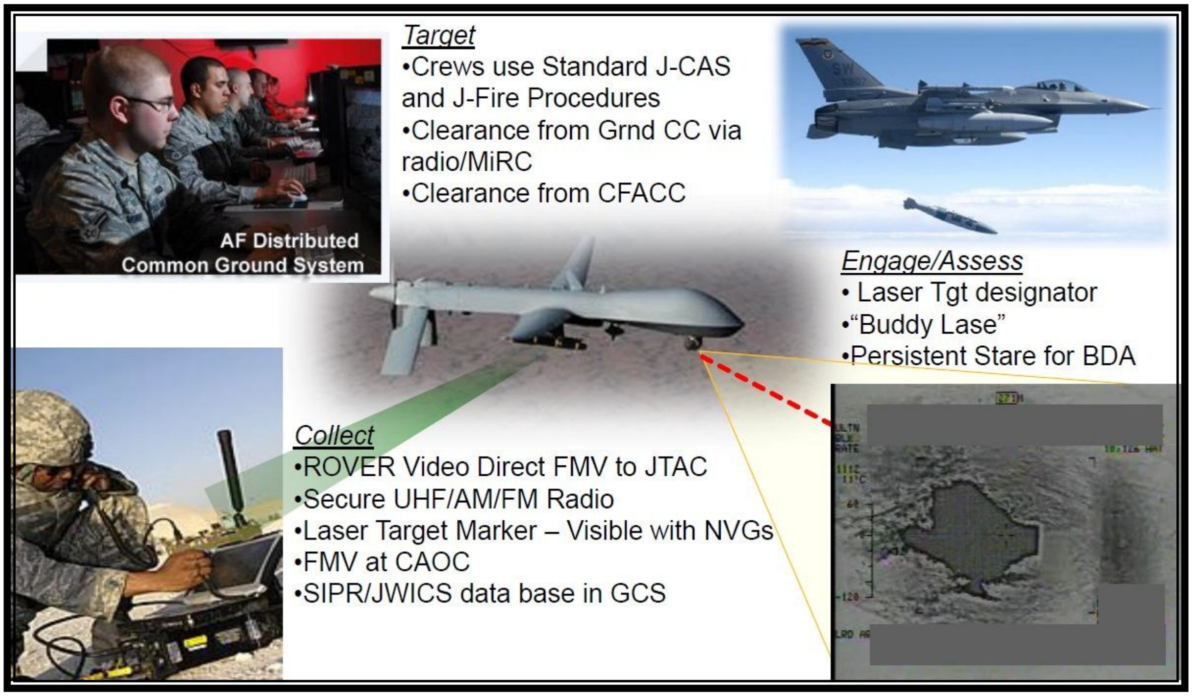
Below: EO: electro-optic. IR: infrared.

News

(Continued from page 11)

A chart for the cockpit (GCS) shows a pilot and a sensor operator, each with two computer-like terminals, along with several large computer monitors. Near the pilot's right hand is a controller similar to a space shuttle rotational hand controller.

A chart titled Remote Split Ops shows a global map with fiber optics connecting Texas Air National Guard (ANG) with a receiver "farm" in Europe and symbols for five Predators or Reapers to the east of Europe, both north and south of the latitude of Spain. The chart shows satellite communications support for the air vehicles and the receiver "farm."



A chart titled Sensor Details notes that EO (day only) has a 6-step 155x optical zoom and 2x / 4x digital zoom. That chart also explains that IR (day, night) has 4-step 56x optical zoom with 2x / 4x digital zoom. [THE END]

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

Museum

DOUGLAS YAZELL, EDITOR

It was a busy day at the museum on the third Saturday of July 2012, the day of the monthly Wings & Wheels lunch program. It was Raffle Day for the 2012 Win-a-Plane raffle, an activity that brought in over $98,000 for the museum this year. Congratulations to winner Michael R. Little of Omaha, Nebraska! And for this monthly event, there were quite a few airplanes, classic cars, and antique fire trucks on display. The museum's web site explains that live music was also planned: Leah White & the Magic Mirrors were scheduled to perform, and they even wrote a song about the museum.

Andrew Broadfoot often supplies photographs for the museum, but the museum images used in this article are not attributed to anyone on the museum's web site.

The museum's web site explains that SPAA MFAA brought the vintage fire trucks for display. Looking at the web site for SPAA MFAA:

"You have reached the home page for the SOCIETY for the PRESERVATION & APPRECIATION of ANTIQUE MOTOR FIRE APPARATUS in AMERICA or SPAAMFAA. SPAAMFAA is an organization of over three thousand members and over fifty Chapters organized in 1958 in Syracuse, NY. Our membership is located all over the globe, but primarily in the United States. Ownership of an antique piece of fire apparatus is not a requirement of membership.

"An individual membership in SPAAMFAA brings you our award winning quarterly publication: Enjine!Enjine! plus a subscription to the Silver Trumpet, the inter-chapter newsletter and a copy of the annual Membership and Apparatus Roster and one copy of the Sources Guide. Click on the Publications link at the top of the page for the latest updates."

The August 2012 Wings & Wheels at the 1940 Air Terminal Museum at Hobby Airport was scheduled for August 18, 2012, as this article was being prepared. The following two Wings & Wheels lunch programs are scheduled for Saturday, September 15, 2012, and Saturday, October 20, 2012, with themes to be announced. We hope to see you there at the museum for an event like this soon!

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

Left: The Society for the Preservation & Appreciation of Antique Motor Fire Apparatus in America. Image credit: The Society's web site.

Link:

http://www.spaamfaa.org/

Left: A vintage fire truck on display at the museum for the July 2012 Wings & Wheels monthly, third Saturday lunch program. Image credit: The museum web site.

Links:

www.1940airterminal.org

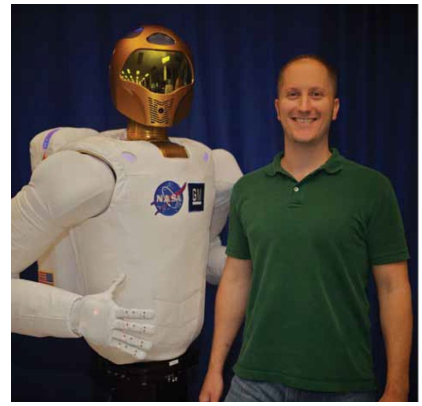
www.leahwhitemusic.com

www.andrewbroadfoot.com

Dinner Meeting

Annual Awards Dinner Meeting 2011-2012

ELLEN GILLESPIE, COUNCILOR



Above: Left: Sean Carter passes the gavel to Daniel Nobles. Center: Alan Sisson thanks J.D. Yamokoski. Right: R2 and J.D. Yamokoski.

On Tuesday, July 31, 2012, AIAA Houston Section held an annual end of year awards dinner meeting at the NASA JSC Gilruth Center. This dinner meeting was well received by approximately 30 people and featured an excellent Robonaut 2 (R2) overview presentation by John Yamokoski.

The outgoing Chair, Sean Carter/NASA-JSC, provided a summary of the 2011-2012 Section activities and made award presentations to key staff members from the 2011-2012 org chart. Additional group awards were made to the Student Paper Conference Planning Committee, Annual Technical Symposium Planning Committee, and the Horizons newsletter team.

A donation for more than $10,000 was presented to the Houston Museum of Natural Science (HMNS) Challenger Learning Center by Michael Frostad and the Yuri's Night Houston 2012 Fun Run Team headed by Mana Vautier. They performed the fundraising for this worthy cause.

The incoming Chair, Daniel Nobles/SAIC, presented the new Houston org chart and welcomed everyone to the start of the new AIAA year. Expected Section improvements for this year include updated technical committees that seek to be more active with Lunch-and-Learns, panel

(Continued on page 15)

Right: From left to right, Dr. Satya Pilla, Daniel Nobles, Clay Stangle, Tom Horn, Michael Frostad, Pamela Loughmiller, Jennifer Wells, Robert Plunkett, Irene Chan and Sean Carter.

All image credits: Shen Ge, except the photo of R2 and J.D. Yamokoski, from the Spring 2011 University of Florida Department of Mechanical and Aerospace Engineering newsletter.

(Continued from page 14)
discussion meetings, dinner meetings, and a monthly social that includes Young Professionals.

The keynote speaker for our awards dinner, Robonaut 2 Deputy Project Manager Nicolaus A. Radford, left on urgent business travel the day of the awards dinner. Dr. Radford kindly sent the R2 Controls Lead John Yamokoski as his substitute speaker. Dr. Yamokoski provided our Section with an excellent presentation.

R2 resides on the International Space Station (ISS) after launching on the Space Shuttle. Robonaut was developed in the 1998 – 2006 timeframe by NASA with the following goals:

- Share EVA activities with astronauts
- Increase efficiency of life at ISS
- Perform future planetary and Near Earth Object (NEO) surface operations

The ISS astronauts really enjoy working with R2.

General Motors (GM) partnered with NASA/JSC to perform development work on R2. GM sought R2 cooperation with NASA/JSC in 2007 after determining that the R2 team at JSC has a quick concept-to-hardware turnaround time and would make a good alliance.

The hand dexterity of R2 is supreme. R2 has a 4DOF thumb, dexterous fingers, fine motor hand skills, and multiple grasps. The capability of R2's hands approaches that of its human counterpart.

R2 has a tactile system with six small axis load cells, 14 per hand. R2's hands are gram sensitive. R2's arms have series elastic control with modular joint electronics.

R2 is smaller than R1, and is comparable in size to a human. R2 has force limiting, contact sensing and multilevel sensors so that he can share space with humans and changing environments. The R1 interface was primarily tele-operation, so R2 retained that capability. R2 is also very capable of supervised autonomous behavior.

Since ballistic robotic flight is not acceptable aboard the ISS, R2's IVA mobility utilizes two spider-like legs to move from ISS node to node. A new version of R2 is in training (on the ground) to use more tools. R2 is also being updated to use its tools more efficiently via smart algorithms that help it determine which hand is better for the chosen tool task.

We thanked Dr. John Yamokoski for his R2 presentation and presented him with two Apollo commemorative medallions as a speaker gift.

The Section is ready to start a new year of programs!

Above: Julie Read, outgoing Vice Chair Operations.

Left: Ellen Gillespie, Councilor.

Below: Norman Chaffee continues his support of our events year after year.

Left: Michael Frostad presents a check for more than $10,000 to the Houston Museum of Natural Science Challenger Learning Center, represented by Dr. Carolyn Sumners.

3AF MP

The European Space Agency Awards Two Studies to EADS Astrium

PHILIPPE MAIRET, 3AF MP AND DOUGLAS YAZELL, EDITOR

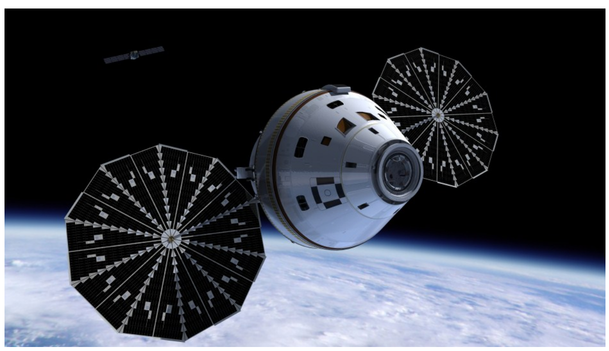
Our French sister section is 3AF MP, l'Association Aéronautique et Astronautique de France, Midi-Pyrénées chapter, www.3af-mp.fr. More information was on our web page at www.aiaa-houston.org, and as of July 1, 2012, that web site is moving to www.aiaahouston.org. Click on technical committees, then International Space Activities Committee (ISAC). The ISAC is chaired by Ludmila Dmitriev-Odier. See the Section News pages of this issue for the 3AF MP organization chart.

The European Aeronautic Defense and Space Company (EADS) Astrium has been selected by the European Space Agency (ESA) to conduct two studies, both to be completed, if possible, before the meeting of the ESA member states at the next Ministerial Council in November 2012.

The first study will, "… explore different service module solutions for the Orion Multi-Purpose Crew Vehicle (MPCV) spacecraft of the United States of America, a vehicle dedicated to human spaceflight exploration. These solutions will be based on technologies developed for the service module of [ESA's] Automated Transfer Vehicle (ATV)."

The second study, "…will identify and define the concept of [a new] autonomous spacecraft with an intrinsic versatility, also based on the know-how and technologies of the ATV." The adjustments made to this vehicle will ensure it many future missions, mainly in the areas of, "transport missions to infrastructure in Low Earth Orbit (LEO)", "in-orbit service missions targeting a spacecraft or debris," and "supply missions for the benefit of autonomous platforms / habitats."

Right: Orion MPCV and its service module with solar panels attached to the service module. Image credit: NASA Glenn Research Center (GRC).



Right: ISS030-E-175090 (28 March 2012) --- European Space Agency's "Edoardo Amaldi" Automated Transfer Vehicle-3 (ATV-3) approaches the International Space Station. The cargo spacecraft docked to the space station at 6:31 p.m. (EDT) on March 28, 2012, delivering 220 pounds of oxygen, 628 pounds of water, 4.5 tons of propellant, and nearly 2.5 tons of dry cargo, including experiment hardware, spare parts, food and clothing. Image credit: NASA.

Europe's First Lunar Lander by 2018

3AF MP

PHILIPPE MAIRET, 3AF MP AND DOUGLAS YAZELL, EDITOR

After more than 30 years, the Moon is once again in the spotlight of space agencies worldwide, as a destination for both robotic missions and human explorers. Europe's ambitions for lunar exploration begin with a lander on the Moon in 2018.

Lunar Lander is a robotic explorer that will demonstrate key European technologies and conduct science experiments. The mission is a forerunner to future human and robotic exploration of the Moon and Mars. It will establish European expertise to allow strong international partnerships in exploration.

Lunar Lander's primary goal is to demonstrate the advanced technologies needed to land precisely and safely. The spacecraft will find its landing site without human intervention, recognizing and avoiding hazards such as craters and boulders autonomously.

On the Moon, it will prove European technologies for surviving and working while exploring the environment around the landing site.

Before operating more ambitious equipment and conducting human activities on the Moon, many questions need to be answered. How hazardous is lunar dust to equipment and astronauts? Does the Moon offer resources that could be used by future missions?

Lunar Lander will touch down near to the Moon's south pole, an interesting location for future exploration missions, where no craft has landed before. The technologies developed to reach this site, together with a deeper understanding of this challenging environment, will equip Europe's scientists and engineers for future cooperation on even more ambitious exploration missions.

Last update: 9 July 2012, ESA

Editor's notes:

This project is still in a preliminary phase. Its continuation will be decided after the next ESA ministerial meeting in November 2012.

*From a United Kingdom (UK) report, the phase B1 contract with EADS Astrium / Bremen started in September of 2010, and the participating countries are Germany, Portugal, Canada, Spain, Belgium and the Czech Republic. Also, mission development already includes UK *Aurora investments (two contributions: **PANGU and ***EAGLE).*

**The Aurora programme is a human spaceflight programme* [though this lunar lander has no crew] *of the European Space Agency (ESA) established in 2001 with the primary objectives of creating, and then implementing, a European long-term plan for exploration of the Solar System using robotic spacecraft and human spaceflight. A secondary objective is to search for life beyond the Earth. (Wikipedia)*

***The PANGU (Planet and Asteroid Natural scene Generation Utility) is a computer graphics utility which development has been funded by ESA and performed by University of Dundee. It generates scenes of planets, moons, asteroids, spacecraft and rovers. The main purpose of the tool is to test and validate navigation techniques based on processing of images coming from on-board sensors, such as camera or imaging LIDAR on a planetary lander. (Wikipedia)*

A 2011 paper

ESA Strategy for Human Exploration and the Lunar Lander Mission.

****ESA EAGLE (Entry and Guided Landing Environment Simulator)*

From the UK-China workshop of September 2011, Software for Planetary Exploration

- *Designed, developed and maintained by SciSys.*
- *Baseline modeling & simulation tool for future ESA exploration missions*
- *Mars, lunar or NEO environments*
- *A single framework, various configurations*
- *Uses international standards & allows development of new functionality*

ESA Lunar lander portrait with robotic arm. Image credit: ESA.

100 Year Starship (100YSS)

Links:

100 Year Starship:
www.100yss.org

Foundation for Enterprise Development:
www.fed.org

Icarus Interstellar:
www.icarusinterstellar.org

100YSS 2012 Public Symposium in Houston September 13-16

Press release from the Dorothy Jemison Foundation for Excellence

Mae Jemison and Team Establish 100 Year Starship with Goal to Make Interstellar Space Travel Reality by 2112

Houston, TX, May 17, 2012 — **The Dorothy Jemison Foundation for Excellence** has been selected by the Defense Advanced Research Projects Agency (DARPA) to receive seed money to form **100 Year Starship** (100YSS), an independent, non-government, long-term initiative which will ensure the capabilities for human interstellar flight exist as soon as possible, and definitely within the next 100 years. The winning 100YSS proposal, "An Inclusive, Audacious Journey Transforms Life Here on Earth and Beyond," was created by the Dorothy Jemison Foundation for Excellence with team members **Icarus Interstellar** and the **Foundation for Enterprise Development**.

Former NASA astronaut Mae Jemison will lead the global multi-partner organization. Dr. Jemison, the world's first woman of color to travel in space (1992's Space Shuttle Endeavour), brings to her leadership role her vast experience as an engineer, physician, professor, former Peace Corps medical officer and entrepreneur. Known for achieving the improbable, Dr. Jemison also brings a spirit of audacity, innovation and inclusion to 100YSS.

"Yes, it can be done. Our current technology arc is sufficient," says Dr. Jemison. "100 Year Starship is about building the tools we need to travel to another star system in the next hundred years. We're embarking on a journey across time and space. If my language is dramatic, it is because this project is monumental. This is a global aspiration. And each step of the way, its progress will benefit life on Earth. Our team is both invigorated and sobered by the confidence DARPA has in us to start an independent, private initiative to help make interstellar travel a reality."

100 Year Starship will bring in experts from myriad fields to help achieve its goal - utilizing not only scientists, en-

(Continued on page 19)

Right: Extrasolar planet Upsilon Andromedae d lies in the habitable zone and if it has moons large enough, they may be able to support liquid water, as the image shows. On the horizon of this hypothetical earth-like moon can be seen Upsilon Andromedae d, possibly a class II planet (Sudarsky classification): since it is too warm to form ammonia clouds this ones are made up of water vapor, white in color instead of the characteristic yellow-reddish clouds of Jupiter and Saturn. Image source: Wikipedia. Image credit: Lucianomendez 2011.

100 Year Starship (100YSS)

Registration Costs

Registration Type	Cost	Student*
Early Registration (Ends July 7th)	$200	$100
Regular Registration (Ends August 30th)	$250	$150
Late/Onsite Registration	$300	$175
Press Registration	See form below	

* Students must present a valid school ID at registration and have a school email address to obtain this rate.

(Continued from page 18)
gineers, doctors, technologists, researchers, sociologists and computer experts, but also architects, writers, artists, entertainers, and leaders in government, business, economics, ethics and public policy. 100YSS will also collaborate with existing space exploration and advocacy efforts from both private enterprise and the government.

In its first year, 100YSS will seek investors, establish membership opportunities, encourage public participation in research projects, and develop the visions for interstellar exploration. A **100 Year Starship Public Symposium** will be held in Houston September 13-16, 2012, inaugurating what will be an annual event open to scientific papers, engineering challenges, philosophical and sociocultural considerations, economic incentives, application of space techniques to improve life on Earth, imaginative exploration of the stumbling blocks and opportunities to the stars, and broad public involvement.

The 100 Year Starship also will include a scientific institute, **The Way**, whose major emphasis will be speculative, long-term science and technology.

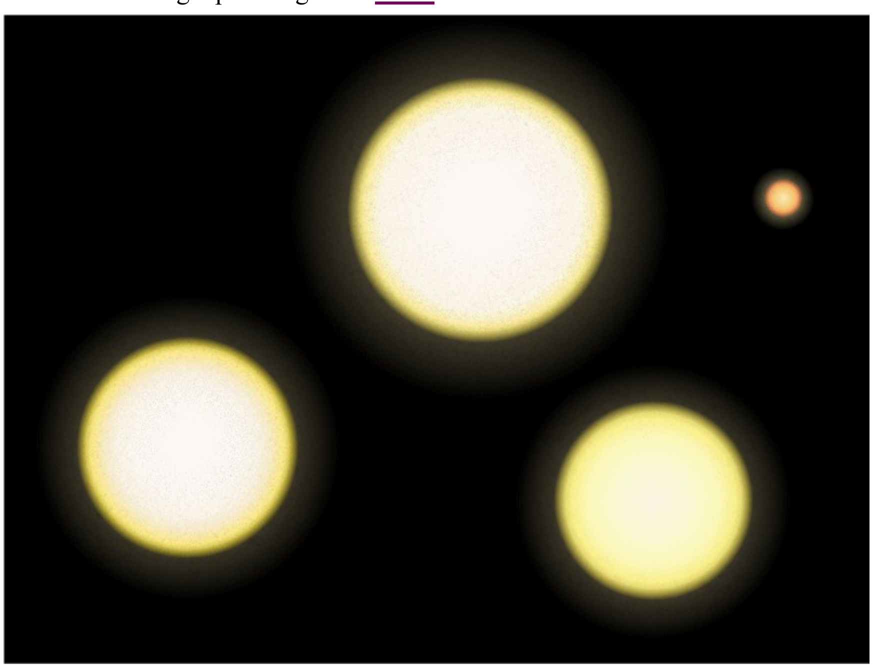
Alongside the Dorothy Jemison Foundation for Excellence, a nonprofit organization that promotes science, technology, engineering and mathematics (STEM) awareness and achievement, the principal 100 Year Starship team members are: **Icarus Interstellar**, a non-profit research and development organization dedicated to the research that will enable interstellar flight, and **The Foundation for Enterprise Development**, centered on governance, innovation, entrepreneurship, technology and R & D based organizational planning, management and strategic planning. **The SETI Institute**, a private non-profit organization dedicated to astronomy, life sciences, education and public outreach, will hold a permanent seat on the 100YSS Advisory Council.

To sign up for e-mail alerts from 100 Year Starship or learn more about the 100YSS Public Symposium, visit www.100YSS.org. Follow 100 Year Starship on Twitter (@100YSS). Contact 100 Year Starship at info@100YSS.org.

2012 100YSS
Public Symposium

Hyatt Regency Houston
1200 Louisiana Street
Houston TX 77002 USA

Phone
402-592-6464
888-421-1442



Left: This diagram illustrates, from left to right, the relative size of the Sun, α Centauri A, α Centauri B and Proxima Centauri. Image source: Wikipedia. Image credit: RJHall 2008.

Links:

100 Year Starship:
www.100yss.org

SETI:
www.seti.org

SPACE, the Academy

Right: *The bigger hardware from Excalibur Almaz. Image credit: SPACE.*

Scientific Preparatory Academy for Cosmic Explorers (SPACE) Successfully Concludes Inaugural Event

SHEN GE, SPACE CEO AND CO-FOUNDER

DOUGLAS, ISLE OF MAN, July 16, 2012 – The Scientific Preparatory Academy for Cosmic Explorers (SPACE), an educational and research institution, successfully concluded its *SPACE: From Foray to Habitation* conference

on July 10, 2012. This two-day conference served both as a gathering point for space visionaries interested in overcoming barriers to spaceflight and an opening ceremony for the nascent nonprofit company SPACE.

Notable attendees gave talks discussing new ways of teaching space studies to students, overcoming technical barriers, and overcoming legal barriers with both SPACE personnel and SPACE supporters. Among SPACE personnel was Roy Tucker, a prolific asteroid discoverer, and Virgiliu Pop, a well-known space lawyer focused on outer space property rights. SPACE supporters included Tim Craine, presently in charge of the space sector of the Isle of Man government, Dr. Dorin Prunariu, formerly head of the United Nations Committee on the Peaceful Use of Outer Space (UNCOPUOS) and presently head of The Association of Space Explorers (ASE), Rick Tumlinson, a well-known Texas space entrepreneur, Dr. David Hyland, a professor at Texas A&M University, Chris Welch, the Director of Masters Program at the International Space University (ISU), and Art Dula, founder and CEO of Excalibur Almaz.

All keynote presenters were also present in panel discussions and gave insightful answers to questions such as "What is your vision for the future of space education?" and "What new technologies can provide fundamental paradigm shifts in opening spaceflight?"

The Jurby social, graciously supported by Excalibur Almaz, was also a huge success, thanks to the efforts of both SPACE and Excalibur Almaz. Conference attendees at this social had the opportunity to poke around and climb into real space hardware that flew in the 1970s.

(Continued on page 21)

Below: Dorin Prunariu, head of The Association of Space Explorers (ASE), open to astronauts and cosmonauts who have completed at least one Earth orbit, in the Excalibur Almaz space capsule. Image credit: SPACE.

(Continued from page 20)

Excalibur Almaz plans to launch these flight tested space vehicles to the Moon in the near future, implementing a cislunar trip experience. Art Dula of Excalibur Almaz gave a speech about his own company's plans before declaring his support for SPACE and concluding his speech by giving the floor to SPACE co-founders, including CEO Shen Ge, COO Neha Satak, CVO Virgiliu Pop, CMO Hyerim Kim, CTO Darkhan Alimzhanov and Specialist Roy Tucker. Dr. David Hyland of Texas A&M University was also invited to join this group at the podium, since the establishment of SPACE was inspired by his series of conversations with Roy Tucker.

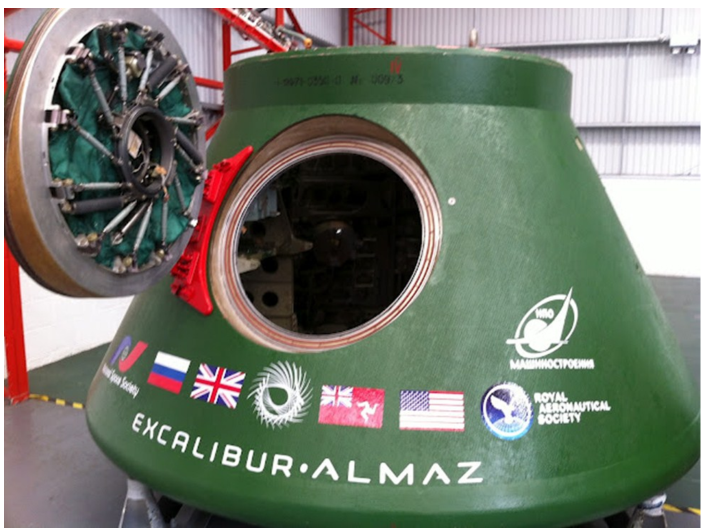
The conference was a resounding success and provided an upsurge of interest in both SPACE and the Space Isle. Conference documents and media documents can be seen on the SPACE Conference website at http://www.spaceconf.com.

The SPACE conference may be over but SPACE itself is just beginning. In addition to continuing research initiatives, SPACE is already planning the next event, the SPACE Retreat, to take place next winter in January/February on the Canary Islands.

For more information, contact Shen Ge, CEO of SPACE at sg@spaceacad.org or Hyerim Kim, CMO of SPACE at hk@spaceacad.org.

About SPACE

SPACE's mission is to become a world-class international, interdisciplinary and hands-on space academy, offering four-year university degrees in fields as diverse as aerospace engineering, space law, astronomy, and space commerce, thereby creating a space culture and a space technology base. SPACE will accomplish this by leveraging its complementary nature with the graduate-level International Space University (ISU, founded in 1987). SPACE will also continue conducting multidisciplinary research with the aim of developing space-enabling technologies and policies.



SPACE, the Academy

SPACE
www.spaceacad.org

Left: Two of the already-in-Earth-orbit-with-crew Excalibur Almaz spacecraft. Image credits: Excalibur Almaz.

History

Suddenly Tomorrow Came… the Audiobook

TED KENNY, HISTORY TECHNICAL COMMITTEE CHAIR

"Suddenly Tomorrow Came ..." I had been digging through my library looking for inspiration and a good project for the local AIAA history committee, when I ran across this title. What a great title for the book formally documenting the JSC's past! As I visited with JSC and HQ history offices (and checked forums like Librovox), I learned this history has never been made into an audio book. Our shared history being limited to the pages of dead trees and flat screens keeps it from many as they exercise at the gym, drive the morning carpool to school, or just sit out at night looking up at the Moon where men once stood.

Who better to speak the history than those that have and are creating that history? I propose that our history committee and AIAA Houston Section take on releasing an audiobook as an upcoming project. Depending on interest, we could create a fun collaboration of over 35 readers, allow our organization to reach out to other JSC organizations for participation, and be a mechanism to bring in others from the ranks of our JSC Alumni or other AIAA groups.

Audiobooks are hard, but we are engineers, and we start by asking, "What are the stats and challenges?"

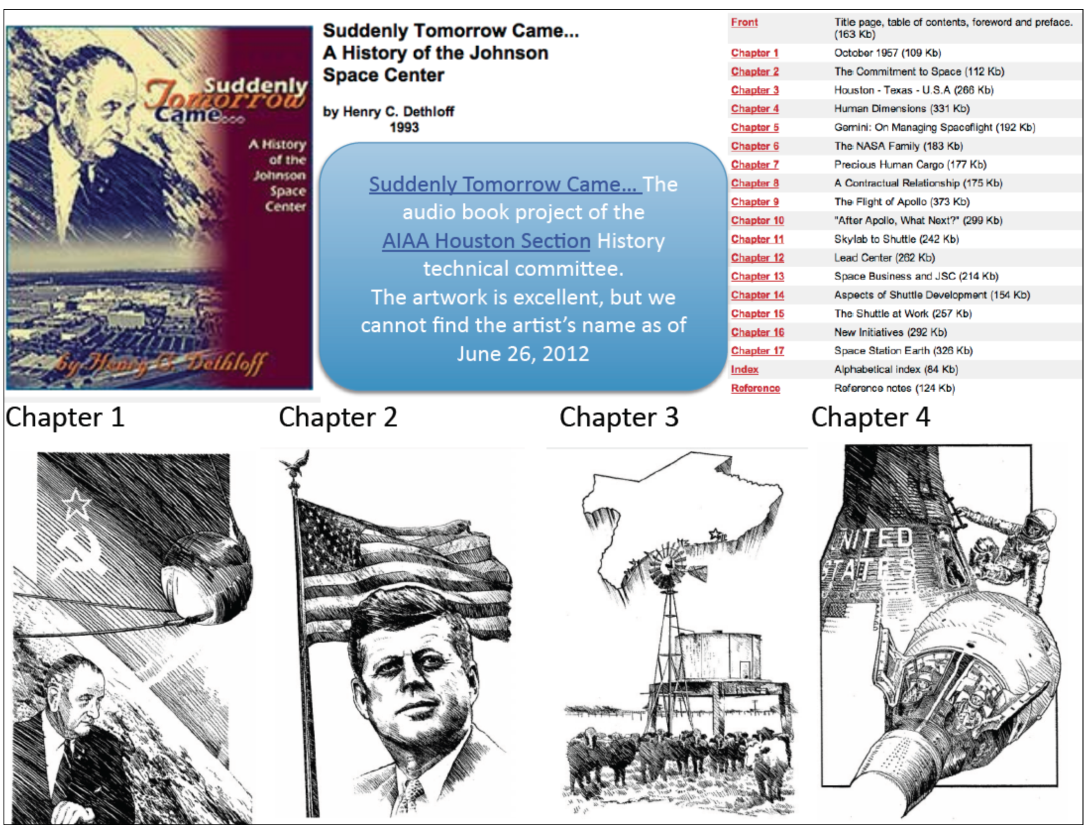
- ~350 pages (this is likely 18 to 20 hours of book)
- 44 figures and tables
- Published in 1993, by Henry Dethloff for NASA, it stops short of covering our recent history. How do we approach that?
- This book is a bit dense with names and other pronunciation challenges from the past. You cannot tell the history of JSC without telling the history of manned spaceflight, which involved many whose names were not as easy to pronounce as John or Jane Smith. We may need an audio crutch for some.
- Multiple non-actor readers (i.e. us) yields a voice of authenticity which is key to this project, but that design choice drives a likely need to set some standards (basic reading pace, for example) and ensuring a level of audio quality. (I am thinking of setting up a super-advanced blanket/coat-rack-based audio studio in my office. People could use that to record over a lunch break on any given day.)

The PDF of the book can be found here: http://www.jsc.nasa.gov/history/suddenly_tomorrow/suddenly.htm

While I enjoy a good luncheon talk or other group meeting, these tend to be ephemeral in nature. I would like to augment such meetings with something our chapter can contribute for a more permanent legacy. I am roughing out a project plan/approach and would encourage anyone interested to drop me a note with any comments or thoughts.

Thanks,
Ted.Kenny-1[at]nasa.gov

Below: Information from the book. Image credit: Douglas Yazell.



The Experimental Aircraft Association (EAA) Chapter 12 (Houston)

Mission

The EAA's Chapter 12, located at Ellington Field in Houston, Texas, is an organization that promotes all forms of recreational aviation. The organization includes interest in homebuilt, experimental, antique and classic, warbirds, aerobatic aircraft, ultra lights, helicopters and commercially manufactured aircraft and the associated technologies.

This organization brings people together with an interest in recreational aviation, facilitating social interaction and information sharing between aviation enthusiasts. Many of the services that EAA offers provide valuable support resources for those that wish to develop and improve various skills related to aircraft construction and restoration, piloting, aviation safety and aviation education.

Every individual and organization with an interest in aviation and aviation technology is encouraged to participate. (EAA membership is not required, but encouraged.) Meetings are generally from 6:30 PM to 9:00 PM at Ellington Field in Houston Texas. We welcome everyone. Come as you are and bring a guest; we are an all-aviation friendly organization!

In our May 2011 issue we started our series "EAA/AIAA profiles in general and experimental aviation" with Lance Borden, who is rebuilding his Inland Sport airplane, an aircraft manufactured by his grandfather's 1929 - 1932 company. The second in this series was a profile of Paul F. Dye. The third profile will appear as soon as possible. This series was suggested by Richard Sessions of EAA Chapter 12.

Ideas for a meeting? Contact Richard at rtsessions[at]earthlink.net, Chapter 12 web site: www.eaa12.org. Another email contact: eaachapt12[at]gmail.com. As of April 13, 2012, EAA Chapter 12 is meeting on the first Tuesday of month, based on the calendar on the web site.

Experimental Aircraft Association (EAA) web site: www.eaa.org

Scheduled/Preliminary Chapter 12 Event/Meeting Ideas and Recurring Events:

1st Saturday of each month – La Grange TX BBQ Fly-In, Fayette Regional (3T5)
1st Saturdays – Waco/Macgregor TX (KPWG), Far East Side of Field, Chap 59, Pancake Breakfast with all the goodies 8-10 AM, Dale Breedlove, jdbvmt[at]netscape.com
2nd Saturdays – Conroe TX Chapter 302 10 AM Lone Star Builder's Ctr, Lone Star Executive
2nd Saturdays – Lufkin TX Fajita Fly-In (LFK)
2nd Saturdays – New Braunfels TX Pancake Fly-In
3rd Saturdays – Wings & Wheels, 1941 Air Terminal Museum, Hobby Airport, Houston TX
3rd Saturdays – Jasper TX BBQ Lunch Fly-In (JAS)
3rd Saturdays – Tyler TX Breakfast Fly-In, 8-11, Pounds Field (TYR)
4th Saturdays – Denton TX Tex-Mex Fly-In
4th Saturdays – Leesville LA Lunch Fly-In (L39)
4th Saturdays – Shreveport LA Lunch Fly-In (DTN)
Last Saturdays – Denton Fly-In 11AM-2 PM (KDTO)

Kit (Without Fast Build Options)

Left: Photos from Chris Barber's Lone Star Velocity web site (www.lonestarvelocity.com). Some assembly required! Velocity SE.

Current Events

Who is on the ISS now? (7/26/2012). Expedition 32: July - November 2012.

Above: International Space Station artwork. Image credit: NASA. (NASA ISS web site 7/26/2012.)

Right: ISS032-S-001 (September 2011) --- This patch represents the 32nd expedition to the International Space Station (ISS) and the significance of the science being conducted there for current and future generations. The arch shape of the patch symbolizes the "doorway" to future space exploration possibilities. The ISS, an orbiting laboratory above the Earth, provides a unique perspective for Earth observation and monitoring. The flame depicts the pursuit of knowledge and highlights the importance of education as the key to future human space flight. The astronaut symbol circles the Earth, acknowledging the work of all astronauts, past, present, and future. The names of each crew member located on the border of the patch are written to honor the various cultures and languages on the mission. The three flags also depict the home countries of the Expedition 32 crew members and signify the collaborative ISS partnership of 15 countries working as one. Image credit: NASA.

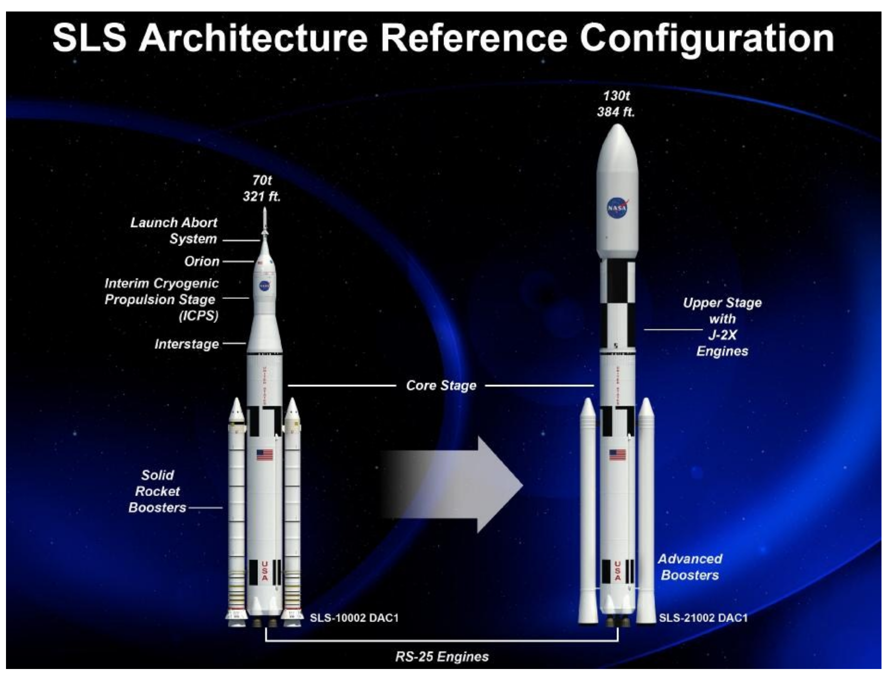
September 25-28, 2012
International Academy of Astronautics (IAA)
SETI San Marino (Search for Extra-Terrestrial Life)
4th IAA Symposium on Searching for Life Signatures
Invited presentation:
Detecting Starships (a literature review),
by Dr. Albert A. Jackson IV (Houston, Texas USA)

International Academy of Astronautics

Space Launch System Passes Major Agency Review

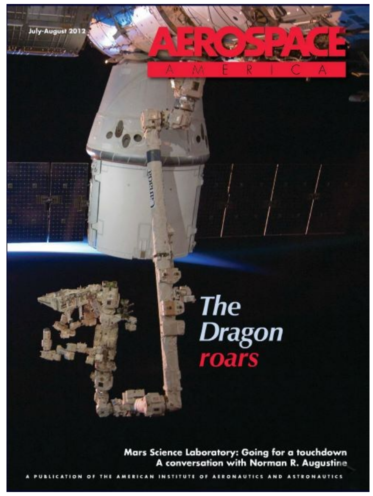
NASA, Thursday, 7/26/2012

The rocket that will launch humans farther into space than ever before passed a major NASA review Wednesday. The Space Launch System (SLS) Program completed a combined System Requirements Review and System Definition Review, which set requirements of the overall launch vehicle system. SLS now moves ahead to its preliminary design phase.



Staying Informed

Norman Augustine interview, July / August 2012 Aerospace America (AIAA members only)



Sally Ride, the first American woman in space, has passed away. (NASA)

Ride's contribution to America's space program continued right up until her death at age 61 this week. After two trips to orbit aboard the shuttle, she went on to an award-winning academic career at the University of California, San Diego, where her expertise and wisdom were widely sought on matters related to space.

See page 27 for news and images of the Boeing X-51A (also known as the X-51A WaveRider).

NOAA: La Niña-related heat waves now 20 times as likely. (Houston Chronicle Sci Guy blog, 7//10/12.)

A new state of the climate report from NOAA has provided the most detailed analysis yet of the extreme weather experienced in the United States and abroad during 2011. It can be found here.

Left: Dr. Ride at the Human Space Flight Review Committee Meeting. Former astronaut Dr. Sally Ride, left, confers with Norman Augustine, chair, prior to the start of the final meeting of the Human Space Flight Review Committee, Wednesday, Aug. 12, 2009, in Washington. Image credit: NASA/Paul E. Alers.

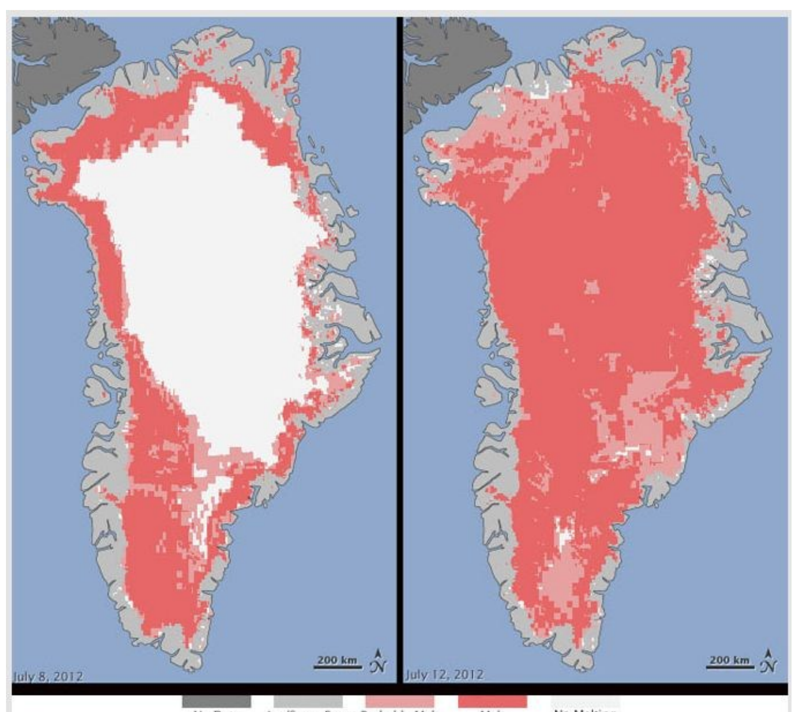
La Niña-related heat waves, like that experienced in Texas in 2011, are now 20 times more likely to occur during La Niña years today than La Niña years 50 years ago.

The UK experienced a very warm November 2011 and a very cold December 2010. In analyzing these two very different events, UK scientists uncovered interesting changes in the odds. Cold Decembers are now half as likely to occur now versus 50 years ago, whereas warm Novembers are now 62 times more likely.

Satellites See Unprecedented Greenland Ice Sheet Surface Melt, NASA, 07/24/12

"Ice cores from Summit show that melting events of this type occur about once every 150 years on average. With the last one happening in 1889, this event is right on time," says Lora Koenig, a Goddard glaciologist and a member of the research team analyzing the satellite data. "But if we continue to observe melting events like this in upcoming years, it will be worrisome."

Nghiem's finding while analyzing Oceansat-2 data was the kind of benefit that NASA and ISRO had hoped to stimulate when they signed an agreement in March 2012 to cooperate on Oceansat-2 by sharing data.



NASA's First Women Flight Controllers

Houston resident Marianne Dyson has a new page on her web site. She was one of the first ten women space shuttle flight controllers.

Calendar

Section events & other events related to aeronautics & astronautics. This July / August 2012 issue of Horizons is scheduled to be online by August 31, 2012.
All items are subject to change without notice.

Section council meetings: email secretary2012[at]aiaahouston.org
Time: 5:30 - 6:30 PM usually
Day: First Monday of most months except for holidays.
Location: NASA/JSC Gilruth Center is often used. The room varies.

Recent events:
31 July 2012 *Annual awards dinner meeting featuring J.D. Yamokoski, Controls Lead for Robonaut 2*
15 August 2012 *Annual executive council leadership retreat*

27 October 2012 Saturday at the Wings Over Houston Airshow with EAA Chapter 12 and CollectSPACE. See www.aiaahouston.org.

AIAA National & International Conferences

2012:

30 July - 1 August 2012 Atlanta, Georgia
48th AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit and 10th International Energy Conversion Engineering Conference
2-3 August 2012: Regional Leadership Conference (RLC), Atlanta, Georgia
Venue: Hyatt Regency Atlanta
13 - 16 August 2012, Minneapolis, Minnesota
AIAA Guidance, Navigation and Control and Co-located Conferences
11 - 13 September 2012, Pasadena, California
AIAA Complex Aerospace Systems Exchange
11 - 13 September 2012, Pasadena, California
AIAA SPACE 2012 Conference & Exposition
17 - 19 September 2012, Indianapolis, Indiana
12th AIAA Aviation Technology, Integration, and Operations (ATIO) Conference and 14th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference
24 - 28 September 2012, **Tours, France**
18th AIAA/3AF International Space Planes and Hypersonic Systems and Technologies Conference
24 - 28 September 2012, Ft. Walton Beach, Florida
7th AIAA Biennial National Forum on Weapon System Effectiveness

2013:

7 - 10 January 2013 Grapevine (Dallas/Ft. Worth Region), Texas
51st AIAA Aerospace Sciences Meeting
25 - 28 March 2013 Daytona Beach, Florida
22nd AIAA Aerodynamic Decelerator Systems Technology Conference and Co-located Conferences
8 - 11 April 2013 Boston, Massachusetts
54th Structures, Structural Dynamics, and Materials and Co-located Conferences

Cranium Cruncher

Dr. Steven E. Everett

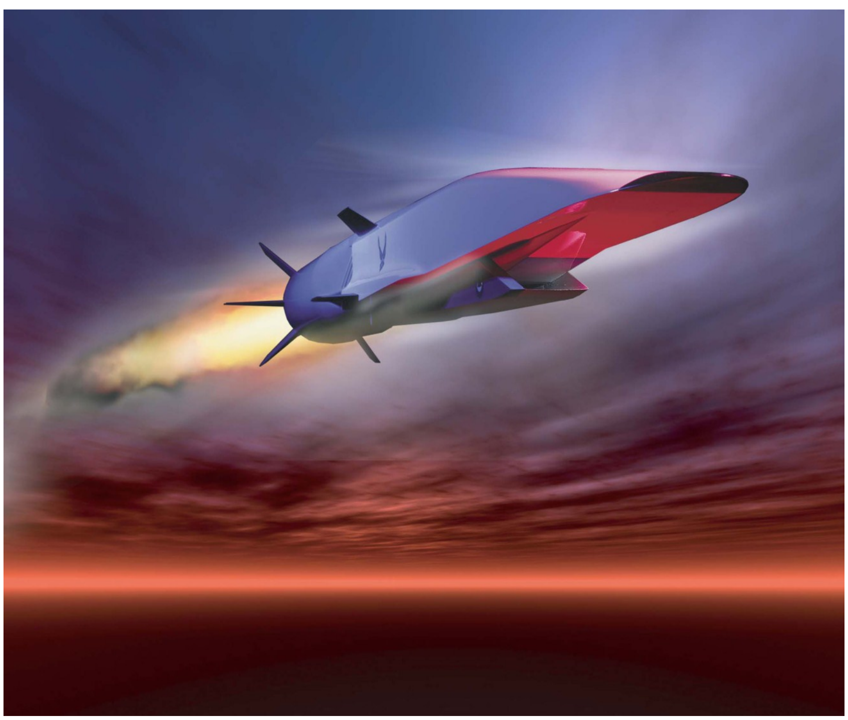
Last month, the reader was given the task of identifying missing digits in a long division problem given only the locations of the digits and the red 7 shown. The solution for this problem is shown below:

```
124 ) 12128316  ( 97809
      1116
        968
        868
        1003
         992
          1116
          1116
```

This month, the problem concerns the finances of contracting launch services. Two companies, AstroLoft and BlueSky Launchers, are both startup companies offering launch services. Each had the capability to provide the same number of launches in the next thirty years, but due to differences in labor and operational costs, Astroloft is offering launch contracts at two for 100 million dollars, while BlueSky is offering launch contracts at three launches for 100 million dollars. Given the limited market for satellite launches, AstroLoft and BlueSky hire a third company, CosmoCorp, to market and sell contracts for them. CosmoCorp arranges to sell launch contracts at five launches (two by AstroLoft and three by BlueSky) for 200 million dollars, and split the proceeds evenly with AstroLoft and BlueSky. After the available capacity for the coming thirty year period had been sold, it was found that 700 million dollars less had been made than would have been if each company had sold contracts individually. Which company lost money in this deal and how much?

Send solutions to *steven.e.everett at boeing.com*.

***Below left**: Artist's concept of X-51A in flight. Image credit: US Air Force. **Bottom right**: The X-51 forebody is an example of a cone -derived waverider. Image credit: US Air Force Research Laboratory. **Top right**: X-51A under the wing of a B-52 at Edwards Air Force Base, July 2009. Image credit: Chad Bellay, US Air Force. Image sources: Wikipedia.*



Section News

Right: from an ESA ATV blog entry… http://blogs.esa.int/atv/ "ATV-3 reboosts ISS: view from 'on console' at ATV-CC. Posted on 18 Jul 2012 by Daniel. ATV-3 conducted its 6th ISS reboost maneuver early this morning, and ESA Mission Director Adam Williams oversaw the activity at ATV-CC, **Toulouse, France**. He's sent in a detailed timeline of how it went -- giving a rare, 'on console' look behind the scenes of ATV operations…" Image credit: ESA, D. Ducros, 2010.

© ESA/D.Ducros - 2010

Association Aéronautique et Astronautique de France (3AF)

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

Section News

Left: Mana Vautier and (at right) Michael Frostad at the dinner meeting of July 31, 2012. Image credit: Shen Ge.

The American Institute of Aeronautics and Astronautics (AIAA)

AIAA Houston Section
Since 1962

P.O. Box 57524
Webster, TX 77598

Executive Council
July 01, 2012 - June 30, 2013

www.aiaahouston.org

Chair
Daniel Nobles / SAIC
281-483-8360 (w) 979-255-4780 (cell)

Chair-Elect
Jonathan Sandys

Past-Chair
Sean Carter / NASA
281-244-7232 (w) 832-651-1000 (cell)

Secretary
Robert Plunkett / MEI
281-483-2797

Treasurer
Clay Stangle
281-217-2172

Vice Chair - Operations
Michael Frostad / ERC
281-461-5867

- **College and Co-Op** — Dr. Gary Turner / Odyssey, 281-862-7825
- **Honors and Awards** — Jennifer Wells / UTAS, 281-336-6302
- **Membership** — Lisa Voiles / USA, 281-244-6467
- **STEM K-12** — Svetlana Hanson / Tietronix, 281-326-0779
- **Professional Development** — Angela Beck / Engineering Redesign
- **Newsletter** — Douglas Yazell, 832-366-5292
- **Publicity** — Shen Ge, 770-617-4046
- **Programs** — Dr. Pamela Loughmiller, 607-227-2620
- **Public Policy** — Melissa Gordon / Lockheed Martin, 321-446-2776
- **Scholarship** — Rafael Munoz / NASA, 281-483-3427
- **Young Professionals** — Tom Horn / Barrios, 540-748-0442
- **Communications** — Eryn Beisner / Barrios, 281-244-0212
- **Webmaster** — Irene Chan / Summit, 323-393-5723
- **E-Mail** — Ryan Miller/ Boeing, 281-226-4430

Councilors
(2-year terms ending June 30, 2014)

- Alan Sisson, 281-235-2075
- Christopher Davila / Barrios, 281-244-8173
- Larry Friesen / UHCL, 281-334-5268
- Shirley Brandt, 713-542-9085
- Sarah Shull / NASA, 281-244-6441

Councilors
(2-year terms ending June 30, 2013)

- Michael Martin / TAMU, 979-220-5517
- Alicia Baker / Baker Hughes, 713-927-2044
- Ellen Gillespie, 281-682-3653
- Matt Johnson / LMCO, 281-333-6080
- Melissa Kronenberger / SAIC, 281-335-2270

Vice Chair - Technical
Brian Banker / NASA
281-483-7907

- **Astrodynamics** — Dr. Albert A. Jackson / Jacobs, 281-483-5037
- **Automation and Robotics** — Dr. Zafar Taqvi / Barrios, 281-244-4436
- **Program Management & Integration** — Dr. Satya Pilla / Boeing, 832-858-3982
- **Extra-Vehicular Activity** — Daryl Schuck/ Honeywell, 281-532-5203
- **Guidance, Navigation, and Control** — Dr. Steven E. Everett / Boeing, 281-734-6284
- **History** — Ted Kenny / NASA
- **In-Space Imaging and Crew Observations** — Dr. Kamlesh Lulla / NASA, 281-483-5159
- **Space Operations** — BeBe Kelly-Serrato / A-SCC, 281-798-9060
- **Life Sciences, Space Processes, and Human Factors** — Julie Mitchell / NASA, 281-244-7417
- **Propulsion and Power Systems** — Sheikh Ahsan / NASA, 281-244-6826
- **Safety and Mission Assurance** — Roger Kleinhammer / SAIC, 281-335-2303
- **Systems Engineering** — Gary Brown / Booz Allen Hamilton, 713-933-6814
- **Space Commercialization** — (Open)
- **International Space Activities Committee** — Ludmila Dmitriev-Odier / USA, 832-524-6307

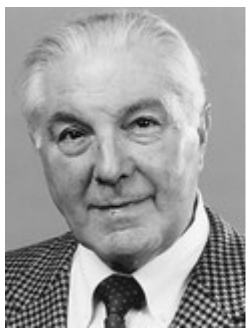
Updated July 31, 2012, Executive Council Voting Members (20) are identified by:

Section News

Sixty Years with Professor Angelo Miele

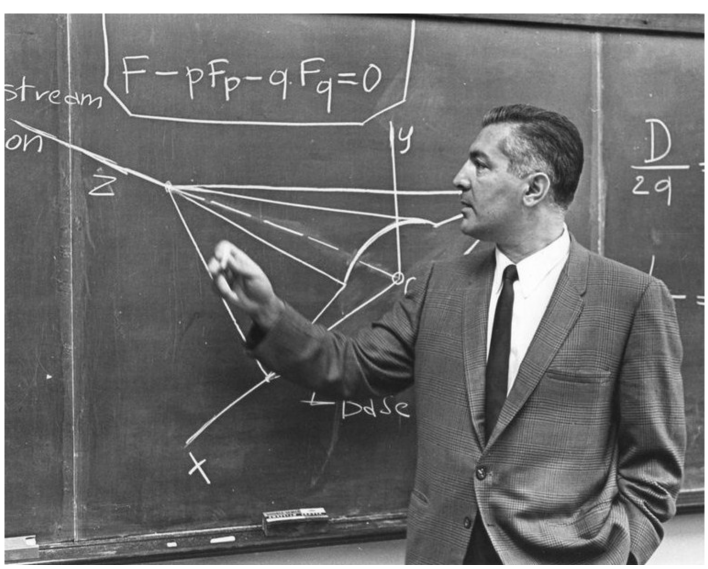
SEAN CARTER, PAST CHAIR

As noted in the Chair's column last issue on page 3, Professor Angelo Miele of Rice University celebrates sixty years with AIAA this year. Professor Miele sent us the following short biography on June 25, 2012.



Right: Image credit: National Academy of Engineering of the National Academies.

Right: Image credit: Rice University, November 15, 2010, a news report by Holly Beretto, Engineering Communications, "Miele Honored by Italian Hometown."



Right: Image credit: Rice University. "Angelo Miele, shown here in the 1960s." This is part of the web site display for 1964 as part of the Rice Centenniel Timeline, starting in 1891.

During the past 60 years, Professor Angelo Miele worked nonstop in several areas of flight mechanics, astrodynamics, applied aerodynamics, optimization theory and numerical methods.

In industry, Miele was Director of Astrodynamics and Flight Mechanics at Boeing Scientific Research Laboratories (1959-64). In academia, he taught at Polytechnic Institute of Brooklyn (1952-55), Purdue University (1955-59) and Rice University (1964-today).

His numerous publications have been nationally and international recognized. He was elected to membership of the USA National Academy of Engineering, the Russian Academy of Sciences and the International Academy of Astronautics. In addition to two earned doctorates in engineering from the University of Rome, Miele holds an honorary doctorate of science from Technion, the Israel Institute of Technology.

His book Flight Mechanics (Addison Wesley 1962) and his edited book Theory of Optimum Aerodynamic Shapes (Academic Press 1965) were both translated into Russian (Nauka, Moscow,1968). He was elected Fellow of The American Astronautical Society (AAS) and Honorary Fellow of The American Institute of Aeronautics and Astronautics (AIAA). He is the recipient of the Levy Medal (Franklin Institute), Brouwer Award (AAS), Pendray Aerospace Literature Award (AIAA), Mechanics and Control of Flight Award (AIAA), and Schuck Award (American Automatic Control Council).

Most recently, his hometown of Formia (Italy) honored Miele with the 2010 Cicero Prize.

Today Miele continues his teaching and research activities at Rice University as Research Professor Emeritus and Foyt Professor Emeritus. The year 2012 marks not only sixty years of association with AIAA, but also sixty years of life in the United States.

Section News

Texas A&M University AIAA Student Section News

Two students from the Department of Aerospace Engineering won first place in their divisions in the 2012 American Institute of Aeronautics and Astronautics (AIAA) Region IV Student Paper Conference in April at NASA Johnson Space Center in Houston.

James Henrickson won first place in the graduate division for his paper, "Characterization of Shape Memory Alloys Using Artificial Neural Networks." He will compete in the national championship at the 2013 AIAA Aerospace Sciences Conference in Grapevine, Texas. His co-author and research advisor is Dr. John Valasek.

Left to right: Henrickson, Valasek and Probe. Image credit: Texas A&M University. Past Student Branch Chair Mr John M Guthery (j.g[at]tamu.edu).

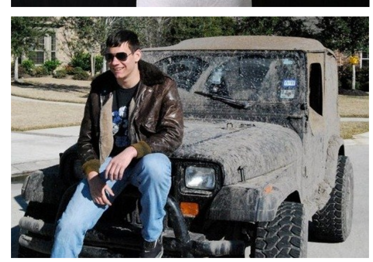
Aggie Austin Probe won first place in the public outreach division for his presentation, "Texas A&M Sigma Gamma Tau Community Outreach." Probe is the president of Sigma Gamma Tau (**ΣΓΤ**), the aerospace engineering honor society, and his presentation highlighted **ΣΓΤ** outreach activities.

The contest was hosted by the the AIAA Houston Section and the University of Texas at Austin's AIAA Student Branch. AIAA Region IV comprises Texas A&M, the University of Texas at Austin, University of Houston, University of Texas at Arlington, University of Oklahoma, Oklahoma State University, Texas Christian University, University of New Mexico, University of Arkansas and Rice University.

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.

Brian Freno '08 Chair	Bob Cline '13 Speaker Chair	Grant Atkinson '11 Graduate Representative
Rahul Venkatraman '13 Vice Chair	Nhan Phan '14 SEC Chair	Nick Ortiz '13 Senior Class Representative
John Guthery '11 Secretary	Travis Dawsey Activity Chair	Alejandro Orozco '14 Junior Class Representative
Erica Lovig '13 Treasurer	Lauryn Hoch '15 Publicity Chair/ Webmaster	Logan Hodge '15 Sophomore Class Representative



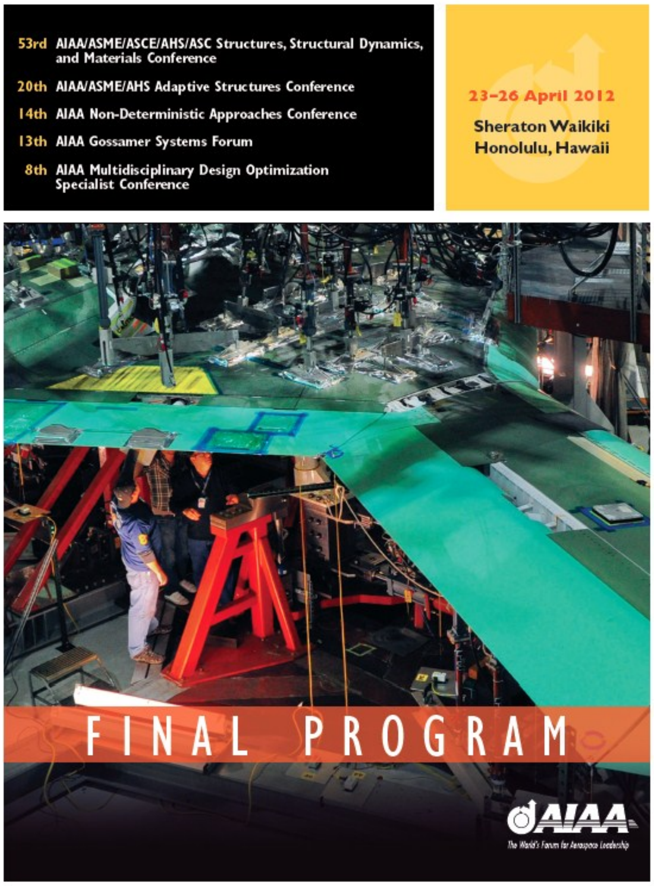
Above: Lauryn Hoch and Logan Hodge. Image credits: Texas A&M University AIAA student section web site.

Rice University AIAA Student Section Advisor:
Professor Andrew Meade
meade[at]rice.edu
713-348-58880
www.ruf.rice.edu/~meade/

Conference Papers

Recent AIAA Papers by Section Members

DOUGLAS YAZELL, EDITOR



Search date: July 27, 2012.
Search terms: Houston, the College Station in author affiliation field.

Left: The icon for the search engine at www.aiaa.org.

53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference 20th AIAA/ASME/AHS Adaptive Structures Conference

Utilizing Photogrammetry and Strain Gage Measurement to Characterize Pressurization of an Inflatable Module
Doug Litteken NASA JSC, Houston, TX; Molly Selig NASA JSC, Houston, TX; Gerard Valle NASA JSC, Houston, TX; Ovidio Oliveras Jacobs Engineering, Houston, TX, AIAA-2012-1913

Structural Verification of the First Orbital Wonder of the World - The Structural Testing and Analysis of the International Space Station (ISS)
John Zipay NASA JSC, Houston, TX; Karen Bernstein NASA JSC, Houston, TX; Raymond Patin NASA JSC, Houston, TX; Erica Bruno United Space Alliance, Webster, TX; Phillipe Deloo ESA, Noordwijk, THE NETHERLANDS, AIAA-2012-1772

Design and Testing of the Inflatable Aeroshell for the IRVE-3 Flight Experiment
David Lichodziejewski Airborne Systems, Santa Ana, CA; Christopher Kelley Airborne Systems, Santa Ana, CA; Benjamin Tutt Airborne Systems, Santa Ana, CA; David Jurewicz Airborne Systems, Santa Ana, CA; Glen Brown Airborne Systems, Santa Ana, CA; Brian Gilles Airborne Systems, Santa Ana, CA; Dennis Barber Oceaneering, Houston, TX; Robert Dillman NASA Langley Research Center, Hampton, VA; Charles Player NASA Langley Research Center, Hampton, VA, AIAA-2012-1515

20th AIAA/ASME/AHS Adaptive Structures Conference

Experiments of Vortex-Induced Vibration of a Flat Plate Exposed to a Normal Cross Flow
Yi Yang Texas A&M University, College Station, TX; Thomas Strganac Texas A&M University, College Station, TX, AIAA-2012-1832

Aeroelastic Simulation of Structures in Hypersonic Flow
Robert Brown Texas A&M University, College Station, TX; Kaushik Das Texas A&M University, College Station, TX; John Whitcomb Texas A&M University, College Station, TX; Paul Cizmas Texas A&M University, College Station, TX, AIAA-2012-1497

Failure Initiation Prediction in Textile Composites Under Complex Thermo-Mechanical Loading Based on Meso-scale Analysis
Wesley McLendon Texas A&M University, College Station, TX; John Whitcomb Texas A&M University, College Station, TX, AIAA-2012-1495

(Continued on page 33)

Conference Papers

(Continued from page 32)

Computational Micromechanical Modeling of Ceramic-SMA Composites
Brian Lester Texas A&M University, College Station, TX; Dimitris Lagoudas Texas A&M University, College Station, TX,, AIAA-2012-1493

Rate-free Control of Nonlinear Wing Section Using Pitch and Plunge Measurements Only
Neha Satak Texas A&M University, College Station, TX; Edwin Peraza Hernandez Texas A&M University, College Station, TX; John Hurtado Texas A&M University, College Station, TX, AIAA-2012-1486

Infotech@Aerospace 2012
Garden Grove, California, June 19-21, 2012

Towards Autonomous Operation of Robonaut 2
Julia Badger NASA JSC, Houston, TX; J. Yamokoski Oceaneering Space Systems, Houston, TX; Brian Wightman Oceaneering Space Systems, Houston, TX,, AIAA-2012-2441

Tele-Operation Control of Robonaut on the International Space Station
Reginald Berka NASA JSC, Houston, TX; S. Michael Goza NASA JSC, Houston, TX; Elliott Potter NASA JSC, Houston, TX; Courtney Edmondson NASA JSC, Houston, TX; Noe De La Pena NASA JSC, Houston, TX, AIAA-2012-2427

A Lower Bounding Linear Programming approach to the Perimeter Patrol Stochastic Control Problem
Krishnamoorthy Kalyanam Air Force Research Laboratory, Wright-Patterson AFB, OH; Swaroop Darbha Texas A&M University, College Station, TX; Myoungkuk Park Texas A&M University, College Station, TX; Meir Pachter Air Force Institute of Technology, Wright-Patterson AFB, OH; Phil Chandler Air Force Research Laboratory, Wright-Patterson AFB, OH; David Casbeer Air Force Research Laboratory, Wright-Patterson AFB, OH, AIAA-2012-2454

Analysis of Virtual Sensors for Predicting Aircraft Fuel Consumption
Timothy Woodbury Texas A&M University, College Station, TX; Ashok Srivastava NASA Ames Research Center, Moffett Field, CA, AIAA-2012-2449

(Continued on page 34)

Conference Papers

(Continued from page 33)

42nd AIAA Fluid Dynamics Conference and Exhibit New Orleans, Louisiana, June 25-28, 2012

Computational Fluid Dynamics Validation and Post-test Analysis of Supersonic Retropropulsion in the Ames 9x7 Unitary Tunnel
Kerry Zarchi NASA Ames Research Center, Moffett Field, CA; Daniel Schauerhamer Jacobs, Houston, TX; William Kleb NASA Langley Research Center, Hampton, VA; Jan-Renee Carlson NASA Langley Research Center, Hampton, VA; Karl Edquist NASA Langley Research Center, Hampton, VA; Emre Sozer ERC, Inc., Huntsville, AL, AIAA-2012-2705

On the Unsteady Shock Wave Interaction with a Backward-Facing Step: Inviscid Analysis
Nicole Mendoza Texas A&M University, College Station, TX; Rodney Bowersox Texas A&M University, College Station, TX, AIAA-2012-2709

PIV of a Mach 5 Turbulent Boundary Layer over Diamond Roughness Elements
Scott Peltier Texas A&M University, College Station, TX; Raymond Humble Texas A&M University, College Station, TX; Rodney Bowersox Texas A&M University, College Station, TX, AIAA-2012-3061

The Influence of Favorable Pressure Gradients upon the Coherent Motions in a Mach 5 Turbulent Boundary Layer
Scott Peltier Texas A&M University, College Station, TX; Raymond Humble Texas A&M University, College Station, TX; Rodney Bowersox Texas A&M University, College Station, TX, AIAA-2012-3060

Reynolds Stresses in a Hypersonic Boundary Layer with Streamline Curvature-Driven Favorable Pressure Gradients
Nathan Tichenor PM and AM Research, Tuscon, AZ; Raymond Humble Texas A&M University, College Station, TX; Rodney Bowersox Texas A&M University, College Station, TX, AIAA-2012-3059

Stability of Hypersonic Compression Cones
Eduardo Perez Texas A&M University, College Station, TX; Travis Kocian Texas A&M University, College Station, TX; Joseph Kuehl Texas A&M University, College Station, TX; Helen Reed Texas A&M University, College Station, TX, AIAA-2012-2962

The Characterization and Feasibility of a Low-Duty-Cycle Fast Valve for Impulse Facilities
David Taylor Texas A&M University, College Station, TX; Nicole Mendoza Texas A&M University, College Station, TX; Rodney Bowersox Texas A&M University, College Station, TX, AIAA-2012-2827

Experimental Investigation of the Crossflow Instability in Moderate Freestream Turbulence
Robert Downs Texas A&M University, College Station, TX; Erica Lovig Texas A&M University, College Station, TX; Edward White Texas A&M University, College Station, TX, AIAA-2012-2824

30th AIAA Applied Aerodynamics Conference New Orleans, Louisiana, June 25-28, 2012

Evaluation of Drogue Parachute Damping Effects Utilizing the Apollo Legacy Parachute Model
Kelly Currin NASA Kennedy Space Center, Cape Canaveral, FL; Joe Gamble Lockheed Martin Corporation, Houston, TX; Daniel Matz NASA JSC, Houston, TX; David Bretz NASA JSC, Houston, TX, AIAA-2012-3227

(Continued on page 35)

(Continued from page 34)

Conference Papers

Preliminary Ramjet/Scramjet Integration with Vehicles Using Osculating Flowfield Waverider Forebodies
Patrick Rodi Lockheed Martin Corporation, Houston, TX, AIAA-2012-3223

Non-Symmetric Waverider Star Bodies for Aerodynamic Moment Generation
Patrick Rodi Lockheed Martin Corporation, Houston, TX, AIAA-2012-3222

High Lift-to-Drag Ratio Waveriders for Missions in the Martian Atmosphere
Patrick Rodi Lockheed Martin Corporation, Houston, TX; George Bennett, Hamilton Sundstrand, Houston, TX, AIAA-2012-3221

A Transonic Laminar-Flow Wing Glove Flight Experiment: Computational Evaluation and Linear Stability
Matthew Roberts Texas A&M University, College Station, TX; Helen Reed Texas A&M University, College Station, TX; William Saric Texas A&M University, College Station, TX, AIAA-2012-2668

A Transonic Laminar-Flow Wing Glove Flight Experiment: Overview and Design Optimization
Michael Belisle Texas A&M University, College Station, TX; Matthew Roberts Texas A&M University, College Station, TX; Thomas Williams Texas A&M University, College Station, TX; Matthew Tufts Texas A&M University, College Station, TX; Aaron Tucker Texas A&M University, College Station, TX; William Saric Texas A&M University, College Station, TX; Helen Reed Texas A&M University, College Station, TX, AIAA-2012-2667

28th Aerodynamic Measurement Technology, Ground Testing, and Flight Testing Conference including the Aerospace T&E Days Forum New Orleans, Louisiana, June 25-28, 2012

Real-Time Measurement of Skin Friction Using Calibrated Multi-Element Hotfilm Arrays
Robert Long Texas A&M University, College Station, TX; Edward White Texas A&M University, College Station, TX, AIAA-2012-3012

Acoustic Forcing and Control of Reflected Waves in the Klebanoff-Saric Wind Tunnel
Matthew Kuester Texas A&M University, College Station, TX; Edward White Texas A&M University, College Station, TX, AIAA-2012-2862

43rd AIAA Thermophysics Conference New Orleans, Louisiana, June 25-28, 2012

Arcjet Testing and Thermal Model Development for Multilayer Felt Reusable Surface Insulation
Frank Milos NASA Ames Research Center, Moffett Field, CA; Carl Scott LZ Technology, Houston, TX; Steven Del Papa NASA JSC, Houston, TX, AIAA-2012-2869

(Continued on page 36)

Conference Papers

(Continued from page 35)

42nd International Conference on Environmental Systems San Diego, California, July 15-19, 2012

Extravehicular (EVA) Operations in the Geostationary Environment
William Atwell The Boeing Company, Houston, TX, AIAA-2012-3646

Radiation Shielding Evaluation Tools for Risk Reduction on Future Human Space Missions
Hatem Nounu Universities Space Research Association, Houston, TX; Myung-Hee Kim Universities Space Research Association, Houston, TX; Francis Cucinotta NASA JSC, Houston, TX, AIAA-2012-3645

MPCV Flight Suit Performance After an Uncontrolled Crew Cabin Depressurization Event
Miriam Sargusingh NASA JSC, Houston, TX, AIAA-2012-3644

Potential Uses of Deep Space Cooling for Exploration Missions
Michael Swickrath NASA JSC, Houston, TX; Jeffery Sweterlitsch NASA JSC, Houston, TX; Joe Chambliss NASA JSC, Houston, TX, AIAA-2012-3638

Single Loop Thermal Control for Deep Space Exploration
Thomas Leimkuehler Paragon Space Development Corporation, Houston, TX; Gary Lantz Paragon Space Development Corporation, Houston, TX, AIAA-2012-3637

Tissue Equivalent Proportional Counter Microdosimetry Measurements Aboard High-Altitude and Commercial Aircraft
Brad Gersey Prairie View A & M University, Prairie View, TX; Richard Wilkins Prairie View A & M University, Prairie View, TX; William Atwell The Boeing Company, Houston, TX; W. Kent Tobiska Space Environment Technologies, Inc., Pacific Palisades, CA; Christopher Mertens NASA Langley Research Center, Hampton, VA, AIAA-2012-3636

Simulation of Cosmic Rays Directionality at Low Earth Orbit
William Atwell The Boeing Company, Houston, TX; Francis Badavi NASA Langley Research Center, Hampton, VA, AIAA-2012-3635

International Space Station Major Constituent Analyzer On-orbit Performance
Ben Gardner United Technologies Corporation, Pomona, CA; Phillip Erwin United Technologies Corporation, Pomona, CA; Souzan Thoresen United Technologies Corporation, Pomona, CA; Chris Matty NASA JSC, Houston, TX, AIAA-2012-3633

Impacts of an Ammonia Leak on the Cabin Atmosphere of the International Space Station
Stephanie Duchesne Wyle, Houston, TX; Jeffrey Sweterlitsch NASA JSC, Houston, TX; Chang Son The Boeing Company, Houston, TX; Jay Perry NASA Marshall Space Flight Center, Huntsville, AL, AIAA-2012-3632

Suitport Feasibility - Development and Test of a Suitport and Space Suit for Human Pressurized Space Suit Donning Tests
Robert Boyle NASA JSC, Houston, TX; Kate Mitchell NASA JSC, Houston, TX; Charles Allton NASA JSC, Houston, TX; Hsing Ju Jacobs, Houston, TX, AIAA-2012-3631

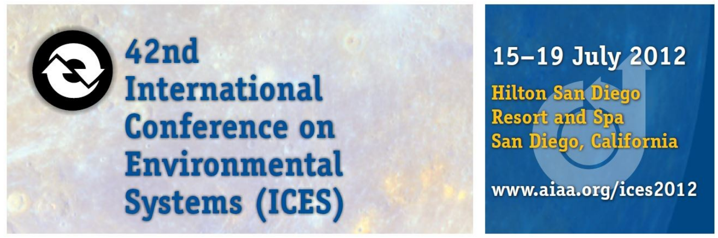
Environmental Control and Life Support (ECLS) Hardware Commonality for Exploration Vehicles
Robyn Carrasquillo NASA Marshall Space Flight Center, Huntsville, AL; Molly Anderson NASA JSC, Houston, TX, AIAA-2012-3623

Environmental Controls and Life Support System (ECLSS) Design for a Space Exploration Vehicle (SEV).
Imelda Stambaugh NASA JSC, Houston, TX; Branelle Rodriguez NASA JSC, Houston, TX; Melissa Borrego Jacobs, Houston, TX; Subramanian Sankaran Jacobs, Houston, TX; Walt Vonau Jacobs, Houston, TX, AIAA-2012-3622

(Continued on page 37)

(Continued from page 36)

Conference Papers



Life Support Systems for a New Lunar Lander Molly Anderson NASA JSC, Houston, TX; Henry Rotter NASA JSC, Houston, TX; Imelda Stambaugh NASA JSC, Houston, TX; Evan Yagoda Jacobs, Houston, TX, AIAA-2012-3621

Investigation into the High Voltage Shutdown of the Oxygen Generator System Aboard the International Space Station
Joyce Carpenter United Technologies Corporation, Windsor Locks, CT; Gregory Gentry The Boeing Company, Houston, TX; Greg Diderich Jacobs, Houston, TX; Robert Roy United Technologies Corporation, Windsor Locks, CT; John Golden The Boeing Company, Houston, TX; Steve VanKeuren Anadarko Industries, LLC, Houston, TX; John Steele United Technologies Corporation, Windsor Locks, CT; Tony Rector United Technologies Corporation, Windsor Locks, CT; Jerome Varsik United Technologies Corporation, Windsor Locks, CT; Daniel Montefusco United Technologies Corporation, Windsor Locks, CT; Harold Cole The Boeing Company, Huntsville, AL; Mark Wilson The Boeing Company, Houston, TX; Erica Worthy NASA JSC, Houston, TX, AIAA-2012-3613

International Space Station Environmental Control and Life Support System Status for the Prior Year: 2010 - 2011
David Williams NASA JSC, Houston, TX; Gregory Gentry The Boeing Company, Houston, TX; Jason Dake NASA JSC, Houston, TX, AIAA-2012-3612

Human Thermal Model Evaluation using the JSC Human Thermal Database
Thomas Cognata Jacobs, Houston, TX; Grant Bue NASA JSC, Houston, TX; Janice Makinen NASA JSC, Houston, TX, AIAA-2012-3611

Packing Optimization of a Sorbent Bed Containing Dissimilar and Irregular Shaped Media
Nathan Holland Jacobs, Houston, TX; Hailey Piowaty Jacobs, Houston, TX; Jayleen Guttromson-Johnson NASA JSC, Houston, TX, AIAA-2012-3597

Microbiological Characterization of the International Space Station Water Processor Assembly External Filter Assembly S/N 01
Mark Wilson The Boeing Company, Houston, TX; Natalee Weir The Boeing Company, Houston, TX; Rebekah Bruce United Technologies Corporation, Windsor Locks, CT; Airan Yoets United Technologies Corporation, Windsor Locks, CT; Thomas Molina United Technologies Corporation, Windsor Locks, CT; Glenn Sitler Wyle, Houston, TX; Donald Carter NASA Marshall Space Flight Center, Huntsville, AL, AIAA-2012-3595

Status of ISS Water Management and Recovery
Donald Carter NASA Marshall Space Flight Center, Huntsville, AL; Nicole Orozco The Boeing Company, Houston, TX, AIAA-2012-3594

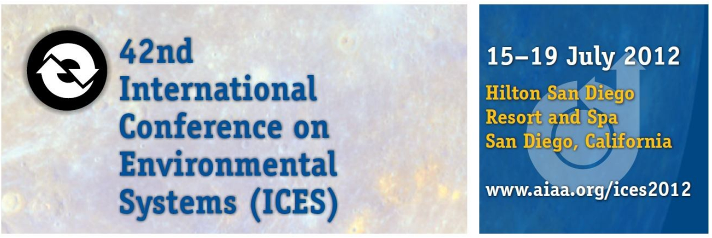
Management of the Post-Shuttle Extravehicular Mobility Unit (EMU) Water Circuits
David Etter United Technologies Corporation, Windsor Locks, CT; Tony Rector United Technologies Corporation, Windsor Locks, CT; Terry Hill NASA JSC, Houston, TX; Kevin Wells NASA JSC, Houston, TX; John Steele United Technologies Corporation, Windsor Locks, CT, AIAA-2012-3593

Extravehicular Activity Development and Verification Testing at NASA's Neutral Buoyancy Laboratory
Juniper Jairala Jacobs, Houston, TX; Robert Durkin NASA JSC, Houston, TX; Ralph Marak NASA JSC, Houston, TX; Angela Prince NASA JSC, Houston, TX; Stephanie Sipila NASA JSC, Houston, TX; Zane Ney United Space Alliance, Houston, TX; Scott Parazynski University of Texas Medical Branch, Galveston, TX; Arthur Thomason Barrios Technology, Galveston, TX, AIAA-2012-3592

U.S. Spacesuit Knowledge Capture Status and Initiatives
Cinda Chullen NASA JSC, Houston, TX; Ronald Woods NASA JSC, Houston, TX; Juniper Jairala Jacobs, Houston, TX; Rose Bitterly Jacobs, Houston, TX; Joe McMann Olde Irish Consulting, Temple, TX; Cathleen Lewis Smithsonian Institution, Washington, DC, AIAA-2012-3590

(Continued on page 38)

Conference Papers



(Continued from page 37)

Extravehicular Activity Systems Education and Public Outreach in Support of NASA's STEM Initiatives in Fiscal Year 2011
Heather Paul NASA JSC, Houston, TX; Mallory Jennings NASA JSC, Houston, TX; Erika Guillory Lamberth NASA JSC, Houston, TX, AIAA-2012-3589

The Development of Models for Carbon Dioxide Reduction Technologies for Spacecraft Air Revitalization
Michael Swickrath NASA JSC, Houston, TX; Molly Anderson NASA JSC, Houston, TX, AIAA-2012-3586

CFD Ventilation Study for the Human Powered Centrifuge at the International Space Station
Chang Son The Boeing Company, Houston, TX; Nikolay Ivanov New Technologies and Services, St. Petersburg, RUSSIAN FEDERATION; Denis Telnov New Technologies and Services, St. Petersburg, RUSSIAN FEDERATION; Evgueni Smirnov St. Petersburg State Polytechnic University, St. Petersburg, RUSSIAN FEDERATION, AIAA-2012-3583

Numerical Study of Ammonia Leak and Dispersion in the International Space Station
Nikolay Ivanov New Technologies and Services, St. Petersburg, RUSSIAN FEDERATION; Denis Telnov New Technologies and Services, St. Petersburg, RUSSIAN FEDERATION; Chang Son The Boeing Company, Houston, TX; Evgueni Smirnov St. Petersburg State Polytechnic University, St. Petersburg, RUSSIAN FEDERATION, AIAA-2012-3582
42nd International Conference on Environmental Systems, San Diego, California, July 15-19, 2012

Dynamic Modeling of Process Technologies for Closed-Loop Water Recovery Systems.
Rama Kumar Allada ERC, Inc., Houston, TX; Kevin Lange Jacobs, Houston, TX; Molly Anderson NASA JSC, Houston, TX, AIAA-2012-3564

Series Bosch System Development
Morgan Abney NASA Marshall Space Flight Center, Huntsville, AL; J. Matthew Mansell NASA Marshall Space Flight Center, Huntsville, AL; David Long NASA Marshall Space Flight Center, Huntsville, AL; Christopher Evans NASA Marshall Space Flight Center, Huntsville, AL; Michael Swickrath NASA JSC, Houston, TX; Lee Miller ECLS Technologies, LLC, Huntsville, AL; John Thomas Raytheon Company, Huntsville, AL, AIAA-2012-3554

CO2 Washout Testing of the REI and EM-ACES Space Suits
Kate Mitchell NASA JSC, Houston, TX; Jason Norcross Wyle, Houston, TX, AIAA-2012-3549
42nd International Conference on Environmental Systems, San Diego, California, July 15-19, 2012

Six-Tube Freezable Radiator Testing and Model Correlation
Sean Lillibridge NASA JSC, Houston, TX; Moses Navarro Jacobs, Houston, TX, AIAA-2012-3543
42nd International Conference on Environmental Systems, San Diego, California, July 15-19, 2012

Experimental Investigation of Sublimator Performance at Transient Heat Loads
Rubik Sheth NASA JSC, Houston, TX; Thomas Leimkuehler Paragon Space Development Corporation, Tuscon, AZ; Ryan Stephan NASA JSC, Houston, TX, AIAA-2012-3540

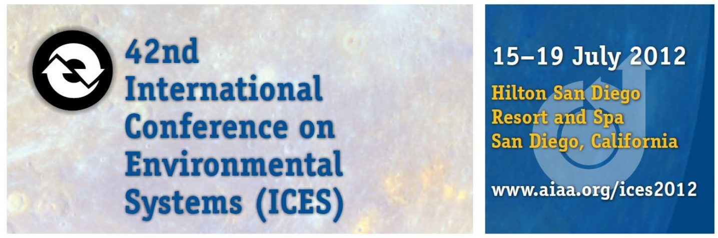
A Comparison of Methods for Assessing Space Suit Joint Ranges of Motion
Lindsay Aitchison NASA JSC, Houston, TX; Sudhakar Rajulu NASA JSC, Houston, TX; Elizabeth Benson Wyle, Houston, TX, AIAA-2012-3534

Evaluating Suit Fit Using Performance Degradation
Sarah Margerum Lockheed Martin Corporation, Houston, TX; Matthew Cowley Lockheed Martin Corporation, Houston, TX; Lauren Harvill Lockheed Martin Corporation, Houston, TX; Elizabeth Benson MEI Technologies, Inc., Houston, TX; Sudhakar Rajulu NASA JSC, Houston, TX, AIAA-2012-3533
42nd International Conference on Environmental Systems, San Diego, California, July 15-19, 2012

Space Suit Joint Torque Measurement Method Validation
Dana Valish NASA JSC, Houston, TX, AIAA-2012-3532

(Continued on page 39)

(Continued from page 38)



Multi Purpose Crew Vehicle Environmental Control and Life Support Development Status
Richard Barido NASA JSC, Houston, TX; Robyn Carrasquillo NASA Marshall Space Flight Center, Huntsville, AL; Cynthia Cross NASA JSC, Houston, TX; John Lewis NASA JSC, Houston, TX; George Rains Jacobs, Houston, TX, AIAA-2012-3531

Use of Heritage Hardware on Orion MPCV Exploration Flight Test One
George Rains Jacobs, Houston, TX; Cynthia Cross NASA JSC, Houston, TX, AIAA-2012-3530

Orion ECLSS/Suit System - Ambient Pressure Integrated Suit Test
Richard Barido NASA JSC, Houston, TX, AIAA-2012-3529

Comparison of Four Strong Acids on the Precipitation Potential of Gypsum in Brines during Distillation of Pretreated, Augmented Urine: Preliminary Results
Dean Muirhead Barrios Technology, Houston, TX; Chris Carrier Barrios Technology, Houston, TX, AIAA-2012-3528

Preliminary Feasibility Testing of the Brine Residual In-Containment (BRIC) Concept
Michael Callahan Jacobs, Houston, TX; Karen Pickering NASA JSC, Houston, TX; Stuart Pensinger NASA JSC, Houston, TX, AIAA-2012-3526

Experimental Investigation of Ice Phase Change Material Heat Exchangers
Thomas Leimkuehler Paragon Space Development Corporation, Houston, TX; Ryan Stephan NASA JSC, Houston, TX, AIAA-2012-3520

Determination of Survivable Fires
Daniel L. Dietrich NASA Glenn Research Center, Cleveland, OH; Justin Niehaus NASA Glenn Research Center, Cleveland, OH; Gary Ruff NASA Glenn Research Center, Cleveland, OH; David Urban NASA Glenn Research Center, Cleveland, OH; John Easton NASA Glenn Research Center, Cleveland, OH; Amber Abbott NASA Glenn Research Center, Cleveland, OH; Fumiaki Takahashi NASA Glenn Research Center, Cleveland, OH; John Graf NASA JSC, Houston, TX, AIAA-2012-3512

Energy Expenditure During Extravehicular Activity through Apollo
Heather Paul NASA JSC, Houston, TX, AIAA-2012-3504

Simulated Lunar Testing of Metabolic heat regenerated Temperature Swing Adsorption
Sebastian Padilla Paragon Space Development Corporation, Tucson, AZ; Chad Bower Paragon Space Development Corporation, Tucson, AZ; Christine Iacomini Paragon Space Development Corporation, Tucson, AZ; Heather Paul NASA JSC, Houston, TX, AIAA-2012-3503

Design Analysis of a High Temperature Radiator for the Variable Specific Impulse Magnetoplasma Rocket (VASIMR)
Rubik Sheth NASA JSC, Houston, TX; Eugene Ungar NASA JSC, Houston, TX; Joe Chambliss NASA JSC, Houston, TX; Leonard Cassady Ad Astra Rocket Company, Houston, TX, AIAA-2012-3497

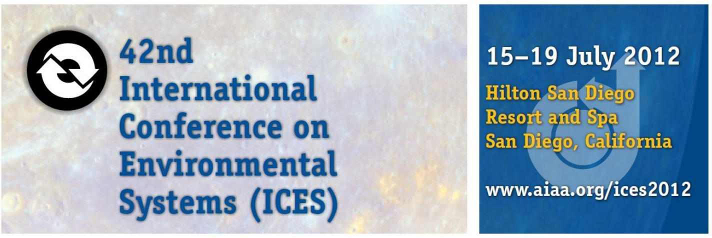
Reliability Impacts in Life Support Architecture and Technology Selection
Kevin Lange Jacobs, Houston, TX; Molly Anderson NASA JSC, Houston, TX, AIAA-2012-3491

Spacesuit Evaporator-Absorber-Radiator (SEAR)
Grant Bue NASA JSC, Houston, TX; Edward Hodgson United Technologies Corporation, Windsor Locks, CT; Michael Izenson Creare, Inc., Hanover, NH; Scott Cupples NASA JSC, Houston, TX, AIAA-2012-3484

Maturing Pump Technology for EVA Applications in a Collaborative Environment
Edward Hodgson United Technologies Corporation, Windsor Locks, CT; Edward Gervais Cascon, Inc., Yarmouth, ME; Ian Anchondo NASA JSC, Houston, TX; Steven Dionne United Technologies Corporation, Windsor Locks, CT, AIAA-2012-3483

(Continued on page 40)

Conference Papers



(Continued from page 39)

Transformation of Air Quality Monitor Data from the International Space Station into Toxicological Effects Groups
John James NASA JSC, Houston, TX; Selina Zalesak Universities Space Research Association, Houston, TX, AIAA-2012-3469

Update 2011: Air Quality Monitor Experiment to Measure Volatile Organic Compounds on board the International Space Station
Thomas Limero Wyle, Houston, TX; Patti Cheng Wyle, Houston, TX; Eric Reese Wyle, Houston, TX; Jared Jones Wyle, Houston, TX; William Wallace Wyle, Houston, TX, AIAA-2012-3468

Performance Characterization and Simulation of Amine-Based Vacuum Swing Adsorption Units for Spacesuit Carbon Dioxide and Humidity Control
Michael Swickrath NASA JSC, Houston, TX; Carly Watts NASA JSC, Houston, TX; Molly Anderson NASA JSC, Houston, TX; Summer McMillin Jacobs, Houston, TX; Craig Broerman Jacobs, Houston, TX; Aaron Colunga Jacobs, Houston, TX; Matthew Vogel Jacobs, Houston, TX, AIAA-2012-3461

Performance and Life Tests of a Regenerative Blower for EVA Suit Ventilation
Michael Izenson Creare, Inc., Hanover, NH; Weibo Chen Creare, Inc., Hanover, NH; Mallory Jennings NASA JSC, Houston, TX; Heather Paul NASA JSC, Houston, TX, AIAA-2012-3460

Long Duration Testing of a Spacesuit Water Membrane Evaporator Prototype
Janice Makinen NASA JSC, Houston, TX; Grant Bue NASA JSC, Houston, TX; Marlon Cox NASA JSC, Houston, TX; Carly Watts NASA JSC, Houston, TX; Colin Campbell NASA JSC, Houston, TX; Matthew Vogel Jacobs, Houston, TX; Aaron Colunga Jacobs, Houston, TX, AIAA-2012-3459

Spacesuit Portable Life Support System Breadboard (PLSS 1.0) Development and Test Results
Carly Watts NASA JSC, Houston, TX; Matthew Vogel Jacobs, Houston, TX, AIAA-2012-3458

Application of Commercial Non-Dispersive Infrared Spectroscopy Sensors for Sub-ambient Carbon Dioxide Detection
Michael Swickrath NASA JSC, Houston, TX; Molly Anderson NASA JSC, Houston, TX; Summer McMillin Jacobs, Houston, TX; Craig Broerman Jacobs, Houston, TX, AIAA-2012-3454

Next Generation Life Support Project: Development of Advanced Capabilities for Human Exploration Missions
Daniel Barta NASA JSC, Houston, TX, AIAA-2012-3446

Logistics Reduction and Repurposing Beyond Low Earth Orbit
James Broyan NASA JSC, Houston, TX; Michael Ewert NASA JSC, Houston, TX, AIAA-2012-3445

National Aeronautics and Space Administration (NASA) Environmental Control and Life Support (ECLS) Integrated Roadmap Development
Jordan Metcalf NASA JSC, Houston, TX; Laurie Peterson NASA JSC, Houston, TX; Robyn Carrasquillo NASA Marshall Space Flight Center, Huntsville, AL; Robert Bagdigian NASA Marshall Space Flight Center, Huntsville, AL, AIAA-2012-3444

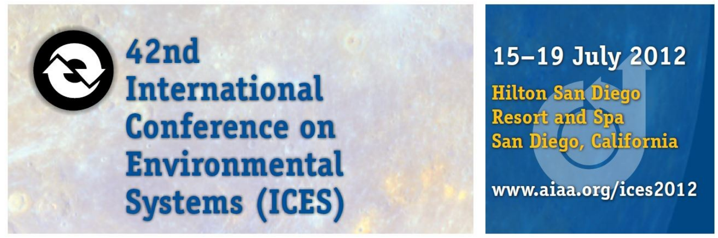
Flexible path Environmental Control and Life Support Technology - Possible first Steps to Move Beyond LEO
Edward Hodgson United Technologies Corporation, Windsor Locks, CT; Dave Converse United Technologies Corporation, Windsor Locks, CT; Matthew Duggan The Boeing Company, Houston, TX; Gregory Gentry The Boeing Company, Houston, TX, AIAA-2012-3443

Development of the ISS EMU SPEEDR
Terry Hill NASA JSC, Houston, TX; Sean Murray United Technologies Corporation, Windsor Locks, CT; Robert Wichowski United Technologies Corporation, Windsor Locks, CT; David Rosenbush United Technologies Corporation, Windsor Locks, CT; Craig Bernard NASA JSC, Houston, TX, AIAA-2012-3438

(Continued on page 41)

(Continued from page 40)

Conference Papers



Reversible Ammonia Sorption on Carbon for the Primary Life Support System (PLSS)
Marek Wójtowicz Advanced Fuel Research, Inc., East Hartford, CT; Joseph Cosgrove Advanced Fuel Research, Inc., East Hartford, CT; Michael Serio Advanced Fuel Research, Inc., East Hartford, CT; Mallory Jennings NASA JSC, Houston, TX, AIAA-2012-3437

Use of Aquaporins to Achieve Needed Water Purity on the International Space Station for the Extravehicular Mobility Unit Space Suit System
Terry Hill NASA JSC, Houston, TX; Brandon Taylor Baylor University, Waco, TX, AIAA-2012-3436

Environmental Monitoring as part of Life Support: Preparing for Deep Space Missions
Darrell Jan Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA; Jay Perry NASA Marshall Space Flight Center, Huntsville, AL; J. Torin McCoy NASA JSC, Houston, TX, AIAA-2012-3433

Deep Space Habitat ECLS Design Concept
Su Curley NASA JSC, Houston, TX; Imelda Stambaugh NASA JSC, Houston, TX; Michael Swickrath NASA JSC, Houston, TX; Molly Anderson NASA JSC, Houston, TX; Henry Rotter NASA JSC, Houston, TX, AIAA-2012-3417

The Single Habitat Module Concept for Exploration
Joe Chambliss NASA JSC, Houston, TX, AIAA-2012-3416

Mission to Planet Mars
Frank Eichstadt Oceaneering Space Systems, Houston, TX, AIAA-2012-3415

Miniature Total Organic Carbon Analyzer: Early Development
Paul Mudgett NASA JSC, Houston, TX; Gary Erickson Xylem, Inc., College Station, TX, AIAA-2012-3414

ISS Potable Water Quality for Expeditions 26 through 29
John Straub Wyle, Houston, TX; Debrah Plumlee Wyle, Houston, TX; John Schultz Wyle, Houston, TX; J. Torin McCoy NASA JSC, Houston, TX, AIAA-2012-3413

Design and Evaluation of a Water Recirculation Loop Maintenance Device for the Advanced Spacesuit Water Membrane Evaporator
John Steele United Technologies Corporation, Windsor Locks, CT; Tony Rector United Technologies Corporation, Windsor Locks, CT; Grant Bue NASA JSC, Houston, TX; Janice Makinen NASA JSC, Houston, TX; Colin Campbell NASA JSC, Houston, TX, AIAA-2012-3412

Advanced EMU Portable Life Support System (PLSS) and Shuttle/ISS EMU Schematics, A Comparison
Colin Campbell NASA JSC, Houston, TX, AIAA-2012-3411

Comprehensive Trade Study of Biological Systems for Primary Treatment in an Integrated Water Processing System
Kyle Kubista Texas Tech University, Lubbock, TX; William Jackson Texas Tech University, Lubbock, TX; Audra Morse Texas Tech University, Lubbock, TX; Molly Anderson NASA JSC, Houston, TX; Kevin Lange NASA JSC, Houston, TX; Karen Pickering NASA JSC, Houston, TX, AIAA-2012-3401

A Wavelet Decomposition Method for Tuning Thermal Models to Aperiodic Transient Test Data
Matthew Kaplan ATA Engineering, Inc., San Diego, CA; Matt Garrett ATA Engineering, Inc., San Diego, CA; Bryan Rasmussen Texas A&M University, College Station, TX, AIAA-2012-3640

Miniature Total Organic Carbon Analyzer: Early Development
Paul Mudgett NASA JSC, Houston, TX; Gary Erickson Xylem, Inc., College Station, TX, AIAA-2012-3414

Collier's 1952-54

Man Will Conquer Space Soon! (1952-54)

Douglas Yazell, Editor

The first inkling for the readers of the weekly magazine Collier's came in the form of a press release, "Collier's *Man Will Conquer Space Soon!*, For release 7:00 PM, EST, Thursday, March 13, 1952. Please guard against premature release!" John Sisson's *Dreams of Space* blog has a complete copy of this press release.

Next came the preview box shown on this page. This was in the March 15, 1952 issue of Collier's. In the March 22, 1952 issue of Collier's, authors and artists from the space science community contributed six articles totaling twenty-five pages. This series continued in later issues of this weekly magazine, as shown in the table on the next page. During 1952, 1953 and 1954, eight issues of this weekly magazine presented articles in this series, *Man Will Conquer Space Soon!*

Following a Horizons tradition, we present each Collier's article in its entirety before starting the next one, instead of jumping from page 40 to page 72, for example. In that respect, our reprint differs from the original magazine.

We replaced the original advertisements with complimentary ads from our Collier's team members listed on this page.

Scott Lowther owns five of these eight issues of Collier's. Ron Miller provided scans for the seventh issue of Collier's in this series. John Sisson provided scans for the fourth and fifth issues of Collier's in this series.

Thanks to UNZ.org, we can see every page of Collier's from these eight issues and other related issues, though most of those scans use a low

(Continued on page 43)

NEXT WEEK in Collier's

Man Will Conquer Space Soon!

Facts you should know about rocket travel are told in a startling symposium by leading U.S. space scientists, brilliantly illustrated by Chesley Bonestell, Rolf Klep and Fred Freeman

Crossing the Last Frontier
By DR. WERNHER von BRAUN
Technical Director, Army Ordnance Guided Missiles Development Group

Can We Survive in Space?
By DR. HEINZ HABER
Department of Space Medicine, USAF School of Aviation Medicine

This Side of Infinity
By DR. JOSEPH KAPLAN
Professor of Physics, Institute of Geophysics, University of California

The Heavens Open
By DR. FRED L. WHIPPLE
Chairman, Department of Astronomy, Harvard College Observatory

Who Owns the Universe?
By OSCAR SCHACHTER
Deputy Director, Legal Department, United Nations

A Station in Space
By WILLY LEY
Noted rocket scientist and author

PLUS REGULAR ARTICLES . . . FICTION . . . CARTOONS

Collier's for March 15, 1952

Right: A copy of the announcement from page 92 of the March 15, 1952 issue of the weekly magazine Collier's. This informs the readers about what's coming in the March 22, 1952 issue of Collier's. Image credit: Scott Lowther, Aerospace Projects Review. Thanks to UNZ.org for making page 92 visible for everyone.

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!

Collier's 1952-54

(Continued from page 42)
setting for image resolution. Examples of related issues are those containing Coming Next Week previews, letters to the editors (Week's Mail, with a delay of seven or eight weeks) and editorials.

Dr. Albert A. Jackson IV wrote about these Collier's articles in Horizons. His first such article was for our April 2002 issue, a cover story, *The Ugly Spaceship and the Astounding Dream*. That related to the 50th anniversary of this series of Collier's articles. Dr. Jackson wrote again on this subject in our Horizons issue of March / April 2012 (pages 48-55), the 60th anniversary of this series of Collier's articles. Sixty years after their publication, these articles still merit our attention.

On the following pages, this issue of Horizons presents these articles from the March 22, 1952 issue of Collier's, the first of eight issues in this series. We allow readers to see the text clearly and enjoy the artwork thanks to high-quality scanning and cleanup. Scott Lowther sends me the scans for use in Horizons.

We plan to continue these reprints in each issue of Horizons until we finish this series, *Man Will Conquer Space Soon!* That might require eight bimonthly issues of Horizons, but we prefer a shorter schedule. Issues two and three in this series are titled *Man on the Moon*, so both issues are a natural fit for our next issue of Horizons. Issues four, five and six in this series are titled

(Continued on page 44)

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

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.

Collier's 1952-54

editor2012@aiaahouston.org
(Douglas Yazell)

(Continued from page 43)
Man's Survival in Space, so those issues are a natural fit for the following issue of Horizons. In this manner, we might reprint *Man Will Conquer Space Soon!* in five bimonthly issues of Horizons instead of eight bimonthly issues.

These Collier's space articles are historic and historical. They contain great paintings, they are inspiring and they are still effective in advocating sending humans to Mars and setting up human-tended bases on the Moon. These articles were never perfect, but von Braun and his Collier's team set a high mark for space journalism.

This is probably the first time anyone can enjoy reproductions of these articles in their entirety using high resolution images. We plan to publish this issue of Horizons as a low resolution PDF file (about 23 MB) and a high resolution PDF file (about 45 MB).

In our next issue, we plan to present the 1952 Week's Mail in response to this first of eight issues of Collier's space articles. Please send comments to our Horizons editor so that we can add a few words from *your* notes.

Enjoy *Man Will Conquer Space Soon!*

Below: Image credits: Scott Lowther, with help from other team members.

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!

The Collier's Series Backstory

Collier's 1952-54

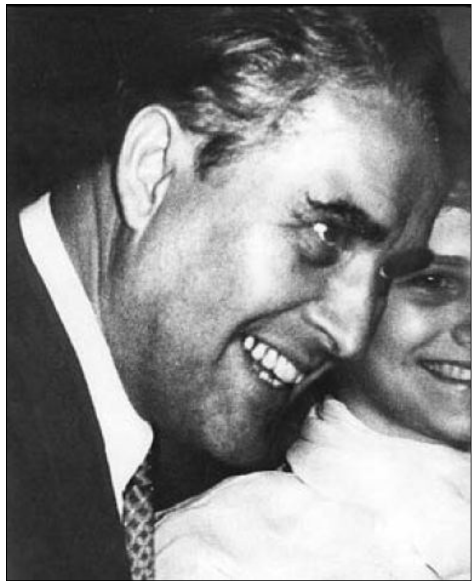
DR. ALBERT A. JACKSON IV

The Collier's magazine series on spaceflight in the 1950s quite possibly made the Apollo program a reality. It sprang from an idea of Wernher von Braun's that failed!

After advising the Army from 1946 to 1947 on the testing of captured V2s, von Braun and his team were languishing at White Sands Mexico waiting to see what the Defense Department would do with them. Von Braun and many of his Peenemünders had started their lives in spaceflight dreaming of expeditions to the Moon and Mars, trying to think of a way to interest the general public. He had the idea he could light a fire with a science fiction novel about an expedition to Mars. First he wanted to work out the details down to the bolt head. He gathered some fellow experts who spent hard and long hours on the V2 project, Krafft Ehricke, Dr. Hans Friedrich, Dr. Josef Jenissen, Dr. Adolf Thiel, Dr. Carl Wagner and Dr. Joachim Mühlner.

I had a chance to interview Joachim Mühlner in 2000. He mentioned that von Braun and Ehricke were the devoted visionaries. In later years Ehricke became important in the development of the Atlas, but wrote extensively about advanced space flight and astrodynamics.

Von Braun and this team created a detailed mission plan using ten spacecraft to take an expedition of seventy men to Mars. All spacecraft were designed from propulsion to communication, life support, everything! Logistics were specified down to the food wrappers! It was assembled into a technical appendix using pencil, paper and slide rules.



Left: Wernher von Braun and his daughter Iris during a visit to Texas A&M University at College Station. The year was probably 1966. This image is from page 19 of our February 2008 issue of Horizons. The original photograph was taken at a reception following a speech about Apollo plans. This was taken with available light using 35 mm Kodak tri-X pan and printed by the photographer on high-contrast enlarging paper. Image credit: James C. McLane III.

From this, von Braun wrote a science fiction novel, *Project MARS: A Technical Tale*. An English translation was made and the novel submitted to publishers in America and Germany. No one was interested.

The publisher in Germany was a little bit interested in the novel but convinced von Braun to write a brief booklet broken into seven chapters explaining the material in the *appendix* of the novel. This was published as a special edition of the German spaceflight journal Weltraumfahrt in 1952. The University of Illinois published an English translation, which remains in print as The Mars Project.

Von Braun's friend Willy Ley was acquainted with Cornelius Ryan, an editor at Collier's, the weekly magazine. This led to *Man Will Conquer Space Soon!*, the 1952-54 series of spaceflight articles brilliantly constructed by von Braun with other experts and artists Chesley Bonestell, Fred Freeman and Rolf Klep.

As far as I know, neither the novel nor the Mars Project monographs were ever mentioned in the Collier's series. It was surprising to see in Collier's many of the details from the novel, such as the three-stage ferry ships, the space station, on orbit assembly, the "space taxies" and much more. Many of these designs and mission concepts had been discussed by von Braun and his colleagues as far back as the early 1930s.

Above: Dr. Albert A. Jackson IV. Image credit: Lunar and Planetary Institute.

This magazine series influenced countless young people to pursue a career in spaceflight.

Von Braun's 1948 novel *Project Mars: A Technical Tale* led to the 1952-54 Collier's series of articles, *Man Will Conquer Space Soon!*, a huge influence in the era of the Apollo program, but the novel failed to find a publisher until 2006, 58 years after it was written!

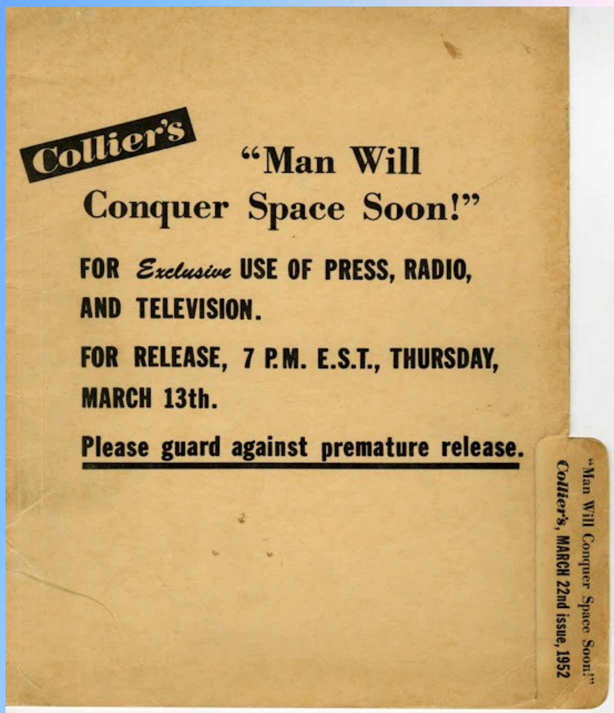
Collier's

March 22, 1952 • Fifteen Cents

Man Will Conquer Space Soon

TOP SCIENTISTS TELL HOW IN 15 STARTLING PAGES

Below: Part of a 1952 press release for the "Man Will Conquer Space Soon!," articles in the March 22, 1952 issue of Collier's. This is from John Sisson's Dreams of Space blog.



ALBERT E. WINGER
Chairman of the Board

CLARENCE E. STOUCH
President

Collier's

EDWARD ANTHONY, *Publisher*
LOUIS RUPPEL, *Editor*

RICHARD CHAPLIN, *Assistant Publisher* GORDON MANNING, *Managing Editor*

DAVID MANESS, *Assistant Managing Editor*
ALLEN CLEATON, *Senior Associate Editor*
KNOX BURGER, *Fiction Editor*
JAMES THRASHER, *Editorials*
WILLIAM O. CHESSMAN, *Art Director*
GURNEY WILLIAMS, *Cartoon Editor*
JAMES A. QUIGNEY, *Photo Editor*
WALTER DAVENPORT, *Senior Correspondent*

Associate Editors · BERT BACHARACH · HOWARD BRODIE · WARREN BROWN
JEAN B. CAMPBELL · SEY CHASSLER · HOWARD COHN · LONNIE COLEMAN
BETSY CORRIGAN · WILLARD B. CROSBY · BILL DAVIDSON · JOHN DENSON
MACLENNAN FARRELL · EVELYN HARVEY · DIANA HIRSH · JERRY KORN · JOHN LEAR
FRANKLIN C. LORANGER · TOM MEANY · JOHN C. PELLEW · ELEANOR PORTER
CORNELIUS RYAN · JANET SHEPS · RED SMITH · FRANCIS WALLACE · JAMES N. YOUNG

Editorial Research · ROSANNE McVAY, *Chief*
MADELIN ALK, DIANE DOWNS, JANICE MOSES, MARTHA WEINMAN

Bureaus

WASHINGTON: JAMES C. DERIEUX, *Chief;* TODD WRIGHT
WEST COAST *(Los Angeles)*: THEODORE STRAUSS, *Chief;* ROBERT CAHN, JOHN FLOREA
MIDWEST *(Chicago)*: BILL FAY
SOUTH *(Atlanta)*: WILLIAM A. EMERSON, JR.
EUROPE *(Paris)*: SEYMOUR FREIDIN, BILL STAPLETON, WILLIAM RICHARDSON
FAR EAST *(Tokyo)*: CHARLOTTE KNIGHT

March 22, 1952

ARTICLES

Exposing the Psycho-Phonies . . . . JHAN ROBBINS 15
"Available Vinson" . . . . ROBERT BENDINER 18

MAN WILL CONQUER SPACE SOON

What Are We Waiting For? . . . . EDITORIAL 23
Crossing the Last Frontier . . . . DR. WERNHER von BRAUN 24
A Station in Space . . . . WILLY LEY 30
The Heavens Open . . . . DR. FRED L. WHIPPLE 32
This Side of Infinity . . . . DR. JOSEPH KAPLAN 34
Can We Survive in Space? . . . . DR. HEINZ HABER 35
Who Owns the Universe? . . . . OSCAR SCHACHTER 36
Space Quiz Around the Editor's Desk 38

For Women Only . . . . COLLIER'S COLOR CAMERA 68
Paddling His Own Konno . . . . BILL FAY 76

FICTION

The Curragh Race . . . . WALTER MACKEN 16
My Brother's Widow . . . . JOHN D. MacDONALD 20
(PART TWO OF FIVE PARTS)
Green Willow Growing . . . . PEGGY SIMSON CURRY 44
Affair of the Heart . . . . JOHN WYNDHAM 62
(THE SHORT SHORT STORY)

Week's Mail 6
48 States of Mind . . . . WALTER DAVENPORT 8
You, Too, Can Learn to Worry . . . . GURNEY WILLIAMS 12
Helping Hand . . . . GUS LUNDBERG 75
Cover . . . . CHESLEY BONESTELL

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

Editorial and Executive Offices, 640 Fifth Avenue, New York 19, N. Y.

COLLIER'S THE NATIONAL WEEKLY Vol. 129, No. 12. **PUBLISHED WEEKLY** by The Crowell-Collier Publishing Company, Springfield, Ohio, U.S.A., Publishers of Collier's, Woman's Home Companion, The American Magazine. Executive and Editorial Offices, 640 Fifth Ave., New York 19, N. Y. Albert E. Winger, Chairman of the Board; Clarence E. Stouch, President; E. A. Schirmer, Executive Vice-President; T. L. Brantly, Peter J. Dennerlein, Edward Anthony, Robert T. Messler, E. P. Seymour, John W. McPherrin, Vice-Presidents; Denis O'Sullivan, Secretary; C. F. Norsworthy, Treasurer.

SUBSCRIPTION PRICES: United States and Possessions, and Philippine Islands, 1 year $5.00; 2 years $8.00; 2½ years (130 issues) $9.00; 3 years $10.00. Canada, 1 year $5.50. Pan-American countries in the Postal Union, 1 year $6.00. All other foreign countries, 1 year $9.00. Payments from foreign countries, except Canada, must be in United States funds, and addressed to The Crowell-Collier Publishing Co., Springfield, Ohio.

ENTERED as second-class matter at the Post Office, Springfield, Ohio, under Act of March 3, 1879. Authorized as second-class mail, Post Office Department, Ottawa, Canada.

MANUSCRIPTS or art submitted to Collier's, The National Weekly, should be accompanied by addressed envelopes and return postage. The Publisher assumes no responsibility for return of unsolicited manuscripts or art.

CHANGES OF ADDRESS should reach us five weeks in advance of the next issue date. Give both the old and new addresses.

MAN WILL CONQUER SPACE SOON

Some of the scientists and illustrators who took part in Collier's symposium (left to right): Rolf Klep, Willy Ley, Dr. Heinz Haber, Dr. Wernher von Braun, Dr. Fred L. Whipple, and Chesley Bonestell

What Are We Waiting For?

ON THE following pages Collier's presents what may be one of the most important scientific symposiums ever published by a national magazine. It is the story of the inevitability of man's conquest of space.

What you will read here is not science fiction. It is serious fact. Moreover, it is an urgent warning that the U.S. must immediately embark on a long-range development program to secure for the West "space superiority." If we do not, somebody else will. That somebody else very probably would be the Soviet Union.

The scientists of the Soviet Union, like those of the U.S., have reached the conclusion that it is now possible to establish an artificial satellite or "space station" in which man can live and work far beyond the earth's atmosphere. In the past it has been correctly said that the first nation to do this will control the earth. And it is too much to assume that Moscow's military planners have overlooked the military potentialities of such an instrument.

A ruthless foe established on a space station could actually subjugate the peoples of the world. Sweeping around the earth in a fixed orbit, like a second moon, this man-made island in the heavens could be used as a platform from which to launch guided missiles. Armed with atomic war heads, radar-controlled projectiles could be aimed at any target on the earth's surface with devastating accuracy.

Furthermore, because of their enormous speeds and relatively small size, it would be almost impossible to intercept them. In other words: whoever is the first to build a station in space can prevent any other nation from doing likewise.

We know that the Soviet Union, like the U.S., has an extensive guided missile and rocket program under way. Recently, however, the Soviets intimated that they were investigating the development of huge rockets capable of leaving the earth's atmosphere. One of their top scientists, Dr. M. K. Tikhonravov, a member of the Red Army's Military Academy of Artillery, let it be known that on the basis of Soviet scientific development such rocket ships could be built and, also, that the creation of a space station was not only feasible but definitely probable. Soviet engineers could even now, he declared, calculate precisely the characteristics of such space vehicles; and he added that Soviet developments in this field equaled, if not exceeded, those of the Western World.

We have already learned, to our sorrow, that Soviet scientists and engineers should never be underestimated. They produced the atomic bomb years earlier than was anticipated. Our air superiority over the Korean battlefields is being challenged by their excellent MIG-15 jet fighters which, at certain altitudes, have proved much faster than ours. And while it is not believed that the Soviet Union has actually begun work on a major project to capture space superiority, U.S. scientists point out that the basic knowledge for such a program has been available for the last 20 years.

What is the U.S. doing, if anything, in this field? In December, 1948, the late James Forrestal, then Secretary of Defense, spoke of the existence of an "earth satellite vehicle program." But in the opinion of competent military observers this was little more than a preliminary study. And so far as is known today, little further progress has been made. Collier's feels justified in asking: What are we waiting for?

We have the scientists and the engineers. We enjoy industrial superiority. We have the inventive genius. Why, therefore, have we not embarked on a major space program equivalent to that which was undertaken in developing the atomic bomb? The issue is virtually the same.

The atomic bomb has enabled the U.S. to buy time since the end of World War II. Speaking in Boston in 1949, Winston Churchill put it this way: "Europe would have been communized and London under bombardment some time ago but for the deterrent of the atomic bomb in the hands of the United States." The same could be said for a space station. In the hands of the West a space station, permanently established beyond the atmosphere, would be the greatest hope for peace the world has ever known. No nation could undertake preparations for war without the certain knowledge that it was being observed by the ever-watching eyes aboard the "sentinel in space." It would be the end of Iron Curtains wherever they might be.

Furthermore, the establishment of a space station would mean the dawning of a new era for mankind. For the first time, full exploration of the heavens would be possible, and the great secrets of the universe would be revealed.

When the atomic bomb program—the Manhattan Project—was initiated, nobody really knew whether such a weapon could actually be made. The famous Smyth Report on atomic energy tells us that among the scientists there were many who had grave and fundamental doubts of the success of the undertaking. It was a two-billion-dollar technical gamble.

Such would not be the case with a space program. The claim that huge rocket ships can be built and a space station created still stands unchallenged by any serious scientist. Our engineers can spell out right now (as you will see) the technical specifications for the rocket ship and space station in cut-and-dried figures. And they can detail the design features. All they need is time (about 10 years), money and authority.

Even the cost has been estimated: $4,000,000,000. And when one considers that we have spent nearly $54,000,000,000 on rearmament since the Korean war began, the expenditure of $4,000,000,000 to produce an instrument which would guarantee the peace of the world seems negligible.

Collier's became interested in this whole program last October when members of our editorial staff attended the First Annual Symposium on Space Travel, held at New York's Hayden Planetarium. On the basis of their findings, Collier's invited the top scientists in the field of space research to New York for a series of discussions. The magazine symposium on these pages was born of these round-table sessions.

The scientists who have worked with us over the last five months on this project and whose views are presented on the succeeding pages are:

- **Dr. Wernher von Braun,** Technical Director of the Army Ordnance Guided Missiles Development Group. At forty, he is considered the foremost rocket engineer in the world today. He was brought to this country from Germany by the U.S. government in 1945.
- **Dr. Fred L. Whipple,** Chairman, Department of Astronomy, Harvard University. One of the nation's outstanding astronomers, he has spent most of his forty-five years studying the behavior of meteorites.
- **Dr. Joseph Kaplan,** Professor of Physics at UCLA. One of the nation's top physicists and a world-renowned authority on the upper atmosphere, the forty-nine-year-old scientist was decorated in 1947 for work in connection with B-29 bomber operations.
- **Dr. Heinz Haber,** of the U.S. Air Force's Department of Space Medicine. Author of more than 25 scientific papers since our government brought him to this country from Germany in 1947, Dr. Haber, thirty-eight, is one of a small group of scientists working on the medical aspects of man in space.
- **Willy Ley,** who acted as adviser to Collier's in the preparation of this project. Mr. Ley, forty-six, is perhaps the best-known magazine science writer in the U.S. today. Originally a paleontologist, he was one of the founders of the German Rocket Society in 1927 and was Dr. Wernher von Braun's first tutor in rocket research.

Others who made outstanding contributions to this issue include:

- **Oscar Schachter,** Deputy Director of the UN Legal Department. A recognized authority on international law, this thirty-six-year-old lawyer has frequently given legal advice on matters pertaining to international scientific questions, which lately have included the problems of space travel.
- **Chesley Bonestell,** whose art has appeared in the pages of Collier's many times before. Famous for his astronomical paintings, Mr. Bonestell began his career as an architect, but has spent most of his life painting for magazines and lately for Hollywood.
- Artists **Fred Freeman** and **Rolf Klep.** Both spent many months working in conjunction with the scientists.

For Collier's, associate editor Cornelius Ryan supervised assembly of the material for the symposium. The views expressed by the contributors are necessarily their own and in no way reflect those of the organizations to which they are attached.

Collier's believes that the time has come for Washington to give priority of attention to the matter of space superiority. The rearmament gap between the East and West has been steadily closing. And nothing, in our opinion, should be left undone that might guarantee the peace of the world. It's as simple as that.

THE EDITORS

Dr. Joseph Kaplan

Oscar Schachter

Fred Freeman

Cornelius Ryan

DRAWINGS BY ROLF KLEP

rolf klep

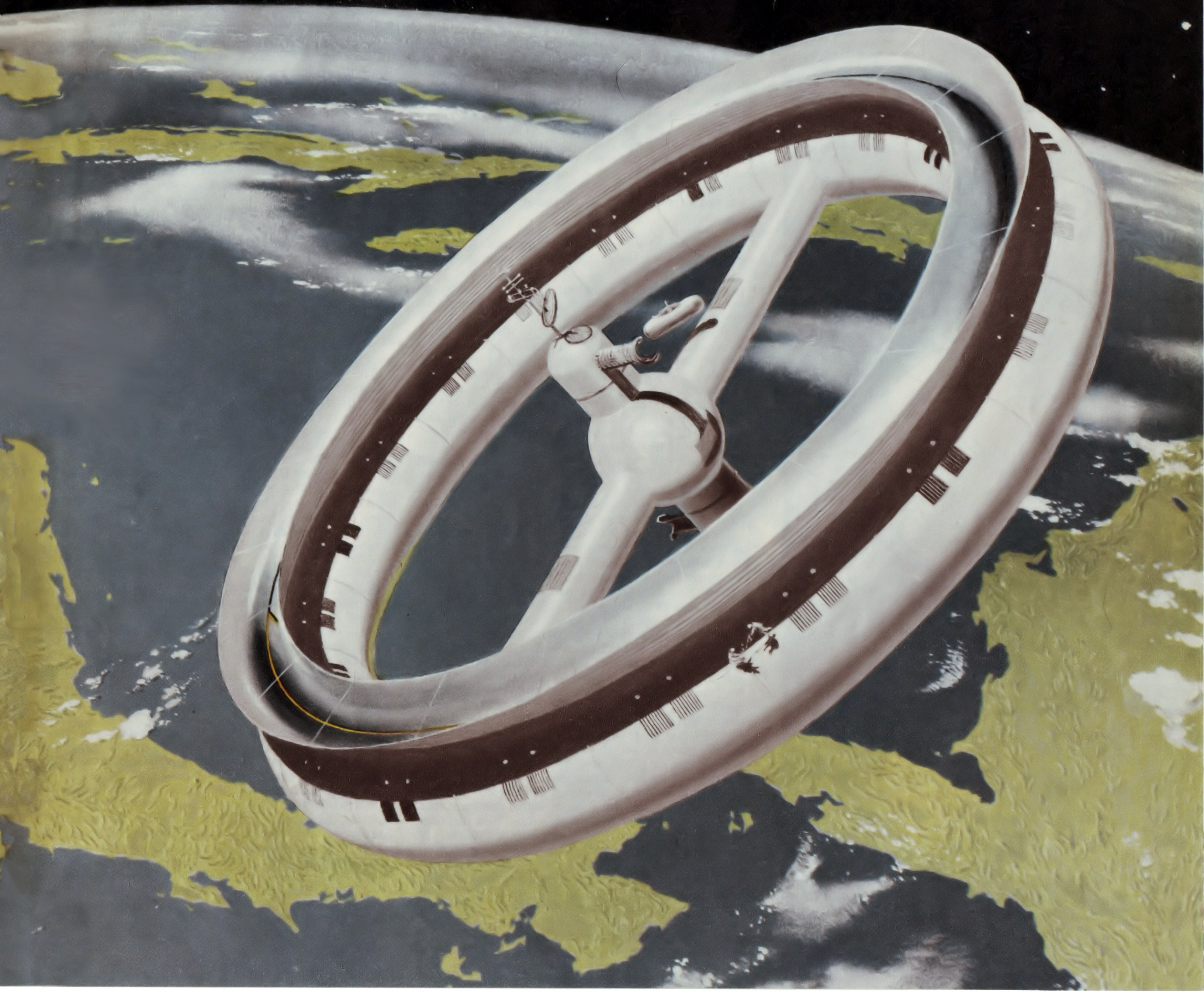
Men and materials arrive in the winged rocket and take "space taxis" to wheel-shaped space station at right. Men wear pressurized suits

CROSSING THE LAST FRONTIER

By DR. WERNHER von BRAUN

Technical Director, Army Ordnance Guided Missiles Development Group, Huntsville, Alabama

Scientists and engineers now know how to build a station in space that would circle the earth 1,075 miles up. The job would take 10 years, and cost twice as much as the atom bomb. If we do it, we can not only preserve the peace but we can take a long step toward uniting mankind



Three "space taxis" can be seen—one leaving rocket, another reaching satellite, a third near the already-built astronomical observatory

WITHIN the next 10 or 15 years, the earth will have a new companion in the skies, a man-made satellite that could be either the greatest force for peace ever devised, or one of the most terrible weapons of war—depending on who makes and controls it. Inhabited by humans, and visible from the ground as a fast-moving star, it will sweep around the earth at an incredible rate of speed in that dark void beyond the atmosphere which is known as "space."

In the opinion of many top experts, this artificial moon—which will be carried into space, piece by piece, by rocket ships—will travel along a celestial route 1,075 miles above the earth, completing a trip around the globe every two hours. Nature will provide the motive power; a neat balance between its speed and the earth's gravitational pull will keep it on course (just as the moon is fixed in its orbit by the same two factors). The speed at which the 250-foot-wide, "wheel"-shaped satellite will move will be an almost unbelievable 4.4 miles per second, or 15,840 miles per hour—20 times the speed of sound. However, this terrific velocity will not be apparent to its occupants. To them, the space station will appear to be a perfectly steady platform.

From this platform, a trip to the moon itself will be just a step, as scientists reckon distance in space.

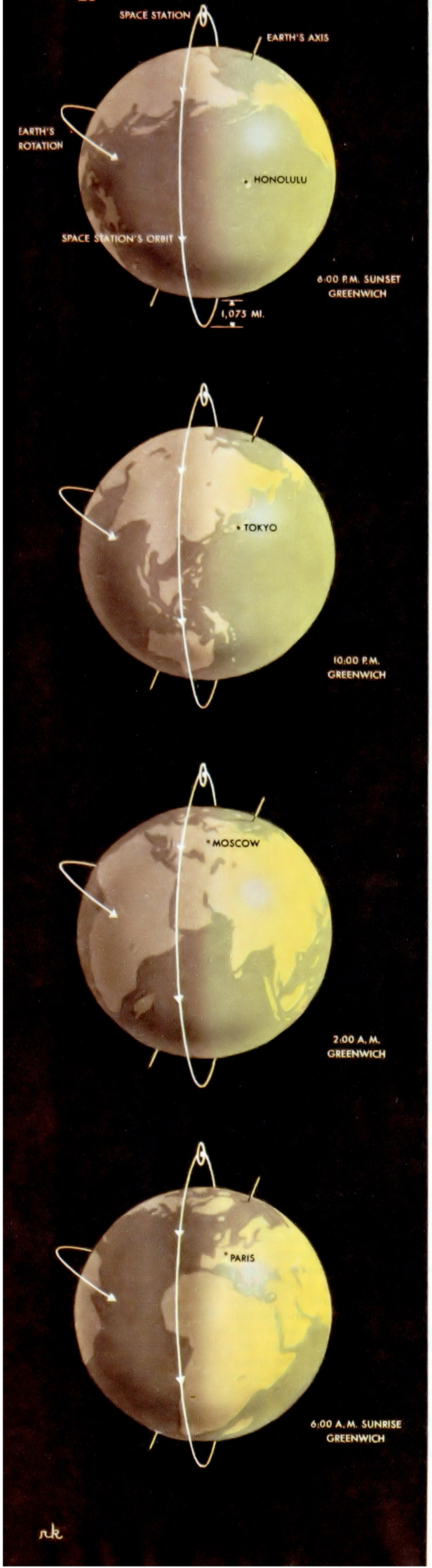
The choice of the so-called "two-hour" orbit—in preference to a faster one, closer to the earth, or a slower one like the 29-day orbit of the moon—has one major advantage: although far enough up to avoid the hazards of the earth's atmosphere, it is close enough to afford a superb observation post.

Technicians in this space station—using specially designed, powerful telescopes attached to large optical screens, radarscopes and cameras—will keep under constant inspection every ocean, continent, country and city. Even small towns will be clearly visible through optical instruments that will give the watchers in space the same vantage point enjoyed by a man in an observation plane only 5,000 feet off the ground.

Nothing will go unobserved. Within each two-hour period, as the earth revolves inside the satellite's orbit, one twelfth of the globe's territory will pass into the view of the space station's occupants; within each 24-hour period, the entire surface of the earth will have been visible.

Over North America, for example, the space station might pass over the East Coast at, say 10:00 A.M., and, after having completed a full revolution around the earth, would—because the

PAINTING BY CHESLEY BONESTELL



earth itself has turned meanwhile—pass over the West Coast two hours later. In the course of that one revolution it would have been north as far as Nome, Alaska, and south almost to Little America on the Antarctic Continent. At 10:00 A.M. the next day, it would appear once again over the East Coast.

Despite the vast territory thus covered, selected spots on the earth could receive pinpoint examination. For example, troop maneuvers, planes being readied on the flight deck of an aircraft carrier, or bombers forming into groups over an airfield will be clearly discernible. Because of the telescopic eyes and cameras of the space station, it will be almost impossible for any nation to hide warlike preparations for any length of time.

* * *

These things we know from high-altitude photographs and astronomical studies: to the naked eye, the earth, more than 1,000 miles below, will appear as a gigantic, glowing globe. It will be an awe-inspiring sight. On the earth's "day" side, the space station's crew will see glaring white patches of overcast reflecting the light of the sun. The continents will stand out in shades of gray and brown bordering the brilliant blue of the seas. North America will look like a great patchwork of brown, gray and green reaching all the way to the snow-covered Rockies. And one polar cap—whichever happens to be enjoying summer at the time—will show as a blinding white, too brilliant to look at with the naked eye.

On the earth's "night" side, the world's cities will be clearly visible as twinkling points of light. Surrounded by the hazy aura of its atmosphere—that great ocean of air in which we live—the earth will be framed by the absolute black of space.

Development of the space station is as inevitable as the rising of the sun; man has already poked his nose into space and he is not likely to pull it back.

On the 14th of September, 1944, a German V-2 rocket, launched from a small island in the Baltic, soared to a peak altitude of 109 miles. Two years later, on December 17, 1946, another V-2, fired at the Army Ordnance's White Sands Proving Ground, New Mexico, reached a height of 114 miles—more than five times the highest altitude ever attained by a meteorological sounding balloon. And on the 24th of February, 1949, a "two-stage rocket" (a small rocket named the "WAC Corporal," fired from the nose of a V-2 acting as carrier or "first stage") soared up to a height of 250 miles—roughly the distance between New York and Washington, but straight up!

These projectiles utilize the same principle of propulsion as the jet airplane. It is based on Isaac Newton's third law of motion, which can be stated this way: for every action there must be a reaction of equal force, but in the opposite direction. A good example is the firing of a bullet from a rifle. When you pull the trigger and the bullet speeds out of the barrel, there is a recoil which slams the rifle butt back against your shoulder. If the rifle were lighter and the explosion of the cartridge more powerful, the gun might go flying over your shoulder for a considerable distance.

This is the way a rocket works. The body of the rocket is like the rifle barrel; the gases ejected from its tail are like the bullet. And the power of a rocket is measured not in horsepower, but in pounds or tons of recoil—called "thrust." Because it depends on the recoil principle, this method of propulsion does not require air.

There is nothing mysterious about making use of this principle as the first step toward making our space station a reality. On the basis of present engineering knowledge, only a determined effort and the money to back it up are required. And if we don't do it, another nation—possibly less peace-minded—will. If we were to begin it immediately, and could keep going at top speed, the whole program would take about 10 years. The estimated cost would be $4,000,000,000—about twice the cost of developing the atomic bomb, but less than one quarter the price of military materials ordered by the Defense Department during the last half of 1951.

Our first need would be a huge rocket capable of carrying a crew and some 30 or 40 tons of cargo into the "two-hour" orbit. This can be built. To understand how, we again use the modern gun as an example.

A shell swiftly attains a certain speed within the gun barrel, then merely coasts through a curved path toward its target. A long-range rocket also requires its initial speed during a comparatively short time, then is carried by momentum.

For example, the V-2 rocket in a 200-mile flight is under power for only 65 seconds, during which it travels 20 miles. At the end of this 65-second period of propulsion it reaches a cut-off speed of 3,600 miles per hour; it coasts the remaining 180 miles. Logically, therefore, if we want to step up the range of a rocket, we must increase its speed during the period of powered flight. If we could step up its cut-off speed to 8,280 miles per hour, it would travel 1,000 miles.

To make a shell hit its target, the gun barrel has to be elevated and pointed in the proper direction. If the barrel were pointed straight up into the sky, the shell would climb to a certain altitude and then simply fall back, landing quite close to the gun. Exactly the same thing happens when a rocket is fired vertically. But to make the rocket reach a distant target after its vertical take-off, it must be tilted after it reaches a certain height above the ground. In rockets capable of carrying a crew and cargo, the tilting would be done by swivel-mounted rocket motors, which, by blasting sideways, would cause the rocket to veer.

* * *

Employing this method, at a cut-off speed of 17,460 miles per hour, a rocket would coast halfway around the globe before striking ground. And by boosting to just a little higher cut-off speed—4.86 miles per second or 17,500 miles per hour—its coasting path, after the power had been cut off, would match the curvature of the earth. The rocket would actually be "falling around the earth," because its speed and the earth's gravitational pull would balance exactly.

It would never fall back to the ground, for it would now be an artificial satellite, circling according to the same laws that govern the moon's path about the earth.

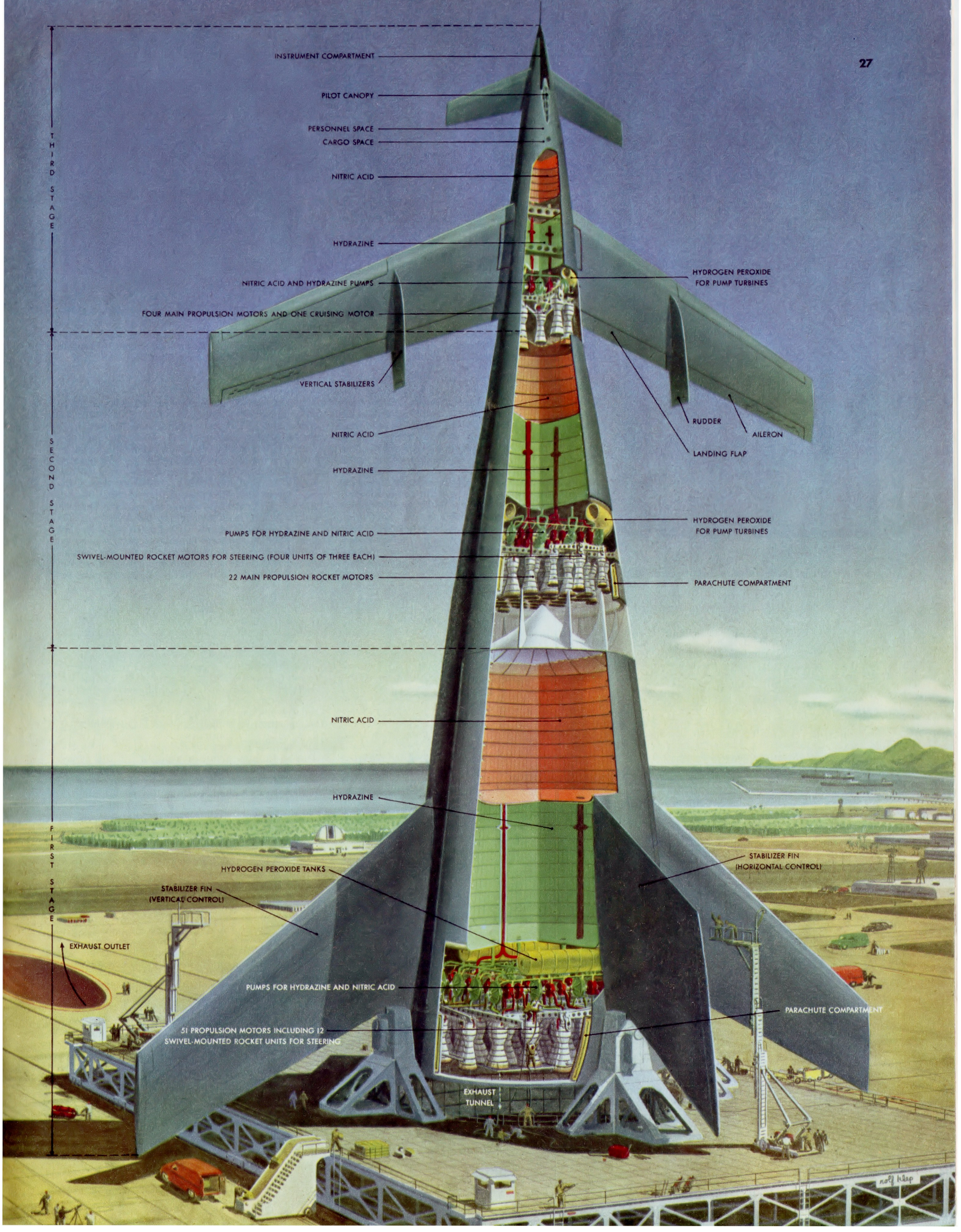
Making it do this would require delicate timing—but when you think of the split-second predictions of the eclipses, you will grant that there can hardly be any branch of natural science more accurate than the one dealing with the motion of heavenly bodies.

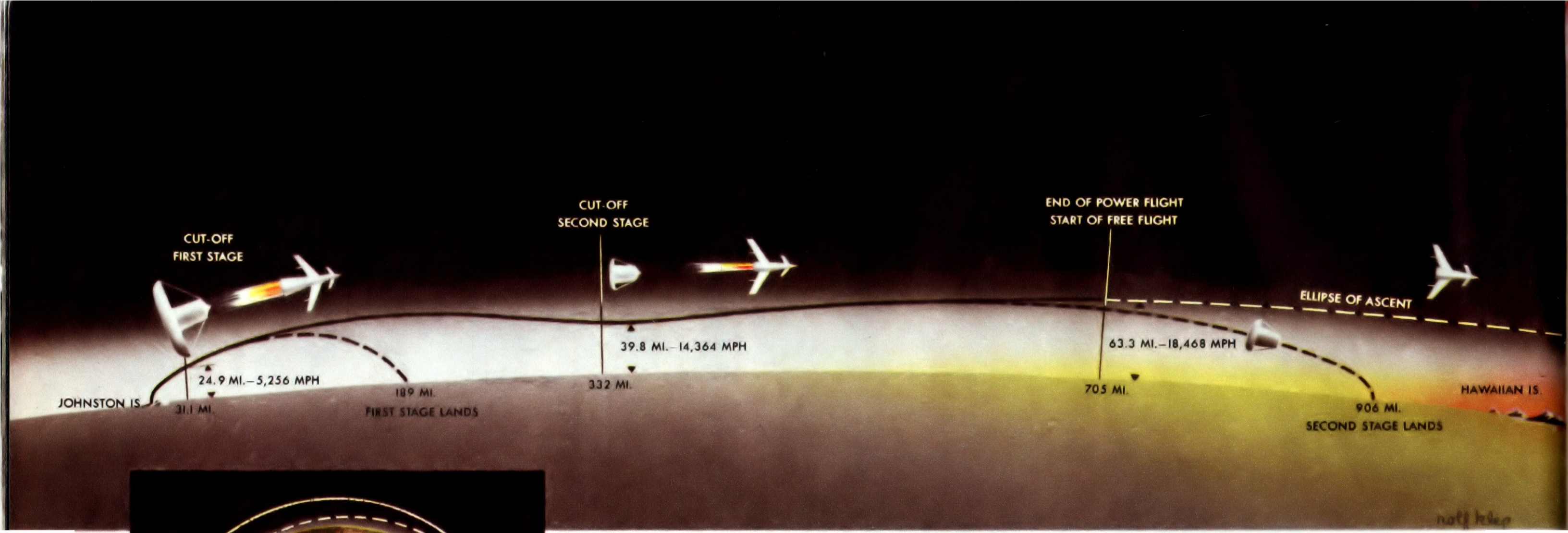
Will it be possible to attain this fantastic speed of 17,500 miles per hour necessary to reach our chosen two-hour orbit? This is almost five times as fast as the V-2. Of course, we can replace the V-2's alcohol and liquid oxygen by more powerful propellants, and even, by improving the design, reduce the rocket's dead weight and thereby boost the speed by some 40 or 50 per cent; but we would still have a long way to go.

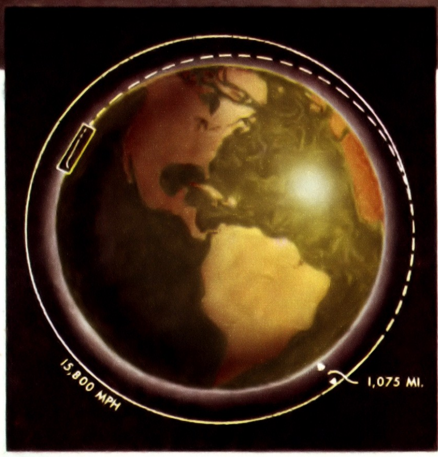
The WAC Corporal, starting from the nose of a V-2 and climbing to 250 miles, has shown us what we must do if we want to step up drastically the speed of a rocket. The WAC started its own rocket motor the moment the V-2 carrying it had reached its maximum speed. It thereby added its own speed to that already achieved by the first stage. As mentioned earlier, such a piggyback arrangement is called a "two-stage rocket"; and by putting a two-stage rocket on

Scale drawings at left show how the space station, depicted by the tiny ring at top of each sketch, will circle the earth. Actually, the man-made satellite, in the 1,075-mile orbit selected as the most desirable, will go around the world every two hours. The four drawings indicate, from top to bottom, time intervals of four hours; during each, the satellite will have made two revolutions. Thus, as the globe turns beneath them, occupants of the station will view every spot on the earth during a 24-hour span. At right is Von Braun's rocket ship design. Tall as a 24-story building, it will weigh 7,000 tons and have a 65-foot base

DRAWINGS BY ROLF KLEP


THIRD STAGE
SECOND STAGE
FIRST STAGE
INSTRUMENT COMPARTMENT
PILOT CANOPY
PERSONNEL SPACE
CARGO SPACE
NITRIC ACID
HYDRAZINE
NITRIC ACID AND HYDRAZINE PUMPS
HYDROGEN PEROXIDE FOR PUMP TURBINES
FOUR MAIN PROPULSION MOTORS AND ONE CRUISING MOTOR
VERTICAL STABILIZERS
RUDDER
AILERON
LANDING FLAP
NITRIC ACID
HYDRAZINE
HYDROGEN PEROXIDE FOR PUMP TURBINES
PUMPS FOR HYDRAZINE AND NITRIC ACID
SWIVEL-MOUNTED ROCKET MOTORS FOR STEERING (FOUR UNITS OF THREE EACH)
22 MAIN PROPULSION ROCKET MOTORS
PARACHUTE COMPARTMENT
NITRIC ACID
HYDRAZINE
STABILIZER FIN (HORIZONTAL CONTROL)
HYDROGEN PEROXIDE TANKS
STABILIZER FIN (VERTICAL CONTROL)
EXHAUST OUTLET
PUMPS FOR HYDRAZINE AND NITRIC ACID
PARACHUTE COMPARTMENT
51 PROPULSION MOTORS INCLUDING 12 SWIVEL-MOUNTED ROCKET UNITS FOR STEERING
EXHAUST TUNNEL





ROLF KLEP

Contrary to widespread notion, rocket ship does not travel straight up all the way. After covering first eight miles vertically, rocket proceeds at angle. Inset art shows complete flight path into two-hour orbit; section in rectangle marks flight segment detailed above

another, still larger, booster, we get a three-stage rocket. A three-stage rocket, then, could treble the speed attainable by one rocket stage alone (which would give it enough speed to become a satellite).

In fact, it could do even better. The three-stage rocket may be considered as a rocket with three sets of motors; after the first set has given its utmost, and has expired, it is jettisoned—and so is the second set, in its turn. The third stage, or nose, of the rocket continues on its way, relieved of all that excess weight.

* * *

Besides the loss of the first two stages, other factors make the rocket's journey easier the higher it goes. First, the atmosphere is dense, and tends to hinder the passage of the rocket; once past it, the going is faster. Second, the rocket motors operate more efficiently in the rarefied upper layers of the atmosphere. Third, after passing through the densest portion of the atmosphere, the rocket no longer need climb vertically.

Imagine the size of this huge three-stage rocket ship: it stands 265 feet tall, approximately the height of a 24-story office building. Its base measures 65 feet in diameter. And the over-all weight of this monster rocket ship is 14,000,000 pounds, or 7,000 tons—about the same weight as a light destroyer.

Its three huge power plants are driven by a combination of nitric acid and hydrazine, the latter being a liquid compound of nitrogen and hydrogen, somewhat resembling its better-known cousin, ammonia. These propellants are fed into the rocket motors by means of turbopumps.

Fifty-one rocket motors, pushing with a combined thrust of 14,000 tons, power the first stage (tail section). These motors consume a total of 5,250 tons of propellants in the incredibly short time of 84 seconds. Thus, in less than a minute and a half, the rocket loses 75 per cent of its total original weight!

The second stage (middle section), mounted on top of the first, has 34 rocket motors with a total thrust of 1,750 tons, and burns 770 tons of propellants. It operates for only 124 seconds.

The third and final stage (nose section)—carrying the crew, equipment and pay load—has five rocket motors with a combined thrust of 220 tons. This "body" or cabin stage of the rocket ship carries 90 tons of propellants, including ample reserves for the return trip to earth. In addition, it is capable of carrying a cargo or pay load of about 36 tons into our two-hour orbit 1,075 miles above sea level. (Also, in expectation of the return trip, the nose section will have wings something like an airplane's. They will be used only during the descent, after re-entering the earth's atmosphere.)

Years before the actual take-off, smaller rocket ships, called instrument carriers, will have been sent up to the two-hour orbit. They will circle there, sending back information by the same electronic method already in use with current rockets. Based on the data thus obtained, scientists, astronomers, and engineers, along with experts from the armed forces, will plan the complete development of the huge cargo-carrying rocket ship.

The choice of the take-off site poses another problem. Because of the vast amount of auxiliary equipment—such as fuel storage tanks and machine shops, and other items like radio, radar, astronomical and meteorological stations—an extensive area is required. Furthermore, it is essential, for reasons which will be explained later, that the rocket ship fly over the ocean during the early part of the flight. The tiny U.S. possession known as Johnston Island, in the Pacific, or the Air Force Proving Ground at Cocoa, Florida, are presently considered by the experts to be suitable sites.

At the launching area, the heavy rocket ship is assembled on a great platform. Then the platform is wheeled into place over a tunnel-like "jet deflector" which drains off the fiery gases of the first stage's rocket motors. Finally, with a mighty roar which is heard many miles away, the rocket ship slowly takes off—so slowly, in fact, that in the first second it travels less than 15 feet. Gradually, however, it begins to pick up speed, and 20 seconds later it has disappeared into the clouds.

Because of the terrific acceleration which will be experienced one minute later, the crew—located, of course, in the nose—will be lying flat in "contour" chairs at take-off, facing up. Throughout the whole of its flight to the two-hour orbit, the rocket is under the control of an automatic gyropilot. The timing of its flight and the various maneuvers which take place have to be so precise that only a machine can be trusted to do the job.

After a short interval, the automatic pilot tilts the rocket into a shallow path. By 84 seconds after take-off, when the fuels of the first stage (tail section) are nearly exhausted, the rocket ship is climbing at a gentle angle of 20.5 degrees.

When it reaches an altitude of 24.9 miles it will have a speed of 1.46 miles per second, or 5,256 miles per hour. To enable the upper stages to break away from the tail or first stage, the tail's power has to be throttled down to almost zero. The motors of the second stage now begin to operate, and the connection between the now-useless first stage and the rest of the rocket ship is severed. The tail section drops behind, while the two upper stages of the rocket ship forge ahead.

After the separation, a ring-shaped ribbon parachute, made of fine steel wire mesh, is automatically released by the first stage. This chute has a diameter of 217 feet and gradually it slows down the tail section. But under its own momentum, this empty hull continues to climb, reaching a height of 40 miles before slowly descending. It is because the tail section could be irreparably damaged if it struck solid ground (and might be dangerous, besides) that the initial part of the trip must be over the sea. After the first stage lands in the water, it is collected and brought back to the launching site.

The same procedure is repeated 124 seconds later. The second stage (middle section) is dropped into the ocean. The rocket ship by this time has attained an altitude of 40 miles and is 332 miles from the take-off site. It also has reached a tremendous speed—14,364 miles per hour.

Now the third and last stage—the nose section or cabin-equipped space ship proper—proceeds under the power of its own rocket motors. Just 84 seconds after the dropping of the second stage, the rocket ship, now moving at 18,468 miles per hour, reaches a height of 63.3 miles above the earth.

At this point we must recall the comparison between the rocket and the coasting rifle shell to understand what occurs. The moment the rocket reaches a speed of 18,468 miles per hour, at an altitude of 63.3 miles, the motors are cut off, even though the fuel supply is by no means exhausted. The rocket ship continues on an unpowered trajectory until it reaches 1,075 miles above the earth. This is the high point, or "apogee"; in this case it is exactly halfway around the globe from the cut-off place. The rocket ship is now in the two-hour orbit where we intend to build the space station.

* * *

Just one more maneuver has to be performed, however. In coasting up from 63.3 miles to 1,075 miles, the rocket ship has been slowed by the earth's gravitational pull to 14,770 miles per hour. This is not sufficient to keep the ship in our chosen orbit. If we do not increase the speed, the craft will swing back halfway around the earth to the 63.3-mile altitude. Then it would continue on past the earth until, as it curves around to the other side of the globe, it would be back at the same apogee, at the 1,075-mile altitude.

The rocket ship would already be a satellite and behave like a second moon in the heavens, swinging on its elliptical path over and over for a long time. One might well ask: Why not be satisfied with this? The reason is that part of this particular orbit is in the atmosphere at only 63.3 miles. And while the air resistance there is very low, in time it would cause the rocket ship to fall back to earth.

Our chosen two-hour orbit is one which, at *all* points, is exactly 1,075 miles above the earth. The last maneuver, which stabilizes the rocket ship in this orbit, is accomplished by turning on the rocket motors for about 15 seconds. The velocity is thus increased by 1,030 miles per hour, bringing the total speed to 15,800 miles per hour. This is the speed necessary for remaining in the orbit permanently. We have reached our goal.

An extraordinary fact about the flight from the earth is this: it has taken only 56 minutes, during which the rocket ship was powered for only five minutes.

From our vantage point, 1,075 miles up, the earth, to the rocket ship's crew, appears to be rotating once every two hours. This apparent fast spin of the globe is the only indication of the tremendous speed at which the rocket ship is moving. The earth, of course, still requires a full 24 hours to complete one revolution on its axis, but the rocket ship is making 12 revolutions around the earth during the time the earth makes one.

We now begin to unload the 36 tons of cargo which we have carried up with us. But how and where shall we unload the material? There is nothing but the blackness of empty space all around us.

We simply dump it out of the ship. For the cargo, too, has become a satellite! So have the crew members. Wearing grotesque-looking pressurized suits and carrying oxygen for breathing, they can now leave the rocket ship and float about unsupported.

Just as a man on the ground is not conscious of the fact that he is moving with the earth around the sun at the rate of 66,600 miles per hour, so the men in the space ship are not aware of the fantastic speed with which they are going around the earth. Unlike men on the ground, however, the men in space do not experience any gravitational pull. If one of them, while working, should drift off into space, it will be far less serious than slipping off a scaffold. Drifting off merely means that the man has acquired a very slight speed in an unforeseen direction.

He can stop himself in the same manner in which any speed is increased or stopped in space—by reaction. He might do this, theoretically, by firing a revolver in the direction of his inadvertent movement. But in actual practice the suit will be equipped with a small rocket motor. He could also propel himself by squirting some compressed oxygen from a tank on his back. It is highly probable, however, that each crew member will have a safety line securing him to the rocket as he works. The tools he uses will also be secured to him by lines; otherwise they might float away into space.

* * *

The spacemen—for that is what the crew members now are—will begin sorting the equipment brought up. Floating in strange positions among structural units and machinery, their work will proceed in absolute silence, for there is no air to carry sound. Only when two people are working on the same piece of material, both actually touching it, will one be able to hear the noises made by another, because sound is conducted by most materials. They will, however, be able to converse with built-in "walkie-talkie" radio equipment. The cargo moves easily; there is no weight, and no friction. To push it, our crew member need only turn on his rocket motor (if he shoved a heavy piece of equipment without rocket power, he might fly backward!).

Obviously the pay load of our rocket ship—though equivalent to that of two huge Super Constellations—will not be sufficient to begin construction of the huge, three-decked, 250-foot-wide space station. Many more loads will be required. Other rocket ships, all timed to arrive at the same point in a continuous procession as the work progresses, will carry up the remainder of the prefabricated satellite. This will be an expensive proposition. Each rocket trip will cost more than half a million dollars *for propellants alone.* Thus, weight and shipping space limitations will greatly affect the specifications of a space station.

In at least one design, the station consists of 20 sections made of flexible nylon-and-plastic fabric. Each of these sections is an independent unit which later, after assembly into a closed ring, will provide compartmentation similar to that found in submarines. To save shipping space, these sections will be carried to the orbit in a collapsed condition. After the "wheel" has been put together and sealed, it will then be inflated like an automobile tire to slightly less than normal atmospheric pressure. This pressure will not only provide a breathable atmosphere within the ring but will give the whole structure its necessary rigidity. The atmosphere will, of course, have to be renewed as the men inside exhaust it.

On solid earth, most of our daily activities are conditioned by gravity. We put something on a table and it stays there, because the earth attracts it, pulling it against the table. When we pour a glass of milk, gravity draws it out of the bottle and we catch the falling liquid in a glass. In space, however, everything is weightless. And this includes man.

This odd condition in no way spells danger, at least for a limited period of time. We experience weightlessness for short periods when we jump from a diving board into a pool. To be sure, there are some medical men who are concerned at the prospect of permanent weightlessness—not because of any known danger, but because of the unknown possibilities. Most experts discount these nameless fears.

However, there can be no doubt that permanent weightlessness might often prove inconvenient. What we require, therefore, is a "synthetic" gravity within the space station. And we can produce centrifugal force—which acts as a substitute for gravity—by making the "wheel" slowly spin about its hub (a part of which can be made stationary).

To the space station proper, we attach a tiny rocket motor which can produce enough power to rotate the satellite. Since *(Continued on page 72)*

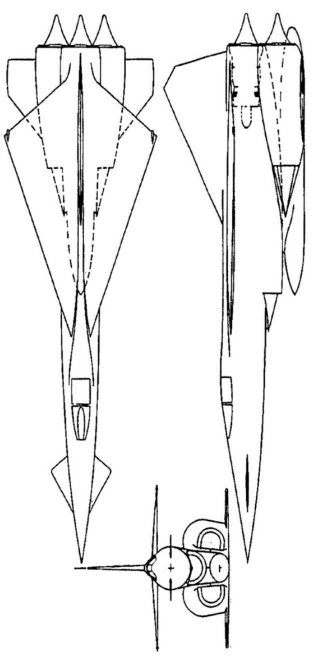
PAINTING BY CHESLEY BONESTELL

Skin of rocket ship's third stage (shown over Cape Town, South Africa) glows red hot on return trip. Phenomenon does not occur during ascent

APR Corner, Mini Edition: Mach 3 VTOL Aircraft for Submarines

By Scott Lowther

In 1958, Boeing-Wichita designed a Mach 3 aircraft specifically to go with the AN-1 and AN-2 submarine aircraft carriers (also Boeing designed). While no designation for the aircraft has been found, data has. They were to be 70 ft long overall, with a wingspan of 21.2 ft. GTOW was 32,630 lbs. VTO was provided by a "Magic Carpet," an unmanned booster aircraft that attached to the aircrafts belly and was also recoverable and reusable. Both aircraft were recovered in the same fashion as the X-13. Missions included interception and bombardment (likely nuclear).



More on this aircraft, the AN-1 and AN-2 and other submarine aircraft carrier designs can be found in issue V1N6 of Aerospace Projects Review.

aerospaceprojectsreview.com

Crossing the Last Frontier

CONTINUED FROM PAGE 29

there is no resistance which would slow the "wheel" down, the rocket motor does not have to function continuously. It will operate only long enough to give the desired rotation. Then it is shut off.

Now, how fast would we like our station to spin? That depends on how much "synthetic gravity" we want. If our 250-foot ring performed one full revolution every 12.3 seconds, we would get a synthetic gravity equal to that which we normally experience on the ground. This is known as "one gravity" or, abbreviated, "1 g." For a number of reasons, it may be advantageous not to produce one full "g." Consequently, the ring can spin more slowly; for example, it might make one full revolution every 22 seconds, which would result in a "synthetic gravity" of about one third of normal surface gravity.

The centrifugal force created by the slow spin of the space station forces everything out from the hub. No matter where the crew members sit, stand or walk inside, their heads will always point toward the hub. In other words, the inside wall of the "wheel's" outer rim serves as the floor.

* * *

How about the temperature within the space station? Maybe you, too, have heard the old fairy tale that outer space is extremely cold—absolute zero. It's cold, all right, but not that cold—and not in the satellite. The ironical fact is that the engineering problem in this respect will be to keep the space station comfortably cool, rather than to heat it up. In outer space, the temperature of any structure depends entirely on its absorption and dissipation of the sun's rays. The space station happens to be in the unfortunate position of receiving not only direct heat from the sun but also reflected heat from the earth.

If we paint the space station white, it will then absorb a minimum of solar heat. Being surrounded by a perfect vacuum, it will be, except for its shape, a sort of thermos bottle, which keeps hot what is hot, and cold what is cold.

In addition, we can scatter over the surface of the space station a number of black patches which, in turn, can be covered by shutters closely resembling white Venetian blinds. When these blinds are open on the sunny side, the black patches will absorb more heat and warm up the station. When the blinds are open on the shaded side, the black patches will radiate more heat into space, thereby cooling the station. Operate all these blinds with little electric motors, hook them to a thermostat, and tie the whole system in with the station's air-conditioning plant—and there's your temperature control system.

Inflating the space station with air will, as we have indicated, provide a breathable atmosphere for a limited time only. The crew will consume oxygen at a rate of approximately three pounds per man per day. At intervals, therefore, this life-giving oxygen will have to be replenished by supply ships from earth. At the same time, carbon dioxide and toxic or odorous products must be constantly removed from the air-circulation system. The air must also be dehumidified, inasmuch as through breathing and perspiration each crew member will lose more than three pounds of water per day to the air system (just as men do on earth).

This water can be collected in a dehumidifier, from which it can economically be salvaged, purified and reused.

Both the air-conditioning and water-recovery units need power. So do the radar systems, radio transmitters, astronomical equipment, electronic cookers and other machinery. As a source for this power we have the sun. On the earth, solar power is reliable in only a few places where clouds rarely obscure the sky, but in space there are no clouds, and the sun is the simplest answer to the station's power needs.

Our power plant will consist of a condensing mirror and a boiler. The condensing mirror will be a highly polished sheet metal trough running around the "wheel." The position of the space station can be arranged so that the side to which the mirror is attached will always point toward the sun. The mirror then focuses the sun's rays on a steel pipe which runs the length of the mirrored trough. Liquid mercury is fed under pressure into one end of this pipe and hot mercury vapor is taken out at the other end. This vapor drives a turbogenerator which produces about 500 kilowatts of electricity.

Of course, the mercury vapor has to be used over and over again, so after it has done its work in the turbine it is returned to the "boiler" pipe in the mirror. Before this can be done, the vapor has to be condensed back into liquid mercury by cooling. This is achieved by passing the vapor through pipes located behind the mirror in the shade. These pipes dissipate the heat of the vapor into space.

Thus we have within the space station a complete, synthetic environment capable of sustaining man in space. Of course, man will face hazards—some of them, like cosmic radiation and possible collision with meteorites, potentially severe. These problems are being studied, however, and they are considered far from insurmountable.

Our "wheel" will not be alone in the two-hour orbit. There will nearly always be one or two rocket ships unloading supplies. They will be parked some distance away, to avoid the possibility of damaging the space station by collision or by the blast from the vehicle's rocket motors. To ferry men and materials from rocket ship to space station, small rocket-powered metal craft of limited range, shaped very much like overgrown watermelons, will be used. These "space taxis" will be pressurized and, after boarding them, passengers can remove their space suits.

On approaching the space station, the tiny shuttle-craft will drive directly into an air lock at the top or bottom of the stationary hub. The space taxi will be built to fit exactly into the air lock, sealing the opening like a plug. The occupants can then enter the space station proper without having been exposed to the airlessness of space at any time since leaving the air lock of the rocket ship.

* * *

There will also be a space observatory, a small structure some distance away from the main satellite, housing telescopic cameras for taking long-exposure photographs. (The space station itself will carry extremely powerful cameras, but its spin, though slow, will permit only short exposures.) The space observatory will not be manned, for if it were, the movements of an operator would disturb the alignment. Floating outside the structure in space suits, technicians will load a camera with special plates or film, and then withdraw. The camera will be aimed and the shutter snapped by remote radio control from the space station.

Most of the pictures taken of the earth, however, will be by the space station's cameras. The observatory will be used mainly to record the outer reaches of the universe, from the neighboring planets to the distant galaxies of stars. This mapping of the heavens will produce results which no observatory on earth could possibly duplicate. And, while the scientists are probing the secrets of the universe with their cameras, they will also be planning another trip through space—this time to examine the moon.

Suppose we take the power plant out of our rocket ship's last stage and attach it to a lightweight skeleton frame of aluminum girders. Then we suspend some large collapsible fuel containers in this structure and fill them with propellants. Finally, we connect some plumbing and wiring and top the whole structure with a cabin for the crew, completely equipped with air and water regeneration systems, and navigation and guidance equipment.

The result will be an oddly shaped vehicle, not much larger than the rocket ship's third stage, but capable of carrying a crew of several people to a point beyond the rear side of the moon, then back to the space station. This vehicle will bear little resemblance to the moon rockets depicted in science fiction. There is a very simple reason: conventional streamlining is not necessary in space.

The space station, as mentioned previously, has a speed of 15,840 miles per hour. Our round-the-moon ship, to leave the two-hour orbit, has to have a speed of 22,100 miles per hour, to cover the 238,000-mile distance to the moon. This additional speed is acquired by means of a short rocket blast, lasting barely two minutes. This throws the round-the-moon ship into a long arc or ellipse, with its remotest point beyond the moon. The space ship will then coast out this distance, unpowered, like a thrown stone. It will lose speed all along the way, due to the steady action of the earth's gravitational pull—which, though weakening with distance, extends far out into space.

Roughly five days after departure, the space ship will come almost to a standstill. And if we have timed our departure correctly, the moon will now pass some 200 miles below us, with the earth on its far side. On this one trip we can photograph most of the unknown half of the moon, the half which has never been seen from the earth. Furthermore, we now have an excellent opportunity to view the earth from the farthest point yet; at this distance, it appears not unlike a miniature reproduction of itself (from the vicinity of the moon, the earth will look about four times as large as the full moon does to earth-bound man).

It is not necessary to turn on the space ship's motors for the return trip. The moon's gravity is too slight to affect us substantially; like the shell which was fired vertically, we simply "fall back" to the space station's orbit. The long five-day "fall" causes the space ship to regain its initial speed of 22,100 miles per hour. This is 6,340 miles per hour faster than the speed of the space station, but, as we have fallen back tail first, we simply turn on the motors for just two minutes, which reduces our speed to the correct rate which permits us to re-enter the two-hour orbit.

* * *

Besides its use as a springboard for the exploration of the solar system, and as a watchdog of the peace, the space station will have many other functions. Meteorologists, by observing cloud patterns over large areas of the earth, will be able to predict the resultant weather more easily, more accurately and further into the future. Navigators on the seas and in the air will utilize the space station as a "fix," for it will always be recognizable.

But there will also be another possible use for the space station—and a most terrifying one. It can be converted into a terribly effective atomic bomb carrier.

Small winged rocket missiles with atomic war heads could be launched from the station in such a manner that they would strike their targets at supersonic speeds. By simultaneous radar tracking of both missile and target, these atomic-headed rockets could be accurately guided to any spot on the earth.

In view of the station's ability to pass over all inhabited regions on earth, such atom-bombing techniques would offer the satellite's builders the most important tactical and strategic advance in military history. Furthermore, its observers probably could spot, in plenty of time, any attempt by an enemy to launch a rocket aimed at colliding with the giant "wheel" and intercept it.

We have discussed how to get from the ground to the two-hour orbit, how to build the space station and how to get a look at the unknown half of the moon by way of a round trip from our station in space. But how do we return to earth?

Unlike the ascent to the orbit, which was controlled by an automatic pilot, the descent is in the hands of an experienced "space pilot."

To leave the two-hour orbit in the third stage, or nose section, of the rocket ship, the pilot slows down the vehicle in the same manner in which the returning round-the-moon ship slowed down. He reduces the speed by 1,070 miles per hour. Unpowered, the rocket ship then swings back toward the earth. After 51 minutes, during which we half circumnavigate the globe, the rocket ship enters the upper layers of the atmosphere. Again, it has fallen tail first; now the pilot turns it so that it enters the atmosphere nose first.

* * *

About 50 miles above the earth, due to our downward, gravity-powered swing from the space station's orbit, our speed has increased to 18,500 miles per hour. At this altitude there is already considerable air resistance.

With its wings and control surfaces, the rocket closely resembles an airplane. At first, however, the wings do not have to carry the rocket ship. On the contrary, they must prevent it from soaring out of the atmosphere and back into the space station's orbit again.

His eyes glued to the altimeter, the pilot will push his control stick forward and force the ship to stay at an altitude of exactly 50 miles. At this height, the air resistance gradually slows the rocket ship down. Only then can the descent into the denser atmosphere begin; from there on, the wings bear more and more of the ship's weight. After covering a distance of about 10,000 miles in the atmosphere, the rocket's speed will still be as high as 13,300 miles per hour. After another 3,000 miles, the speed will be down to 5,760 miles per hour. The rocket ship will by now have descended to a height of 29 miles.

The progress of the ship through the upper atmosphere has been so fast that air friction has heated the outer metal skin of body and wings to a temperature of about 1,300 degrees Fahrenheit. The rocket ship has actually turned color, from steel blue to cherry red! This should not cause undue concern, however, inasmuch as we have heat-resistant steels which can easily endure such temperatures. The canopy and windows will be built of double-paned glass with a liquid coolant flowing between the panes. And the crew and cargo spaces will be properly heat-insulated and cooled by means of a refrigerator-type air-conditioning system. Similar problems have already been solved, on a somewhat smaller scale, in present-day supersonic airplanes.

At a point 15 miles above the earth, the rocket ship finally slows down to the speed of sound—roughly 750 miles per hour. From here on, it spirals down to the ground like a normal airplane. It can land on conventional landing gear, on a runway adjacent to the launching site. The touch-down speed will be approximately 65 miles per hour, which is less than that of today's air liners. And if the pilot should miss the runway, a small rocket motor will enable him to circle once more and make a second approach.

After a thorough checkup, the third stage will be ready for another ascent into the orbit. The first and second stages (or tail and middle sections), which were parachuted down to the ocean, have been collected in specially made seagoing dry docks. They were calculated to fall at 189 miles and 906 miles respectively from the launching site. They will be found relatively undamaged, because at a point 150 feet above the water their parachute fall was broken by a set of cordite rockets which were automatically set off by a proximity fuse.

They, too, undergo a thorough inspection with some replacement of parts damaged by the ditching. Then all three stages are put together again in a towerlike hangar, right on the launching platform, and, after refueling and a final check, platform and ship are wheeled out to the launching site—ready for another journey into man's oldest and last frontier: the heavens themselves. THE END

A self-contained community, this outpost in the sky will provide all of man's needs, from air conditioning to artificial gravity

WHEN man first takes up residence in space, it will be within the spinning hull of a wheel-shaped structure, rotating around the earth much as the moon does. Life will be cramped and complicated for space dwellers; they will exist under conditions comparable to those on a modern submarine. This painting, which is scientifically accurate, shows how the spacemen will live and work inside their whirling station.

The wheel's movement around its hub will provide centrifugal force as a substitute for gravity in weightless space; however, this "synthetic gravity" will not be equal in all parts of the station, since the amount of spin will decrease toward the center. Thus, the topmost of the three decks (the one on the inside of the wheel) will have the least gravity, and the hub itself will have virtually none.

At the extreme left of the painting (below), on the top deck, is the communications center, which maintains radio contact with the earth, with rocket ships in space, and with the space taxis that carry men from rocket ship to space station. Below the communications room, meteorologists chart the weather for the entire earth; on the lowest deck at extreme left is a bunk room.

Next door to the communications and weather sections is the earth observation center, occupying two decks. On the top deck is a large movable map on which "ground zero," the territory the station is passing over at the moment, is spotted. Immediately below the map is a telescopic enlargement of ground zero. Under this, on the center deck, are additional telescopic screens showing other territory (figures over each screen refer to the amount of territory covered by the picture, not to the apparent distance away from the scene).

The electronic computer on the top deck, between the earth observation and celestial observation centers, solves complicated mathematical problems. The large screen in the celestial observation room enables astronomers to study enlarged photographs taken from the satellite's tiny sister station, the observatory. The bottom deck contains a photographic darkroom and part of the system which recovers and purifies waste water.

The next section over is devoted to the handling of cargo. Material arrives from the hub by elevator, and is distributed from the loading room in accordance with decisions made by the weight control center, which is charged with preserving the station's balance. Fuel storage and air-conditioning return ducts are located under this area.

The layers of skin enclosing the space station are shown covering part of the loading area. The outer skin, or meteor bumper, is attached to the inner skin by studs. The view ports are of plastic, tinted to guard against radiation; protective lids are lowered when the windows are not in use. The two black squares, which absorb the sun's heat and warm the satellite, have shutters to control heat absorption. On the meteor bumper wall are hook-on rings, to which spacemen tie lines while outside, to keep from floating away into space.

The sections beyond the pump room (top deck) form the heart of the system which keeps the space station supplied with air. The air control room regulates air pressures in the satellite. The components of the air mixture are determined by chemists in the air testing laboratory. In the room housing the air-conditioning machinery, the interior wall of the space station's inner rim is cut away to show secondary cables and ducts, which furnish power, air and the like, when the main system (right, overhead) fails.

The trough and pipe in the extreme upper-right corner of the picture are a part of the satellite's power plant. The trough is polished to catch the rays of the sun; the heat thus obtained is picked up by mercury in the tube. The mercury, emerging as hot vapor in the room below, drives a turbo-generator.

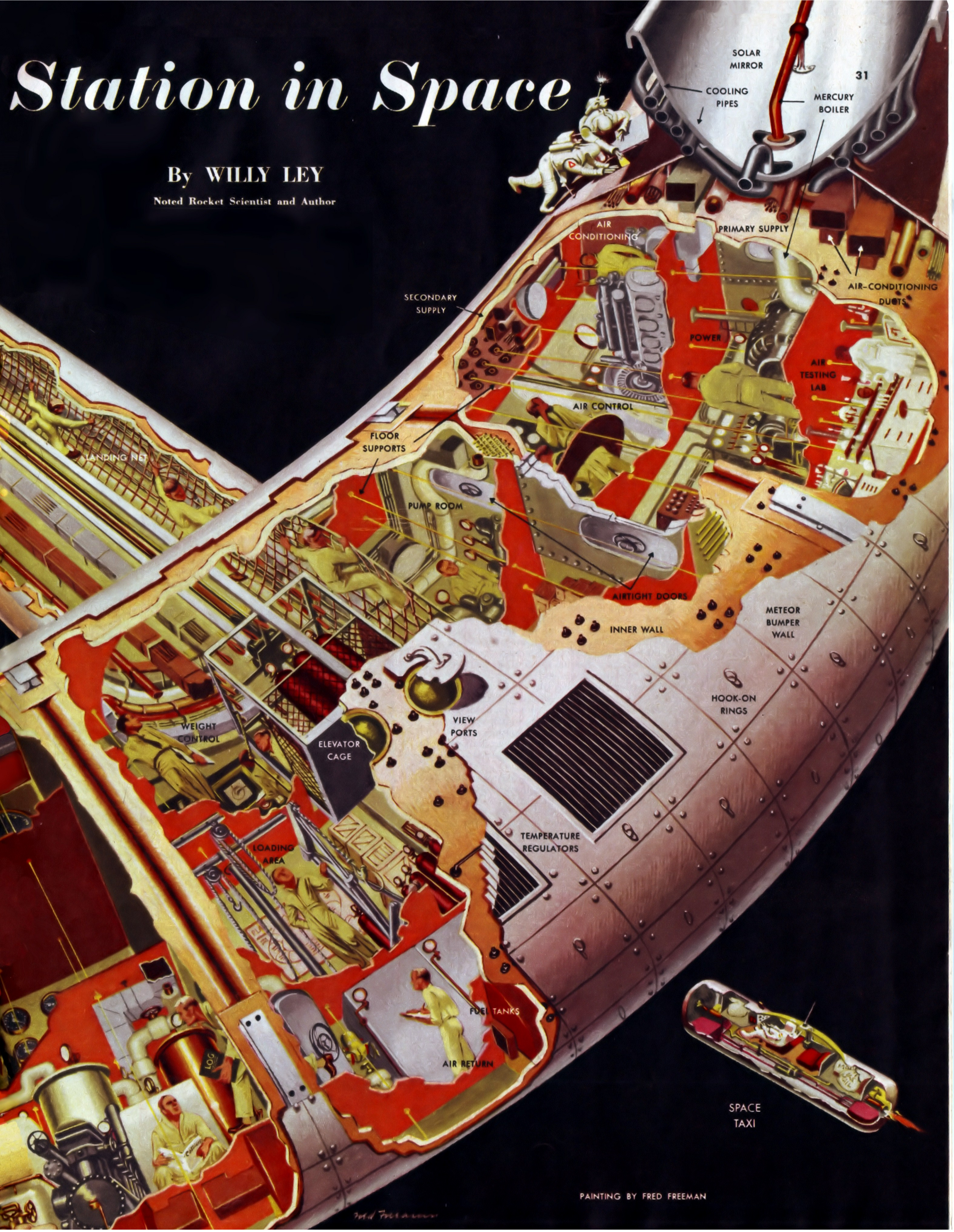
Inside the shaft which leads to the satellite's hub is a landing net to assist men in moving into and out of the gravity-free area. Since the hub is the center of all entrances, departures and loadings, it is kept fairly clear, except for the space station's supply of pressurized suits. At the top and bottom of the rotating hub are turrets which can be turned so space taxis can land in the bell-shaped landing berths. The taxi's body seals the turret shut, and the men move to the space station proper through air locks.

This drawing, of course, shows only a part of the space station. Its many other sections also contain equipment, supplies and living quarters. Balance must be carefully maintained, with each section painstakingly adjusted to the same weight as the section diametrically opposite it on the wheel. If this were not done, the revolving station might wobble, making the synthetic gravity uneven, disturbing the delicate measurements of the scientists within—and weakening the entire structure dangerously.

Station in Space

By WILLY LEY

Noted Rocket Scientist and Author



PAINTING BY FRED FREEMAN

The Heavens Open

By DR. FRED L. WHIPPLE

Chairman, Department of Astronomy, Harvard University

Once above the atmosphere which blindfolds our scientists now, a revolution will take place in astronomy. Man will, for the first time, get a good, clear look at the universe

IN MANY respects, today's astronomers might as well be blindfolded in a deep, dark coal mine. The earth's atmosphere, even on a perfectly clear day or night, blankets out many of the secrets of the universe. Details of the surface of the moon, planets and star groups disappear in a dancing blur because the atmosphere is never really quiet. The extremely significant far ultraviolet light, the X rays and gamma rays of space are indiscernible because the atmosphere permits free passage only to the visible light rays.

The establishment of a telescope and observatory in space will end this era of blindness. It will be as revolutionary to science as the invention of the telescope itself.

The sun, for example, photographed from the space station by X rays, will be an amazing sight. Astronomers have deduced that it very probably will look like a mottled, irregular sunflower. And what we now see as the sun's disk will, in all likelihood, prove to be only the central core of a large fuzzy-looking ball. It will be covered with bright specks and pulsing streaks, while the usually invisible corona will show up as the main source of light.

Similarly, familiar star constellations may look very strange when photographed from the space station or space observatory with plates sensitive to all the wave lengths of ultraviolet light.

Stars send ultraviolet as well as visible light. Some, however, radiate mostly ultraviolet. These appear weak to the eye, but will be exceedingly bright to the special camera. Those which send out very little ultraviolet light will hardly show on the special photographic plates. The Milky Way itself might be markedly changed—I wish I knew just how.

What is even more fascinating to the astronomer than acquiring "full vision" is the fact that space travel will permit him to change position in space. For instance, there is our moon, relatively near and under observation since the first telescope was built. But the moon always turns the same side toward the earth, and almost one half of its total surface has never been seen by man.

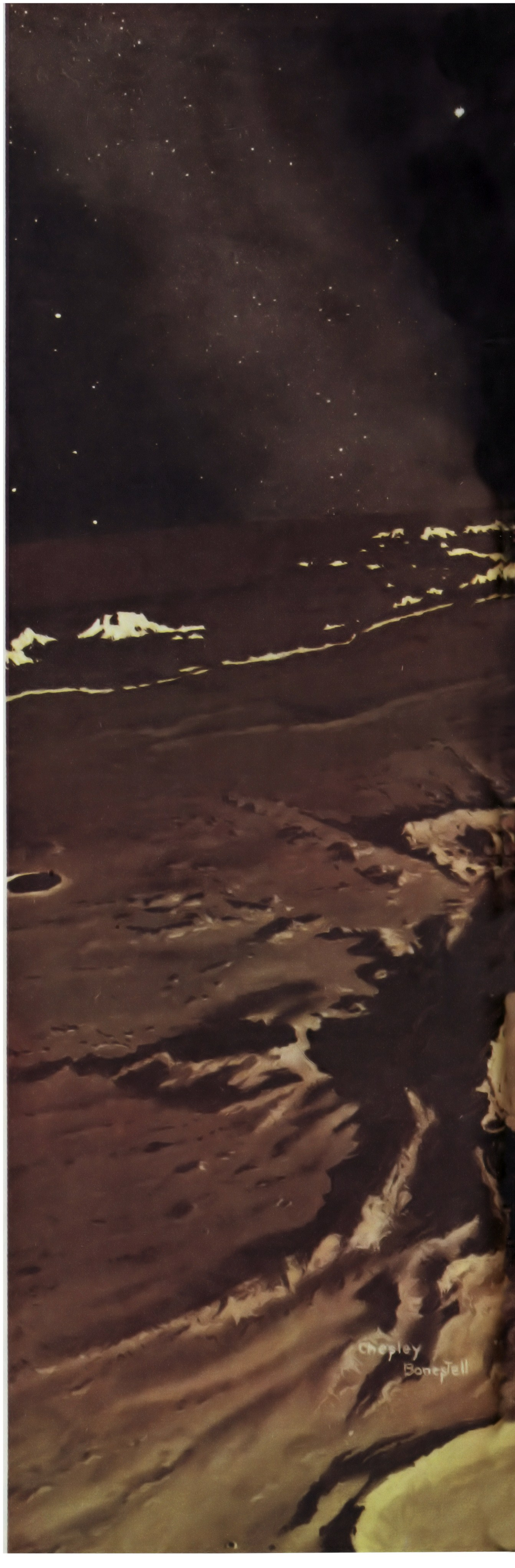
What are the first astronomers who make a round-the-moon journey going to see on that completely unknown portion? Will they find mountains, plains and craters like those we see on the side visible to us now? Or will they find a plain, serrated with jagged canyons—or a landscape unmarked by anything? And were the moon's gigantic craters formed by some type of volcanic action or are they a result of collision with flying mountains from space? Is there really a thick layer of dust covering the moon's surface? Observation from a space ship will give us conclusive answers to all these questions.

The astronomers in the space station will also have a very practical job awaiting them. When the sun becomes temperamental, as it frequently does, it develops gigantic storms on its surface, emitting excessive amounts of ultraviolet light and X rays, and even ejecting high-speed atoms. Although they cannot be observed directly, these emanations knock out our long-range radio communications, cause transcontinental teletypes to go berserk and sometimes even burn out long-range telephone and power cables.

There is little doubt that our space station astronomers, maintaining a 24-hour surveillance of the sun and all its radiations, not only will find the explanation for these solar storms but will learn to predict them in advance. Preparations could then be made to protect our electronic equipment.

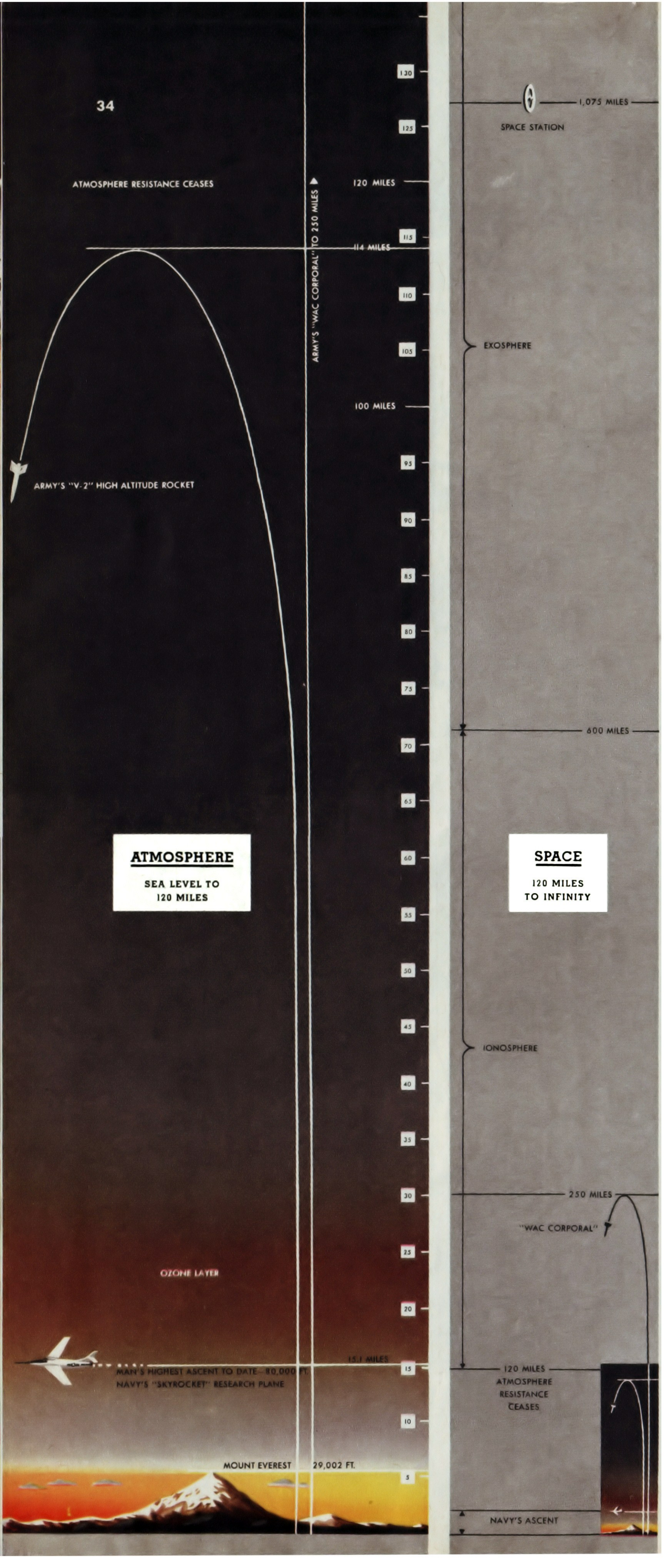
I can mention only a few more projects which will fascinate the astronomers of space. Among them: (1) the mysteries of the superhot and exploding stars; (2) the composition of the atmospheres of other planets, such as Mars; (3) details of the surfaces of other planets (which may offer evidence concerning possible life there); (4) analysis of the great dust and gas clouds of the Milky Way, where stars are born; (5) mapping of similar regions in other great galaxies comprising billions of stars. They should discover important clues regarding the expansion of the universe, its dimensions and its nature.

The astronomer will no longer be limited to seeing as "through a glass, darkly." The universe will spread out clearly before him.



Specially designed round-the-moon ship hovers 200 miles above lunar surface as space scientists take close-up photographs. One-way journey from station in space will take five days to cover 239,000 miles. Never-seen face of the moon is to right. Trip will have to be timed so that sun lights hidden side

PAINTING BY CHESLEY BONESTELL



This Side of Infinity

By Dr. JOSEPH KAPLAN

Professor of Physics, Institute of Geophysics, University of California

WE ARE living at the bottom of a great envelope of air which provides us with life-giving oxygen and water, protects us from the harmful effects of the sun's ultraviolet rays, and shields us from the high-speed projectiles called meteorites. Without this envelope, all life, as we know it, would cease.

This protective covering around the earth is the atmosphere, a mixture of about 20 per cent oxygen, almost 80 per cent nitrogen, and minute quantities of other gases. The mixture is thickest at sea level; with increasing altitude, it becomes thinner and thinner until eventually, for all practical purposes, we may say that it disappears. At 10,000 feet, the air is so thin that man usually has difficulty breathing. Over 20,000 feet, death awaits anyone not carrying oxygen. Over the years, scientists have found it convenient to divide the atmosphere into levels, as shown in the accompanying charts. These layers have distinctive properties which make them of special interest to particular branches of science. The first layer, from sea level to an altitude of eight miles, is of primary scientific importance to meteorologists, for it is here that all weather occurs. In 1898, the French meteorologist, Léon P. Teisserenc de Bort, named it the troposphere.

Until recent times, aeronautical engineers also devoted their main attention to the troposphere. Then, with the development of airplanes that could climb to an altitude of 60,000 feet, they began to show interest in the next level, the stratosphere (also named by De Bort), which extends from eight to 60 miles up. Extremely powerful winds have been found in this layer of the atmosphere, moving at the entirely unexpected rate of 200 miles per hour.

Here, too, was found a section 10 miles thick which attracted the special attention of physicists. For this layer contains an unusually high percentage of ozone (another form of oxygen) produced by the interaction of the sun's ultraviolet rays and oxygen. It is this ozone layer, which they themselves create, that prevents the ultraviolet rays from striking earth and killing all life.

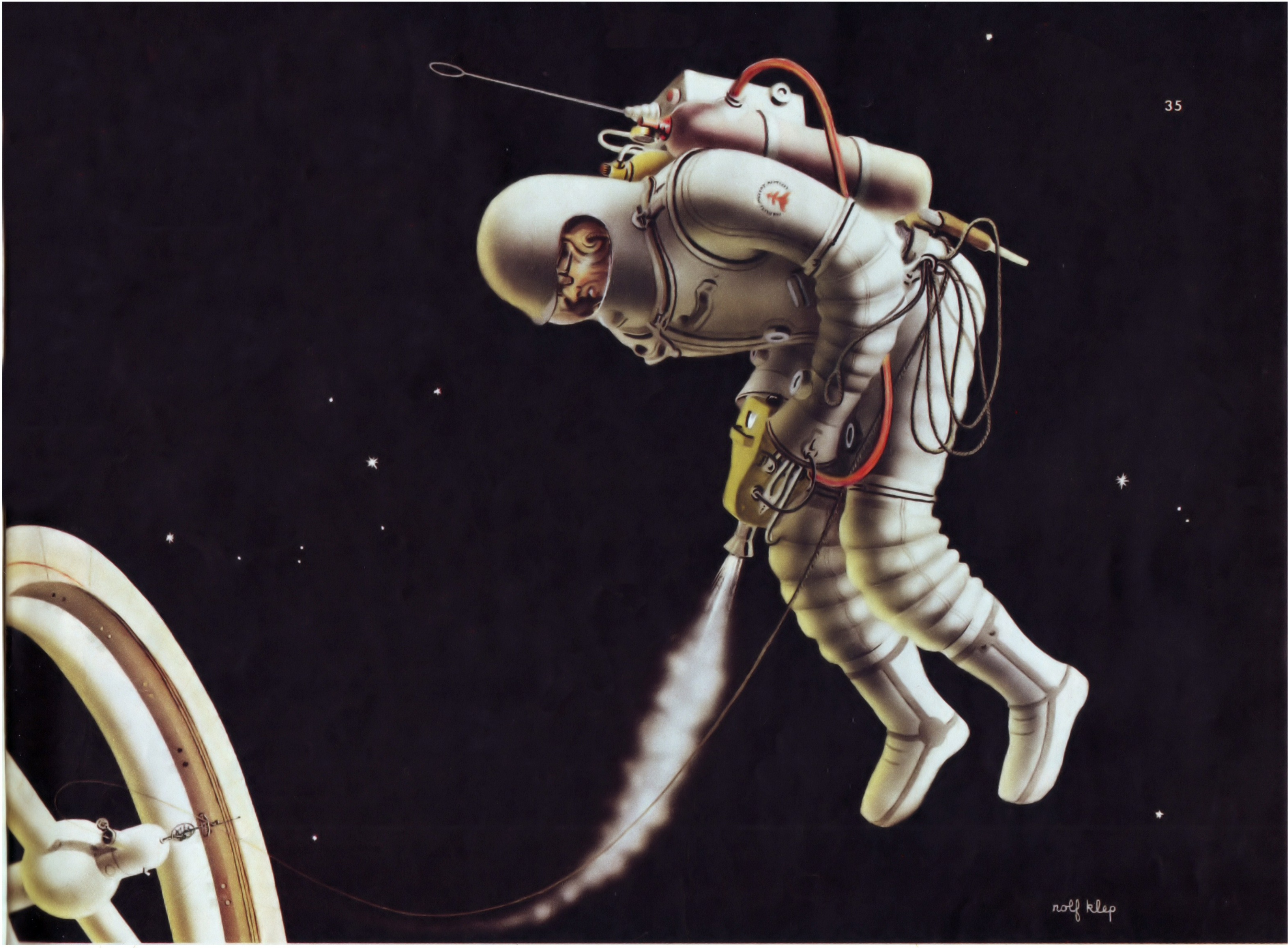
The thermometer, which shows widely varying temperatures on earth, suddenly stabilizes at the lower edge of the stratosphere, reading a constant 67 degrees below zero. Not long ago, it was believed the whole stratosphere remained at this temperature. Recently, however, a warm belt was discovered at 32 miles; the temperature here is a steady 170 degrees *above* zero. Higher up, it sharply decreases again.

The layer from 60 miles to 120 miles is called the ionosphere, of great importance to radio engineers because what little air exists there is electrically charged. This region is subdivided into several strata, each reflecting certain high-frequency radio waves back to earth. It is this charged air which makes it possible to send short-wave radio communications over long distances. The only radio waves which can penetrate this layer without being reflected back to earth are the ultra-short waves used for radar. Their ability to get through was proved conclusively in 1946, when the U.S. Army Signal Corps successfully made radar contact with the moon.

Also in the ionosphere we find the strange, pulsating glows of the aurora borealis and the aurora australis (these phenomena probably would be invisible to anyone passing through them on a flight to space). Because the auroras have traditionally been considered in the domain of the astronomers, members of this branch of science are, like radio experts, interested in the ionosphere.

Above the ionosphere, the air becomes so thin that it no longer serves any function. Scattered single particles of air (molecules and atoms) have been found here, and scientists have noted this fact by giving the area above the ionosphere a name of its own, the exosphere. But the particles are so rare that it is impossible to establish the limits of this layer. There are so few of them that at the 250-mile record altitude reached by the Army's "WAC Corporal" rocket, there is less air than in the best vacuum tube obtainable on earth. (See drawings. Reduced figure, right, shows "WAC Corporal's" course.)

It is at the boundary between the ionosphere and the exosphere that the upper limit of the atmosphere—and the lower limit of space—has been arbitrarily established by the two groups of scientists most interested: the astronomers and the rocket engineers. Their decision was based on the fact that both are concerned with the friction produced by air—the rocketmen because it creates a difficult barrier for rocket ships to cross; the astronomers because meteorites, which are in their scientific province, ignite upon striking fairly dense air. At 120 miles, air friction becomes, for the purposes of both groups, negligible. There space begins.



Tied to space station so he won't float away, spaceman wears radio and oxygen supply on back of pressurized suit, gets propulsion from portable rocket motor. Actual helmet will have dark glass to ward off dangerous ultraviolet rays; artist made it light to show face

CAN WE SURVIVE IN SPACE?

By DR. HEINZ HABER

Department of Space Medicine, United States Air Force School of Aviation Medicine, Randolph Field, Texas

A multitude of problems will beset us, says this authority, but nothing we can't lick

ALL day long, the frail little man attending the forum had listened to the engineers and scientists discuss the conquest of the heavens with huge rocket ships and space stations. Now he had a question.

"Mr. Chairman," he said, "you fellows seem to have worked out all the details. You know how your rocket ships should be designed, you even have plans on paper for machines to reach the moon and other planets. But as an ordinary layman who knows little about these matters, I would like to ask this one question:

"Who is going to design the crew?"

The questioner had put his finger on the greatest difficulty facing the engineers, scientists and doctors in reaching space—man himself.

If the jet plane, guided missile or rocket ship is not perfect, the engineer can redesign the machine over and over until all the kinks have been ironed out. He has a great variety of materials and devices at his disposal. He may eventually succeed in developing a flawless machine. The same cannot be said for man. He is the most important link, and yet the weakest one, in any attempt to conquer space. And he cannot be redesigned.

True, man can adapt himself to extraordinary conditions—he manages to survive anywhere on the face of this globe. But what will happen to him if he ventures into the alien environment known as space—the void beyond the atmosphere?

There is no oxygen for breathing.

The lack of atmospheric pressure can cause his blood to boil.

Dangerous radiation (ultraviolet rays) from the sun hits him with full force and can broil him within minutes.

Atomic bullets, called cosmic rays, plow through his body.

He will be weightless, floating helplessly about, with no up or down.

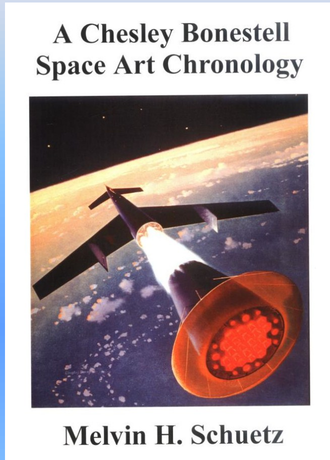
In short, man was not made to survive in the "hostile territory of space." It becomes the problem of the engineers, therefore, to create a highly mobile, self-contained, "packaged" environment for space-faring man. In other words, he needs an airtight shell to produce and preserve earthly conditions as nearly as possible.

Man is extremely hard to please in his demands, but the engineer can lick the problem and supply the crew of a rocket ship or space station with all the necessities for survival. Neither rocket ship nor space station will have the snug comfort of Mother Earth, and flying through space will be a rough job that will call for healthy, tough and physically well-trained individuals. But it can be done.

Some pessimists maintain *(Continued on page 65)*

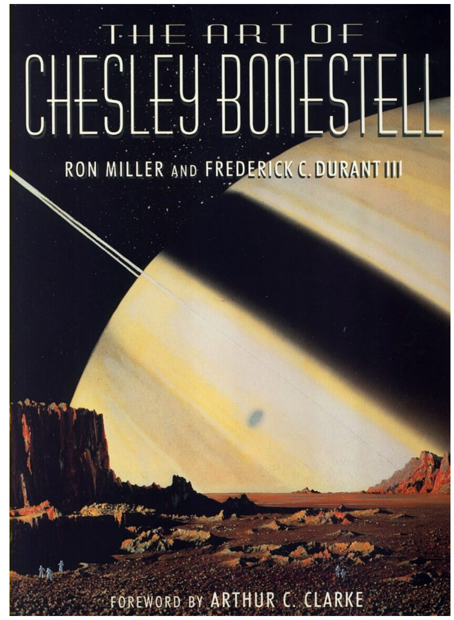
DRAWINGS BY ROLF KLEP

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.



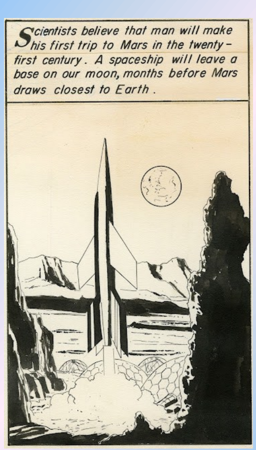
Award winner Ron Miller & Black Cat Studios

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

Dreams of Space, Books & Ephemera

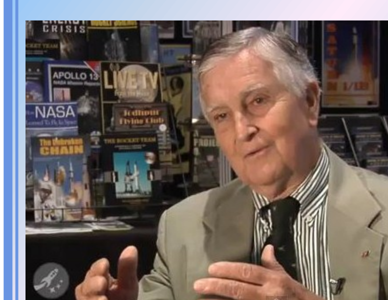
Non-Fiction Children's Books about Space Flight from 1945 to 1975
http://dreamsofspace.blogspot.fr

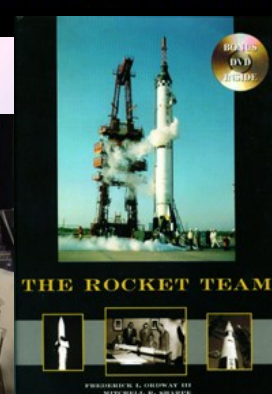
Below: From John Sisson's Dreams of Space [blog]() entry, this art is by Angelo Torres, from a 1961 non-fiction Classics Illustrated comic book, The World Around Us, Undersea Adventures #30.



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]()

Can We Survive in Space?

CONTINUED FROM PAGE 35

that the crew members of a rocket ship wouldn't live to experience space, because they wouldn't even survive the tremendous stresses placed upon them during the ascent. The thrust of the operating rocket motors exerts strong forces upon the ship and its passengers. A motorist gets an inkling of one of these forces: if he steps on the accelerator, he is gently pressed against the back of the automobile seat. But this soft pressure in a car becomes a crushing force in a fast-rising rocket ship. As the space vehicle is whipped forward by the fiery jet of its escaping gases, the force increases in a slowly rising, irresistible surge. To the passenger, it will appear as though several men his own weight are standing on his chest. He will find it difficult to breathe. The fantastic acceleration will distend his features into a grotesque mask.

* * *

For short periods of time, similar stresses occur in present-day fighter aircraft when the pilot pulls out of a steep dive. For this reason, detailed studies have been made on the tolerance of humans under these conditions. In some experiments, men have been strapped into cockpitlike chairs which were then whirled around like a bucket on the end of a string. With such machines, the stresses encountered in modern aviation are being studied and measured. The results indicate that sturdy and healthy individuals will be able to withstand the rigors which the engineer deems inevitable for breaking free from the earth in a rocket ship. Probably the same medical requirements now applicable to Air Force or commercial pilots will be the yardstick used.

The stress of acceleration is not, of course, the only hazard man will encounter as he leaves the friendly atmosphere of the earth. A continuously flowing supply of breathing air is a necessity in the emptiness of space. Man can live without food or water for a considerable length of time. But without oxygen he can live only a few minutes. The crew of the space station must not be allowed to run low on oxygen at any time. Rocket ships will replenish the oxygen containers of the satellites at regular intervals.

Another problem, also tied up with the elementary fact that man cannot live without oxygen, is created by the existence of meteorites. They are the most important single danger to all space-travel projects.

Unfortunately, "empty" space beyond the atmosphere is by no means completely empty. In fact, you may call it a "no man's land" in which ultra-high-speed cosmic "bullets" fly about at random. Hundreds of millions of these "bullets" of various sizes enter the earth's atmosphere every day and often can be seen as meteors or shooting stars. When a cosmic pebble the size of a pea strikes the upper atmosphere, the air resistance heats it until it burns away. This can be seen hundreds of miles distant as a bright streak or flare. Such a meteor hurtling through space at 25 miles a second would puncture more than an inch of armor plate. Very small meteors, the size of large grains of sand, could riddle the thin walls of the space station, permitting the air to escape into space.

The reason for their penetrating powers is the extremely high speed with which these tiny objects move. At an altitude of 1,000 miles, the gravity of the earth pulls them in with a minimum speed of about six miles per second—21,600 miles per hour. Most meteors, however, would strike the earth (if they didn't almost invariably burn away first) much faster than this, even if the earth had no gravity at all. The earth moves around the sun at a rate of 18½ miles per second, or 66,600 miles per hour, while many of the meteors are moving in the opposite direction, and more rapidly. Head-on collisions between the earth and a meteorite raise the observed maximum speed, as calculated from photographs, to about 45 miles per second, or 162,000 miles per hour.

* * *

A radar warning system, unfortunately, would be useless in protecting the space station from meteors. If a meteor were large enough to be detected by the most sensitive radar, it would be large enough to destroy a complete compartment of the space station. And it probably wouldn't be seen until a split second before the collision; in that short interval, we could do nothing to prevent the collision, even if the space station were as mobile as a rocket ship.

That the chance of collision is great enough to cause alarm has been asserted repeatedly by Dr. Fred L. Whipple, of Harvard University's Department of Astronomy.

Dr. Whipple has made a careful study of that question and for the last 15 years has been photographing meteors and measuring the way in which they burn away by friction in the upper atmosphere. He has calculated that an artificial satellite or space station, such as is suggested on these pages, would be punctured by a meteorite about twice a month on the average.

This hazard is far too serious to be ignored in our engineering design. It is probable that the holes made by most meteors will be small enough so that the air would take some time to escape from a single section of the station, but these minutes of grace offer no real security. Even though bells and flashing lights might warn the occupants in time for them to put on oxygen masks before the air pressure became dangerously low, only the most steel-nerved space traveler could sleep calmly, knowing that at any moment the air might suddenly disappear from his quarters.

However, engineering can do something even about the meteoric menace. One device, suggested by Dr. Whipple, is called a "meteor bumper" and consists of a thin secondary wall placed an inch or so outside the main wall of the space station or rocket ship. Incoming meteors would shatter on the outer wall, leaving the inner wall intact. If properly constructed of heavy enough materials, the meteor bumper could reduce the hazard very considerably, stopping 99 out of 100 meteors.

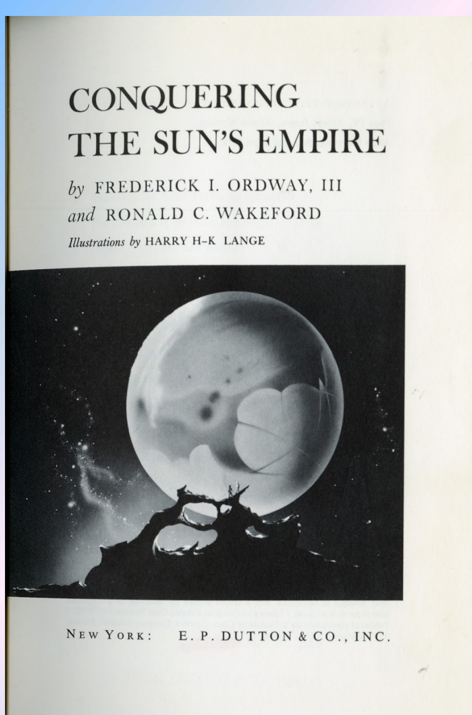
Added protection could be gained by having automatic plugging devices, similar in principle to the Air Force's self-sealing fuel tanks, between the two walls.

* * *

For the space station, Dr. Wernher von Braun, Technical Director of the Army Ordnance Guided Missiles Development Group at Huntsville, Alabama, suggests another method. Each compartment would have a small pressure gauge which would automatically close the doors in the section the moment the pressure dropped as a result of a meteor hit. At the same time, it would automatically start an emergency air blower which would build up the air pressure in the damaged section. Dr. von Braun believes that sufficient time might be bought in this way for the occupants to climb into their space suits. To find the small hole, he also suggests that a harmless colored gas be pumped into the section. This gas would immediately drift toward the opening, which could then be plugged.

But even with these safety measures, there remains a probability that once every few years a relatively large meteor will

"It is filled with truly beautiful space art by Harry H-K Lange. Mr. Lange was involved with some of the concept drawings for the film 2001 [A Space Odyssey], as well as illustrating [a] von Braun book about the history of rocketry." Source: John Sisson's Dreams of Space blog entry of June 18, 2012. This 1963 book is co-authored by Frederick Ira Ordway III.



CONQUERING THE SUN'S EMPIRE

by FREDERICK I. ORDWAY, III
and RONALD C. WAKEFORD

Illustrations by HARRY H-K LANGE

NEW YORK: E. P. DUTTON & CO., INC.

Explorers on Callisto, the second largest moon

Explorers on Miranda viewing the banded atmosphere of Uranus

Astronaut descending from his spaceship onto the surface of the Moon

Above are three more images from John Sisson's Dreams of Space blog entry for "Conquering the Sun's Empire (1963)", a book by Frederick I. Ordway III and Ronald C. Wakeford, with illustrations by Harry H-K Lange.

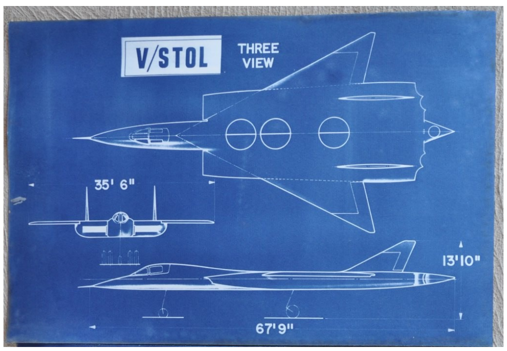
"This is… a book for high school students about man's exploration of the solar system."

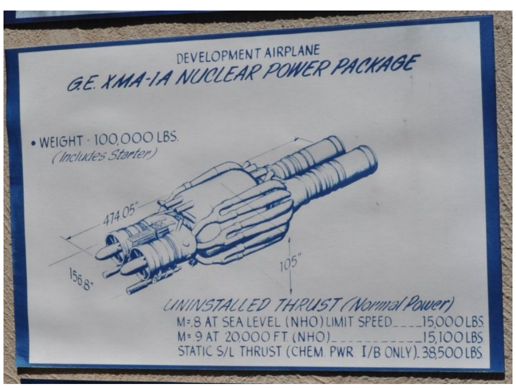
Aerospace Cyanotype Blueprints

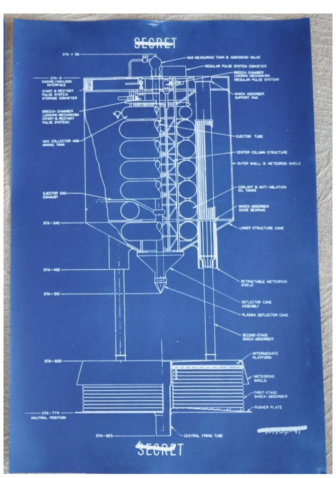
Before digital printing, before the photocopier, diagrams were reproduced via the "blueprinting" process where specially prepared paper was overlaid with a translucent hand-drawn original and exposed to either sunlight or special lamps. The "cyanotype blueprint" has long since fallen out of favor for engineering diagram reproduction, but there's no denying the aesthetic appeal.

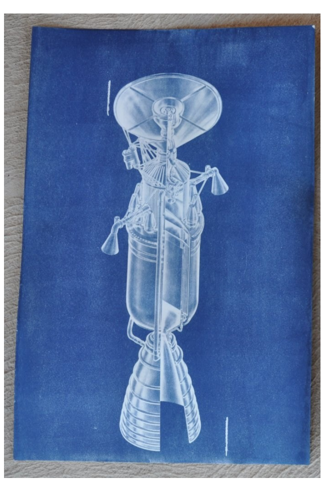
Now available are a series of hand-made blueprints, produced in the original fashion using vintage aerospace diagrams. The perfect art for any aerospace enthusiast.

Some examples:



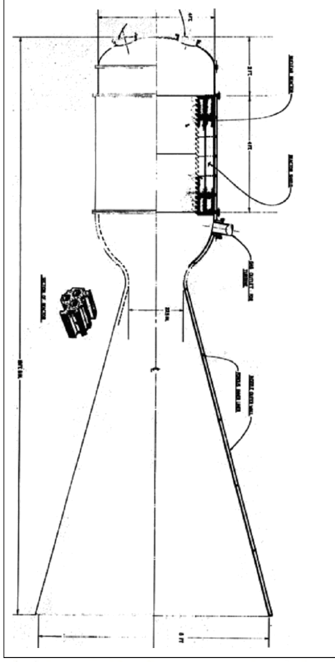






APR Corner, Mini Edition: Early Nuclear Rocket

By Scott Lowther



A North American Aviation concept for a nuclear thermal rocket: 1947. For use in 10,000 n.m. range ICBMs or SSTO vehicles. See APR issue V2N2 for more www.aerospaceprojectsreview.com

smash through both walls of the space station. What would happen to the crew in that compartment?

The air would whistle out, and there would be a rapid drop in pressure. As a result, the crew would be "explosively decompressed." Even the lungful of air the men had inhaled with their last breath would be torn from their chests. They would have exactly 15 seconds left to restore their oxygen supply, before losing consciousness; without the oxygen they would die in a few minutes.

These prospects sound grim, but things are no different today in our modern rocket-driven airplanes. Last fall, the Navy's Douglas Skyrocket—actually a man-carrying rocket craft—rose to an altitude where the air was so thin that breathing became impossible. In this respect the pilot of the Skyrocket was actually in space. He wore a pressurized space suit even though he sat in a pressurized cockpit, for he couldn't risk one of his canopy panels being torn out. If he had lost his cabin air, he would still have had enough oxygen in his airtight suit to have escaped space death.

In the early days of space exploration, it may be found safest to wear a pressure suit even in the pressurized cabin of the rocket ship. But because of the protective devices inside the space station, pressure suits might be worn there only in times of emergency. A slow leak would not be considered serious, for the crew would have plenty of time to retreat into an adjacent compartment and seal off the damaged section until repaired.

* * *

Pressure suits for use by the crew outside the space station can be made of several layers of rubberized nylon topped by a sturdy metal helmet. The helmet's window would have to be made with a darkened piece of transparent material to ward off the sun's excessive ultraviolet rays. Of course, the crew members will carry their own oxygen, and the suits will be equipped with a small air-conditioning unit for removing the exhaled stale gases.

Humidity control will also be very important. The humidity in the suit might be compared to that endured in a three-hour stay in a telephone booth on a summer day, with a temperature of 90 degrees Fahrenheit and a relative humidity of 95 per cent.

For a brief stay in space, the removal of carbon dioxide and water vapor and the replenishing of oxygen will be sufficient. But the space station must be fully air-conditioned, because a proper atmosphere must be permanently maintained.

The skin of the space station, the paint, the cargo, the complex machinery which is in constant operation and even the bodies of the crew all give off fumes. On the ground we hardly notice the smell in a machine shop, for example, because it is dissipated by air currents. However, in the space station such vapors might in time poison the occupants, if they were allowed to accumulate. Even smoking will probably be strictly rationed, partly to save oxygen and partly to avoid overloading the capacity of the air-conditioning unit.

In venturing into space, man abandons the powerful shield or filter of the atmosphere which protects him on earth from the hazards of the little-known effects of cosmic rays. These atomic bullets—which, like the meteors, crisscross space at enormous speeds—are one of the great mysteries of the region beyond our atmosphere. Scientists know they exist and believe they may be dangerous, but little other information on them has come to light.

Cosmic rays are potentially dangerous because they are related to some of the types of rays produced in atomic explosions and in the manufacture of the A-bomb. Civil defense has made the public conscious of the term "radiation sickness." Will exposure in space cause radiation sickness?

We have no clear-cut answer to this question. Cosmic rays are so powerful that they cannot be reproduced artificially in the laboratory. But, although we do not know where they come from, we do know that they are extremely rare. We can conclude, therefore, that short trips through the thin rain of cosmic rays will almost certainly be harmless affairs. A round-the-moon trip can be made without getting radiation sickness. At this time practically no information is available as to the possible ill effects of extended cosmic-ray exposure. But if it should be found that man can absorb only so much cosmic radiation with safety, frequent rotation of the space station personnel will be the answer.

Of course, long before man ventures into space, animals will be sent up in small rocket ships for the study of radiation effects over extended periods of time. A sheep, a rooster and a duck were the first living beings to take to the air in a balloon, more than 150 years ago. And it seems that more such honors are in store for the animal kingdom. Unfortunately, however, these dumb animals will be unable to communicate their experiences. So, in the final analysis, the exploration of space must await the arrival of man.

* * *

It will be, needless to say, a strange experience. And one of its strangest aspects will be the absence of gravity (except within the space station, which will provide its own "synthetic gravity" by spinning slowly to produce centrifugal force). The result of the lack of gravitational pull will be weightlessness—and there can be no doubt that weightlessness will be the most unearthly and unforgettable experience shared by those who venture beyond the earth's atmosphere. Space and weightlessness will become synonymous, like desert and thirst, or arctic and cold.

The consequences of weightlessness are being discussed in many circles of medical science, and the opinions expressed cover a wide range of possibilities. Some believe that weightlessness will be entirely harmless; others have gone so far as to predict that man can survive only a few minutes without gravity. This latter point of view, in the opinion of top experts, is almost certainly wrong.

In the first place, blood circulation will be affected only slightly. The heart pumps the blood through the body whether it has weight or not. Secondly, eating does not require the help of gravity. We can even eat "upward," while hanging head downward from a bar. Neither will the digestion be influenced.

* * *

While the machinery of the body will go on operating in an orderly fashion even if it is weightless, man will possibly encounter trouble when he attempts to go about his daily routine. Weightless man may well find himself in this position:

Imagine a muscular weight lifter taking a good grip on what he thinks is a solid 300-pound weight, but is actually a much lighter contraption made of wood. His anticipation is utterly deceived, and the ill-adjusted strength he applies, to his great surprise, throws the fake weight violently upward.

Space-faring man will consistently experience much the same thing: he will find that his co-ordination, based on a lifelong experience with gravity, suddenly fails him in this new environment. A simple movement on earth, such as rising from his chair, will, in space, jerk him across the cabin toward the opposite wall. The co-ordination of the body, which is so automatic here on earth that we take it for granted, will have to be acquired all over again.

Since the customary effects of gravity are absent, there is no "up" or "down"—a factor certain to prove confusing. Normally, we rely to a great extent on gravity for orientation. But in a rocket ship, all orientation will depend on the eyes. It probably can be acquired, but until it has been learned, there exists the possibility of "space sickness," which will reduce efficiency even if it does not completely incapacitate the crew.

Not only the men will float around aimlessly in the weightlessness of a coasting rocket ship—objects will do the same, and this will cause trouble if careful thought is not given to the design beforehand.

In space, we must use other forces to substitute for gravity. Every metal object must be made of steel, or at least have a steel strip inlaid somewhere on it. Such tools can be kept in place with magnets, along the lines of the magnetic knife board in use in many of today's kitchens. Where magnetism cannot do the job, as with papers, friction will have to substitute for gravity—the clip-board is an everyday example of such a device.

As for eating utensils, the function of the knife and fork will remain the same. The knife still cuts and the fork utilizes friction to hold food after it has been speared. The spoon, however, is useless aboard a rocket ship (and so is the fork when used like a spoon), so the well-planned table in space will include some offspring of the sugar tongs, something which will hold food by friction.

Liquids will be especially annoying; any liquid from milk to Burgundy is likely to imitate what any bottled heavy sauce does on the ground. If you tilt a bottle in space nothing will come out, for, since the liquid does not weigh anything, there is no reason for it to pour. But when you shake the bottle, all the contents will come out in one splash. The solution to that particular problem is a very old invention: the drinking straw, which does not rely on gravity but on air pressure. Another method: plastic bottles, which, when squeezed, eject liquid.

Cooking aboard the space station will not be too difficult, because the satellite enjoys synthetic gravity. However, in rocket ships it will be quite different from the same process on the ground. Open pots or pans are useless, for boiling water will simply erupt from an open pot because of the steam bubbles which form at the bottom. Likewise, the first explosive sizzle of a steak's fat will send the meat floating across the cabin. Only closed cooking pots can be used and the ideal broiler is the so-called electronic range which cooks by short wave. (Naturally, if the crew members of the rocket ship are wearing pressure suits, they will have to open the visors of their helmets to eat.)

In long rocket-ship trips from the space station to other planets, seasoned space travelers may enjoy sleeping literally on an air cushion, just floating in air, possibly with a string tied to their wrists or ankles so that the reaction of their breathing will not "float" them away.

* * *

So far, we don't know whether the familiar pressure of a bed against the body is necessary for falling asleep. If it is, it can be "faked" during the weightless state by having a set of rubber straps force the body against a board or other flat surface. Beginners, however, will have to sleep in special bunks. These will look like six-foot lengths of pipe, upholstered inside and equipped with wire mesh covers at both ends. These wire mesh covers—the "wire" would probably be nylon string and the mesh widely spaced—would keep the sleeper inside his "bed." Without them, he might push himself out of it by unconscious movements or even be sucked over to the outlet end of the air-conditioning system.

For most of us, weightlessness will hardly be an agreeable and welcome feeling, and learning to live with it may prove a painful lesson. However, man has an astonishing ability to adjust himself to extreme conditions. A few individuals may even get to enjoy weightlessness, after a fashion. The crew members will probably be able to master its intricacies and go about their daily chores with ease.

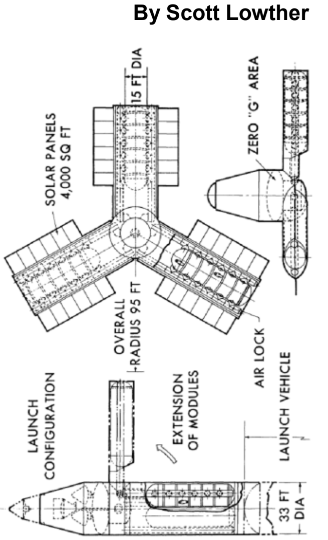
We can be reasonably certain that man will be able to survive in space because we have sufficient knowledge of what will happen to the rocket ship or space station and to man himself. We can plan intelligently for his survival. Unlike the earth's early explorers, the pioneers of space know pretty well what they are headed for, and they know that they will be equipped adequately.

The conquest of space hinges on man's survival in space. And the crews of rocket ships and space stations, while they can never be completely protected against hazards such as meteors, will probably be safer than pedestrians crossing a busy street at a rush hour.

THE END

APR Corner, Mini Edition: Radial Module Space Station

By Scott Lowther

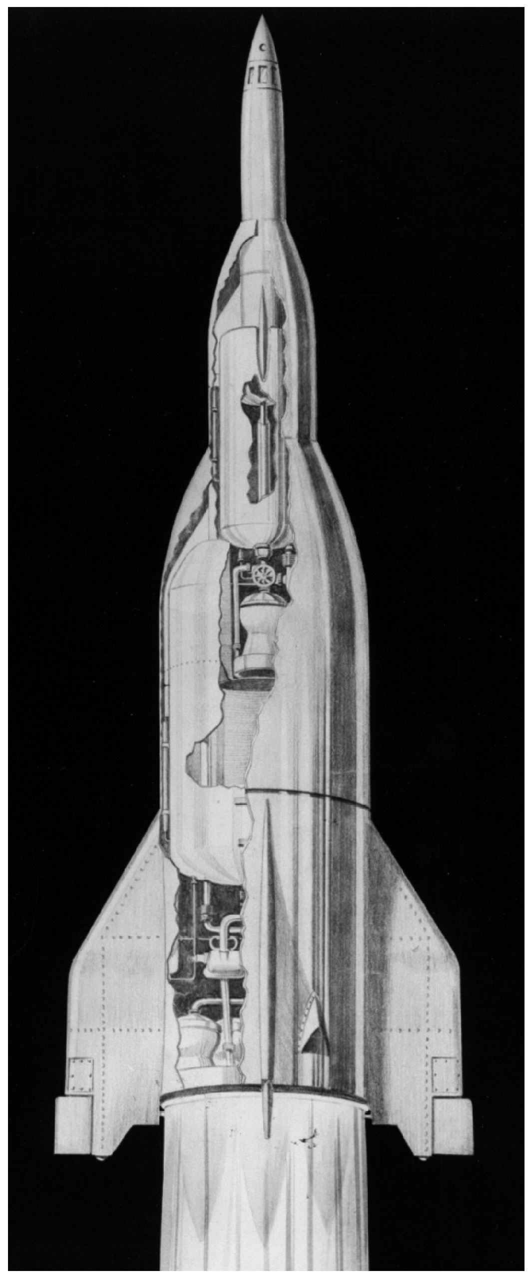


NASA concept for artificial gravity space station, ca. 1963. This would be launched by a single Saturn V. See APR issue V1N6 for more www.aerospaceprojectsreview.com

APR Corner, Mini Edition: A-9/10/11

By Scott Lowther

Werner von Braun had plans for more advanced versions of the A-4 ("V-2") rocket during WWII. The A-4b, for instance, was to have stubby wings that would increase range via gliding. The A-9 was to be the second stage of an ICBM, with the all-new larger A-10 1st stage. After the war, von Braun claimed to US Army interrogators that he had even further plans… the A-11 would go under the A-9/10, putting the A-9 into orbit; the A-12 would go under the A-11 and orbit an A-10 modified into a reusable shuttle. While there is virtually no evidence of these designs having been any more than vague notions during wartime, in 1946 at Ft. Bliss von Braun directed the artist Gerd de Beek (an illustrator at Peenemunde) to create a cutaway painting of the A-11. A few particulars for the A-11 and A-12 were produced, though apparently no illustration of the A-12. The numbers given for the A-12 turn out to be virtually identical to those of the *Collier's* Ferry Rocket, providing a heritage from the V-2 to the Ferry Rocket.



More information on A-4 derivatives including the A-8, A-9, A-10, A-11 and A-12 can be found in issue V5N6 of *Aerospace Projects Review.* www.aerospaceprojectsreview.com

Mars, at its closest 35,000,000 miles from the earth, as seen from its outer moon Deimos, where man could land before going on to the planet

Who Owns the Universe?

By OSCAR SCHACHTER

Deputy Director, Legal Department, United Nations

The approaching age of space travel poses legal problems that lawyers already are grappling with. The freedom-of-the-seas principle may solve some of them

WE HAVE all heard about attempts to sell real estate on the moon and have laughed at the poor suckers who bit. Indeed, to say that someone wants the moon means simply that he wants the impossible. But now that scientists have shown that man can conquer space and that new worlds lie within his reach, the question of "owning" the moon and the planets no longer seems to be so much of a joke. Today, the question is not at all farfetched and, in fact, it may well have important consequences for all of us.

Of course, the real issue is not whether private individuals may sell real estate on the moon or go into business outside of the earth. The serious question, like so many others today, concerns national governments and their respective rights and powers. Will these governments claim "ownership" (or, more correctly, sovereignty) of the moon and other celestial bodies, just as today claims are being made to the barren wastes of the antarctic? Will there be national rivalry to plant the Stars and Stripes, the Union Jack and the Hammer and Sickle far off in space, so that the governments can then assert exclusive control and keep others away?

And what of rocket ships and space stations? What rules will govern them and, most important, will they be free to move about high above peaceful nations, laden with weapons of mass destruction? In this time of international tension, it may not be too soon to think about these questions.

Where can one find principles and precedents to answer these problems? Interestingly enough, we have to go back four centuries, to the great age of exploration and conquests, when Columbus, Magellan, Vasco da Gama and the Cabots found and claimed new worlds for their royal sovereigns. It was these colorful adventurers, hunting for treasure and glory, who set the scene for the development of new legal principles— indeed, of the whole new system of international law that was to govern the relations between independent nations for centuries thereafter. The reason for this was that the discovery of these new territories immediately presented political and legal issues.

The great maritime powers of that day, Spain and Portugal, had to find a method of settling their claims to avoid war. With the advent of British sea power, further adjustments had to be made. There was the obvious problem of deciding who was to exercise sovereignty over the new areas. (The lawyers referred to these regions as *"terra nullius,"* that is, land which belonged to no one.) Was it enough that the navigators made the initial discovery and then sailed away after planting the royal emblem? Or was it necessary that there be an occupation, at least a small settlement, in order to acquire dominion over the newly found region? And, finally, could the seas themselves be claimed as national territory?

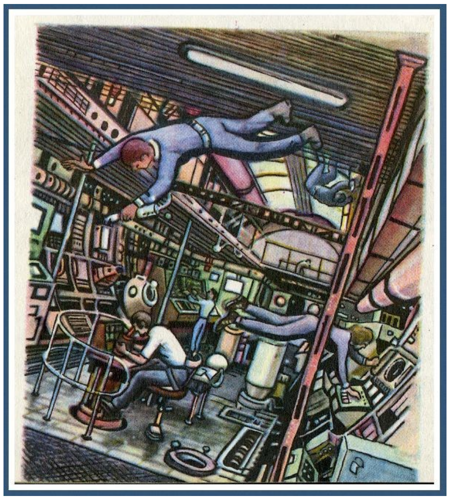
At first, it was thought that these questions could be settled through the authority of the Pope. Almost immediately after Columbus' discovery, the famous Papal Bull of 1493 was issued, dividing the world between Spain and Portugal by a meridian line running a hundred leagues west of the Azores, through both poles. What *(Continued on page 70)*

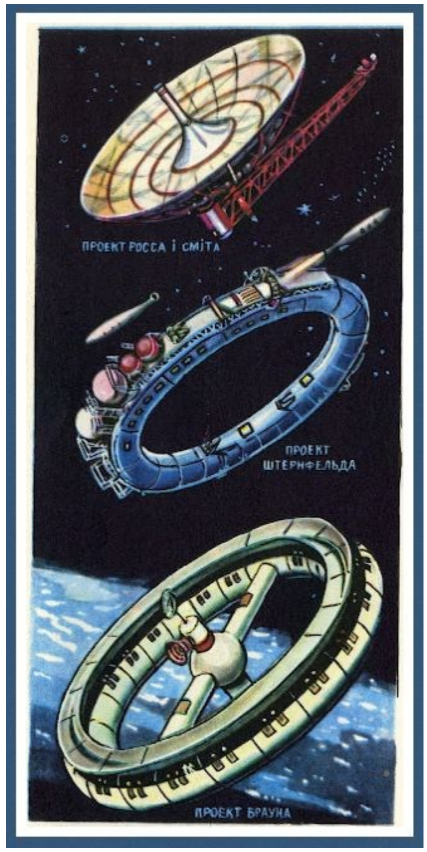
PAINTING BY CHESLEY BONESTELL

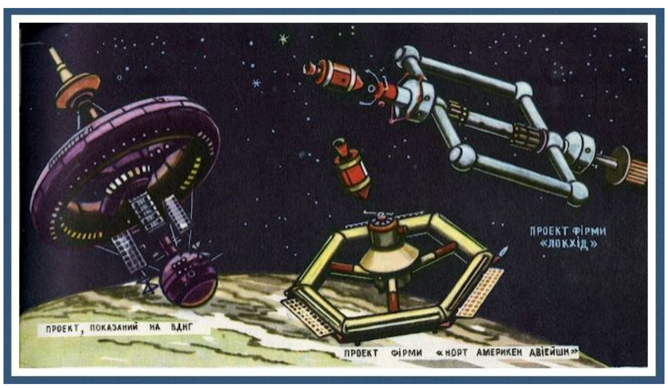
Dreams of Space - Books and Ephemera

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

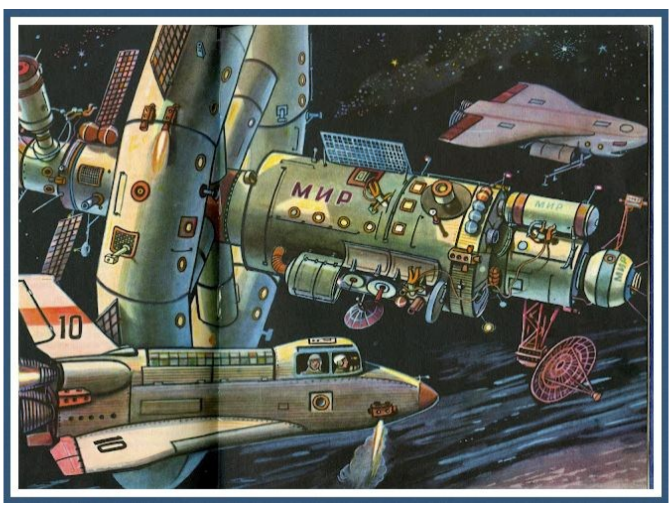
http://dreamsofspace.blogspot.fr

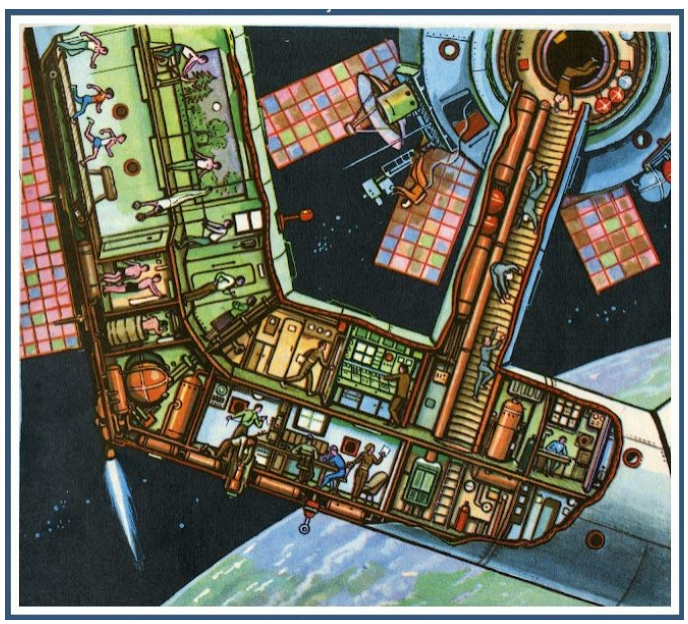






These are a few of the images from John Sisson's Dreams of Space article about this1975 Russian (1979 Ukrainian) book, "Home on Orbit."

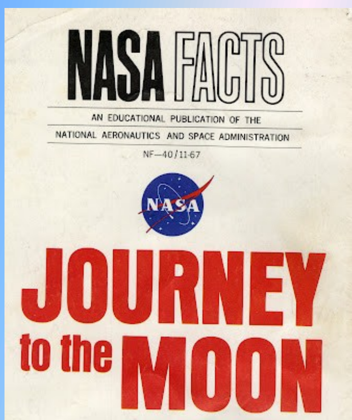




The blog entry of July 20, 2012 from John Sisson's Dreams of Space presents:

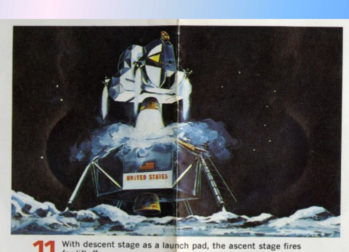
Journey to the Moon
NASA Facts 40-11/67 (1967)

"The paintings are beautiful [examples] of what they expected to see."




9 One astronaut remains in lunar orbit while two land on the moon in the lunar module.


10 The two astronauts explore the moon, obtain samples and place instruments.



11 With descent stage as a launch pad, the ascent stage fires for liftoff.

Who Owns the Universe?

CONTINUED FROM PAGE 36

is probably most significant about this papal bull (and others like it) was that it introduced the notion of law to the problem of new territories. It was based on the assumption that sovereignty was not just a matter of naked power or, as it has been called, of the "divine right of grab"; at least there had to be a legal basis.

However, the papal bull did not settle the actual problem. England for one, as a Protestant country, did not accept it; moreover, English freebooters like Sir Francis Drake and Sir John Hawkins soon made a mockery of Spanish claims to dominion over the seas. With the victory over the Armada, all claims to exclusive ownership of the high seas by Spain were effectively ended. The significant result was the development of the principle of freedom of the seas, a fundamental feature of international law, and one which has contributed greatly to the peace and economic development of the world.

In regard to the land, as in the case of the sea, the decree of the Pope was not a final settlement, but only the beginning of the development of rules of law. Both Spain and Portugal were soon obliged to justify their claims by legal principles. It was then that new rules emerged which were to decide what countries were to govern the new territories.

What were these rules? Perhaps the most important was that the mere discovery of new territory was not considered sufficient to confer sovereignty. Even extended exploration was not enough; nor did the giving of names to portions of the lands or waterways make any difference. It was, however, agreed that if a country effectively occupied new territory, through settlement it acquired sovereignty. Thus Columbus felt obliged to leave some of his crew on the island of Hispaniola (Haiti) to justify legally the Spanish claims.

* * *

But it is important to note that settlement was not always essential. In many cases, claims rested merely on certain symbolic acts of possession. The French and Portuguese would erect crosses or monuments bearing the royal arms. The Spanish and English used more elaborate ceremonials, usually a whole ritual, to denote the formal taking of possession. For example, the English sometimes used a "turf and twig" ceremony, taking from the land a clod of earth and a twig as tokens of acquiring ownership. The Russians also employed symbolic acts, such as burying copper plates bearing their coat of arms in the Aleutian Islands and the Alaskan coast. These various rituals were generally considered effective, though it is by no means certain that they would be accepted today.

In recent years there has been further development. The emphasis has shifted from the taking of physical possession and settlement to displaying the authority of government in a practical way. The whole problem is presented sharply today in connection with claims to the antarctic region. This great area has been claimed by a number of nations on the basis of exploration and display of governmental authority. But so far none of these claims has been accepted and the controversy remains unresolved.

The dispute over the antarctic shows how the principles of law developed in the period of the discovery and exploration of America have their effects today. Moreover, the controversy foreshadows the conflict that may arise when the first rocket ships reach the moon and other celestial bodies.

Governments will, of course, tend to think and act in terms of their own particular interest; they will normally use past practice to further their special claims. If this pattern is followed, we may expect to see that the first landings on the moon will involve all sorts of acts intended to support claims of sovereignty. Obviously, the flag will be planted and, very likely, names will be given to places on the moon (though astronomers have already named the larger lunar features). We might then be reading of lunar "Washingtons" and "New Yorks," perhaps of King George mountains and Stalin craters.

In place of the old ceremonials with crosses and coats of arms, scientific instruments might be left behind, and these might be regarded as having symbolic as well as practical value. Finally, there might be attempts by governments to exercise control, perhaps even to issue licenses, and to claim the right to exclude those who are not licensed. All of this would be the old story of territorial rivalry—but this time extended into the heavens themselves.

We may well ask whether this is the only way governments can deal with the problem. Would it not be possible to by-pass the whole problem of national sovereignty in outer space?

The answer to this might be found in the analogy with the system governing the high seas. We have already seen that at one time governments maintained that the open seas as well as the land belonged to them. These were not just theoretical claims; they were enforced by men-of-war. Passage was often prohibited and tolls were levied. It was not until the time of Queen Elizabeth I that this system was challenged.

When the Spanish ambassador lodged a protest against Francis Drake's voyage to the Pacific in 1577, Elizabeth rejected the protest, declaring that the sea, like the air, was common to all mankind and that no nation could have title to it. The Dutch (like the English, a rising maritime and commercial power) also flouted Spanish and Portuguese claims. Their jurists, including Grotius, the father of international law, argued that the sea was common property and that all peoples were to use it. Gradually this idea prevailed.

Why not extend the same principle, now applicable to the open seas, to outer space and the celestial bodies? These areas would then be considered as belonging to all mankind, and no nation would have the right to acquire any part of them, any more than a nation now has the right to acquire parts of the open sea. The whole idea of national sovereignty outside of the earth would thus be eliminated.

But it might be asked whether this would not result in a state of anarchy, with no rules or restraints whatsoever. The simple answer to this might again be drawn from the analogy with the high seas. Obviously, the open sea is not in a condition of lawlessness; it is, in fact, subject to law, although not to the authority of any single nation.

Similarly, laws would have to be developed to apply to outer space. Certainly a principal object of such laws would be to encourage scientific research and investigation. Thus, there would be the idea of free and equal use rather than exclusive use. Space travel, like navigation on the seas, would be permitted to everyone, no matter what country he came from or under what flag he traveled. In general, interference with such travel would be prohibited and governments would not have the right to appropriate portions of space.

* * *

There might have to be exceptions to the general principle that outer space is completely free and cannot be appropriated. Perhaps governments might be given the right to own and maintain scientific installations, just as today countries are permitted to have lightships and weather stations permanently installed on the open seas. Suppose also that valuable mineral deposits are found on the moon or a planet—would there not have to be a rule permitting countries to exploit these resources when they have discovered and developed them? True, this would be a departure from the idea of free and equal use, but on the other hand it would be quixotic to declare that valuable minerals found and developed by one country should be available to anyone and everyone.

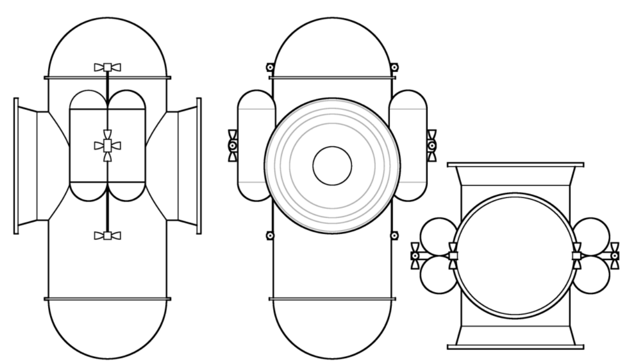
A more immediate problem is presented by the rocket ship itself. When we consider the possible uses of such ships, all sorts of questions arise. Will they be permitted to move about, free from the authority of any particular country and free of any other restraints? One might, for instance, envisage a space station high above the earth equipped to send radio or television signals to the earth. Would that satellite, therefore, be free of all the regulations, both international and national, which safeguard the public interest in this field? And if control is to be exercised, how should it be made compatible with the principle of freedom of outer space which we have urged?

The best way to meet this problem, it

APR Corner, Mini Edition: GD Space Taxi

By Scott Lowther

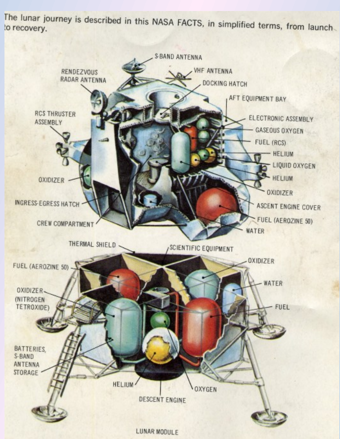
A 1964 General Dynamics "space taxi," similar to the space taxi illustrated more than 10 years earlier in the *Collier's* series. It was a minimal spaceship that would allow crew to transfer between spacecraft without docking the ships or donning spacesuits. Two versions designed… a -man taxi ~9.3 ft tall and a 2-man craft ~11.4 ft tall.



We continue with this blog entry of July 20, 2012 from John Sisson's Dreams of Space:

Journey to the Moon
NASA Facts 40-11/67 (1967)

"On the backside of the [poster] is an enormous painting which I could only scan in pieces. Whether you were alive to see it or are only looking back, it was an awesome moment in the history of the human race and sets us all to dream of what might be possible."



seems to me, is to begin with the idea that each space craft must bear the flag of a particular country; that is, it must have a nationality (perhaps, as an exception, there might be some space craft which could belong to an international organization). If a ship tried to evade this rule, it would be in the same position as a pirate of old and it would be subject to seizure by any government able to lay hands on it.

By requiring that each space craft have a nationality and a flag, it becomes possible to supervise them and control them. They then become subject to the discipline and the laws of the flag-state. If they failed to comply with those rules, they would become subject to penalties. At the same time, the government whose flag they fly would have to guarantee the proper use of the craft. The flag would also protect them against any abuses from other governments.

Since the craft would be mainly subject to national rules, it would be desirable that these have common features. By way of illustration, there would have to be agreement regarding signals for radio communications and similar matters. For the most part, however, the regulation would be left to the government whose flag the craft bears. That government would, in the first place, decide whether the craft was entitled to bear its flag. It would also determine the authority which the captain would exercise; it would provide for the safety of the personnel aboard and it would define and punish criminal acts. To a large extent these rules would be similar to those applicable on the high seas and many questions could be decided simply by referring to the law governing vessels at sea.

Let us return to the example of the space station engaged in broadcasting radio or television programs. In the first instance, the regulation of that station would be carried out by the country to which it belongs. Thus, an American television station operating in outer space presumably would be subject to the authority of the Federal Communications Commission. Perhaps new regulations would have to be devised to meet engineering problems which might arise; but, in any case, it would be clear that a station would not be free to evade control by its own government.

* * *

A much more difficult problem would be presented by a rocket ship or space station devoted to military purposes. In this case, the analogy with the high seas may be questionable. The high seas, as we well know, may become a theater of war and, generally speaking, there is no prohibition against belligerent vessels utilizing the open seas for warfare. However, when one conceives of a rocket ship or space station operating far above the earth with bombs of mass destruction, there can be little doubt that the potential danger to mankind would far exceed that which could be caused by a ship of war on the high seas.

This factor may lead to a demand that the use of outer space for military purposes be outlawed. But whether space craft as implements of warfare should be considered separate from other questions of security and disarmament might well be a controversial question in this period of international tension.

Although we have been talking about outer space, we have said nothing about where outer space begins; or to put it in another way, how far up does the territory of a country extend?

Now, this is not a brand-new question. In ancient Roman law, the landowner was considered to own the space above the land upward "to the heavens." But the idea of a private landowner owning all the space above his land has long been abandoned. Today, a man no more owns the air above his land than a man with a house on the seashore owns all the sea in front of his house. However, in contrast, it is well established that a nation does own the space above its territory. This principle obviously has considerable importance in regard to aviation. Thus, when governments entered into treaties relating to aviation they declared that "every power has complete and exclusive sovereignty over the airspace above its territory." This is accepted in international law.

Now, what does the term "airspace" mean in this sense? Does the term "air" extend only to the upper atmospheric regions? Should it be defined in terms of the composition of the gases or their density? So far there has been no authoritative answer to this question. The reasonable answer, it would seem, is to consider that the term is used in aviation treaties and therefore it is presumably intended to refer to the part of the atmosphere which contains enough air to allow aircraft (including balloons) to fly. Up to now balloons have gone as high as 21 miles, but it is estimated that air sufficient for flight extends about 60 miles above the earth. Beyond that there is no airspace so far as aircraft are concerned.

Whatever may be the precise boundary of the airspace, it is clear that when we go beyond it we are legally in a no man's world. The whole idea of national territory above the "airspace" would be based on a theoretical and fanciful notion, without any practical application.

* * *

It has been proposed that the upper territory be limited in terms of a country's power to exercise effective control. Presumably, this means that if a state can "control" *(i.e.,* stop) the flight of another nation's rocket at a certain distance, then territorial sovereignty should be limited to that distance. This position has been put forward by a distinguished authority, Mr. John C. Cooper, the director of the Institute of International Air Law. He has proposed "that at any particular time, the territory of each state extends upward into space as far as the then scientific progress of any state in the international community permits such state to control space above it."

It is interesting to note the resemblance between this approach and the old three-mile rule which has fixed the area of a country out into the ocean. This three-mile rule was also based on the idea of effective control—in particular, on the range of shore artillery batteries. At the end of the eighteenth century, these batteries had a range of about three miles, and therefore it was considered that that portion of the sea was within the control of the state.

Although the principle of effective control has been important in international law, one wonders whether it should be applied to this new problem of space travel. It would seem to mean that whenever a country could prevent or interfere with the movement of a rocket ship or space station it would have the legal right to do so. Would this not, in effect, simply be a rule that "might makes right"? And would it not place rocket ships and space stations at the mercy of those national states which would be able to interfere with their free passage?

There certainly does not appear to be any compelling reason in law or principle to carry national sovereignty this far. Indeed, any attempt to extend national territory higher than the airspace is bound to involve difficulties. Why not, then, fix the limit at the upper boundary of the airspace and no higher?

Beyond the airspace, as already noted, we would apply a system similar to that followed on the high seas; outer space and the celestial bodies would be the common property of all mankind, and no nation would be permitted to exercise domination over any part of it. A legal order would be developed on the principle of free and equal use, with the object of furthering scientific research and investigation. It seems to me that a development of this kind would dramatically emphasize the common heritage of humanity and that it might serve, perhaps significantly, to strengthen the sense of international community which is so vital to the development of a peaceful and secure world order. THE END

...SPACE QUIZ

The fascinating aspects of man's study of space are—like space itself—infinite. Naturally, not every one of them could be incorporated in this symposium. However, some of the most intriguing questions which arose during the preparation of this issue, and the answers provided by the scientists who participated in it, are listed below

Q. ***Is interplanetary travel possible?***

VON BRAUN: Certainly, once we have a station in space that would enable us to take off refueled and unimpeded by the earth's atmosphere. Although Venus is the closest planet (26,000,000 miles when it swings toward the earth), the easiest interplanetary trip would probably be to Mars (35,000,000 miles), since either of its two moons is close enough to serve as a space station for the return voyage. To land on Venus, we would have to establish a temporary space station around it. Traveling at the most economical speed, a rocket could make the one-way trip to Mars in 258 days, or to Venus in 146 days.

Q. ***Have any living creatures already been rocketed into space?***

LEY: Yes. It has been announced that certain plant seeds and specimens of the fruit fly (the species *Drosophila melanogaster,* widely used in experiments in genetics) were sent up in V-2 rockets a few years ago. They made the trip unharmed. It seems reasonable to assume that larger creatures have been rocketed past the atmosphere since then.

Q. ***How large can we expect the meteorites to be which will endanger space travel?***

WHIPPLE: They will vary in size from pellets much smaller than a grain of sand (the tiniest of these are called cosmic dust) to monstrous—and, fortunately, rare—affairs that might be termed "flying mountains." The largest meteorite on exhibit anywhere in the world is the Ahnighito, found in Greenland, which is on display at New York's Hayden Planetarium and weighs at least 35 tons. But there is one embedded in the ground at a place called Hoba West, near Grootfontein, South-West Africa, estimated by some to weigh as much as 60 tons. Cosmic dust will not pose a real threat in space, but it will be a nuisance. For although it will not be able to puncture the walls of a space station or rocket ship, it will slowly sandblast all windows continuously exposed, making them more and more difficult to see through. The solution might be transparent plastic window coverings, which could be discarded when rendered useless by the tiny meteorites.

Q. ***What are some of the unsolved hazards that man will encounter in space?***

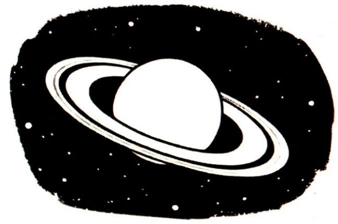
HABER: Granting that scientists have found a workable solution for the menace of meteorites, the greatest remaining hazard is that of the mysterious cosmic rays—nuclear bullets like those released by the atomic bomb, which streak unpredictably through space. To bar them entirely from space craft would require an extremely thick wall of lead or an armor of nickel-steel at least two inches thick. Either of these would be prohibitively heavy. Fortunately, although no one knows how dangerous cosmic rays are, many experts are quite optimistic. Another unsolved hazard is a psychological one: men cooped up in small rocket ships, on long trips through space during which there is little to keep them occupied, will suffer from such severe boredom that it may become a very important factor in space travel. There are lesser problems, too, of course, but in all probability most of the hazards of space will be solved by the time construction of the first space station is completed.

Q. ***Since some of the planets have no atmosphere, is it possible that someday we may lose ours?***

KAPLAN: Not unless two very unlikely events occur: (a) if the earth inexplicably loses much of its weight (and, therefore, much of its gravity); or (b) if we move closer to the sun. The more heat the sun pours into the molecules of air that comprise the atmosphere, the faster the molecules move; the faster they move, the more they tend to break away from the gravitational pull that keeps them close to the earth. Those heavenly bodies which lack atmosphere—like the planet Mercury, and all the moons of all the planets, except for Titan, the largest moon of the planet Saturn—lack it because their gravitational pull is too weak.

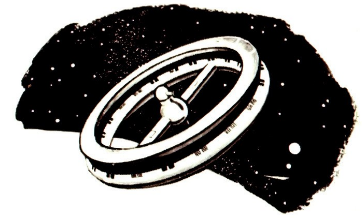
Q. ***What special training, if any, will space travelers require?***

HABER: They will have to be both physically sound and well informed on pertinent subjects. Besides a complete physical checkup, they probably will have to undergo tests to determine their reaction to acceleration and to weightlessness. One important requirement will be familiarity with the theory of space travel; another will be a reasonably good education in astronomy. As knowledge of space travel progresses, special tests for space aptitude doubtless will evolve; meanwhile, most of the early spacemen are likely to be pilots who have flown in jet or rocket airplanes, who are in good health, who have the necessary theoretical knowledge—and who are sufficiently versatile to deal with the wide range of problems likely to be encountered in space.



Q. ***From what places in the world could a rocket ship be launched into space?***

VON BRAUN: There are a number of places which might prove practical. The requirements are simple: any seacoast with 1,000 miles of water in an easterly direction—so that the rocket, which must be launched into space toward the east, could drop its two booster stages over water—would be satisfactory. That description applies to countless islands in various oceans; to the whole east coast of both North and South America; much of the east coast of East Asia; the east coast of the Japanese Islands; the east coast of Madagascar and Africa; and the east coast of both islands of New Zealand, plus part of the east coast of Australia (only part, because in some places either New Zealand or the Great Barrier Reef might interfere). However, it would be desirable to have islands a few hundred miles east of the launching site, from which the vessels could operate which retrieve the two booster stages. That would further restrict our choices.



Q. ***How about rocket travel on earth?***

LEY: Plans for long-range rockets which could travel between two distant points on earth have been developed by various scientists. The latest proposal, for a trip between Los Angeles and New York, is that of Dr. Hsue-shen Tsien of the California Institute of Technology. His winged rocket would rise to a top altitude of more than 300 miles, being powered for only the first third of the climb. Then it would swoop down until it reached an altitude of 27 miles, some 1,200 miles east of its take-off point; the remainder of the trip would be a supersonic glide at that height. Here are some of Dr. Tsien's figures: take-off weight, 50 tons; duration of powered flight, 150 seconds; duration of entire flight, one hour; landing speed, 150 miles per hour. Although such a rocket could be developed now, it is doubtful that a coast-to-coast rocket line would be commercially feasible at present.

Q. ***What is the temperature in space?***

KAPLAN: There isn't any. It may be hard to imagine, but since space is a vacuum it lacks temperature entirely (a vacuum is "nothing," and "nothing" cannot have a temperature). A rocket ship near the orbit of the earth would, however, have an internal temperature determined by the amount of heat it absorbed from the sun (93,000,000 miles away) on one side, and the amount of this heat it lost on its shaded side. This can be controlled to a certain degree. If the ship were of a dark (heat-absorbent) color, it would assume a temperature of about 60 degrees Fahrenheit. If its color were lighter, the temperature would be lower. And if the ship were nearer the earth, it would be somewhat warmer—because it would catch additional sunlight reflected from the earth.

Q. ***Will atomic energy be used to power a rocket ship?***

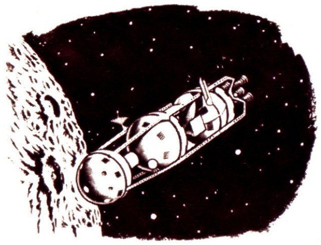
VON BRAUN: Not for some time to come. Atomic power is being developed for submarines and is

Around the Editor's Desk

planned for airplanes, but in both these cases an atomic "pile" will merely substitute for part of the conventional engine; actual propulsion will still be the work of a propeller. In a rocket ship, the rocket does its propelling by ejecting powerful gases behind it. Even if a new method of space propulsion is found, permitting the use of atomic power, an additional problem will be the heavy wall of steel or lead required to protect the crew from radiation. Furthermore, an atomic rocket motor will never be practical for launching rocket ships from the earth, because of its radioactive exhaust. In any event, we need not wait for atomic-powered rockets; known chemical fuels will do the job.

Q. ***Would the artificial air pumped into a space station or the cabin of a rocket ship have the same composition as the air that men breathe on the earth?***

LEY: As part of the necessary protection against meteorites, helium may prove a desirable substitute for the 80 per cent of nitrogen present in the air we normally breathe (the other 20 per cent could continue to be oxygen, as it is on the earth). If a meteorite punctured the skin of a space station or rocket ship, the resultant drop in air pressure would be hazardous even if the loss of oxygen could be countered by wearing masks. Like deep-sea divers brought to the surface too fast, the space-men might suffer an attack of "the bends"—an often fatal affliction caused by the fact that some of the nitrogen we breathe forms painful and dangerous bubbles in the blood when the pressure drops suddenly outside the body. Helium does not dissolve easily in the blood stream. The Navy has tested a helium-oxygen mixture in deep-sea diving with good results.



Q. ***Considering the complicated problems posed by travel in space, how could a guided missile be fired accurately from a satellite to earth?***

VON BRAUN: The principle would be much the same as that used to fly a rocket ship from space to earth. As our space station circled the globe, the missile would be launched *in the opposite direction.* The reason is this: if the missile were simply detached from the space station, it would continue circling the earth, just like another satellite in the same orbit; if it were fired in the same direction as that in which the station was moving, it would fly off farther into space. Only if fired "backward" would it lose sufficient speed, in relation to the earth, to descend from the orbit. It would leave the station at a speed of 1,048 miles per hour; at the time it was fired, the target at which it was aimed probably would be invisible, located on the back side of the spinning earth below. The weapon would enter the atmosphere on a course roughly paralleling the surface of the earth; its position and relationship to the target (when it finally came into view of the satellite) would then be determined by radar. Remote radio control would guide the missile to its destination. Naturally, the guided projectile would not be slowed down further for its "landing," in the way that a rocket ship would be as it came close to the earth. Instead, the weapon would approach the target moving faster than the speed of sound. No place on earth, from pole to pole, would be safe from such a weapon fired from a satellite in space.

Q. ***To what tribunal would questions of space law be referred?***

SCHACHTER: A dispute in space that involved two or more governments could be submitted to the International Court of Justice at the Hague, just as international disputes are today. Naturally, precedents in such a case would be difficult to determine; but the court could apply rules expressly agreed to by the contesting governments. If no such agreement could be reached, international custom or the general principles of law might provide a guide. Alternatively, the governments might submit the case to a special court set up just to decide that one dispute. In a dispute between individuals, rather than governments, jurisdiction might lie with a local court in the place where the individuals normally lived, or perhaps with a court where the space station or rocket ship involved was registered.

Q. ***What, specifically, would be bought by the $4,000,000,000 estimated as the cost of establishing a station in space?***

VON BRAUN: The great bulk of the money would be spent for experimentation, testing, construction of a fuel-producing plant, and other preliminaries to a permanent space program. Once the initial phases of the program had been paid for, costs would drop abruptly. For example, it would be necessary to make special high-altitude test shots with unmanned rockets before actually proceeding with the establishment of a space station. This might involve constructing and firing into space a small version of the three-stage rocket that promises to be the main space vehicle of the immediate future. This small model would be sent into the "two-hour" orbit later to be occupied by the artificial satellite; instruments inside the rocket, employing methods already in use, would transmit vital information back to earth. The fuel to be used in our projected space travels would consist of nitric acid and hydrazine; the first of these ingredients is being mass-produced for commercial use, but special factories would have to be built to manufacture the hydrazine, which has little commercial application at present. In short, the $4,000,000,000 would buy everything from the paper on which the experts did their initial calculations to the circling space station itself. Perhaps a dozen cargo-carrying rocket ships would be needed to carry the components of the station to its orbit around the earth; thereafter, presumably, production of rocket ships would continue. As an indication of how expenses would drop once the project was under way, the ultimate cost of these rocket-powered vehicles probably would be less than $1,000,000 each—no more than the current purchase price of a large air liner.

Q. ***Is there life on other planets?***

LEY: Most astronomers agree that there is primitive plant life, like lichens and algae, on Mars. The presence of this potential food supply has led a number of biologists (although not all of them) to conclude that there may be some form of animal life there, too. It is very doubtful that life of any kind exists on the other planets, however. The five which are farthest from the essential warmth of the sun—Jupiter, Saturn, Uranus, Neptune and Pluto—are much too cold to support life as we know it. Venus, which is closer to the sun than we are, is considered too hot. Peculiarly, Mercury, which is closest of all to the sun, offers the only other possibility of life. That's because Mercury keeps one face turned constantly toward the sun, just as our moon shows only one side to the earth. The "daylight" side of Mercury is extremely hot—hot enough to melt lead. Its "night" side is correspondingly cold. However, these two extremes are separated by a so-called "twilight belt," where temperatures approach those of the earth and Mars. It is just conceivable that life may have taken hold in that dim, narrow strip between the unbearable heat of Mercury's daylight and the terrible cold of its night.

Q. ***Would Soviet Russia enjoy any advantages in a race for space superiority?***

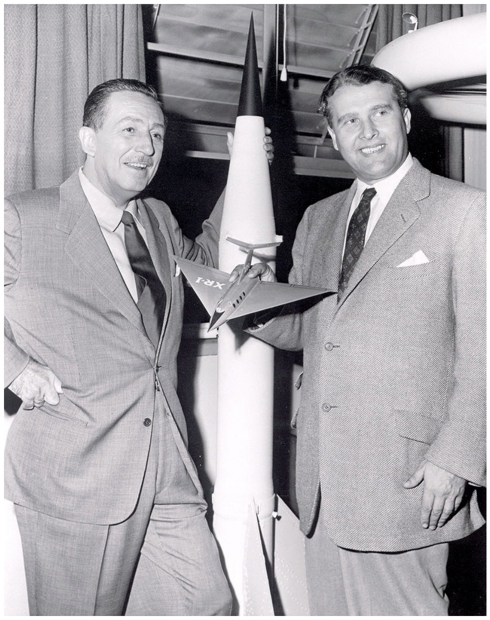
VON BRAUN: Just one advantage of any importance, so far as is known. Because the country is huge, and barricaded behind the Iron Curtain, the initial phases of a space program could be kept secret much more easily in the Soviet Union than in the Western World. One other advantage *may* exist: the Soviets claim a head start. There is no way of telling whether that is true. Obviously, there are several conditions which must be met before any nation could establish a satellite in space, and thus assume space superiority. First, of course, that country would need trained rocket researchers. Whether the U.S.S.R. has such scientists in any number (and of sufficient caliber) is uncertain. Of the experts who gave Germany its enormous lead in rocketry during World War II, only one, Helmuth Groettrup, is working for the Soviet Union; several are employed by the United States. Another major requirement is a highly diversified industrial economy; in this respect, the United States is certainly far advanced over Soviet Russia. Finally, in the matter of the necessary natural resources, it is doubtful that either side has an advantage. The raw materials needed for a space program are fairly common and probably are as easily available in the U.S.S.R. as in the West. Summing up, the advantage in the competition to conquer space probably rests with us—if we move quickly.

DRAWINGS BY LOWELL HESS

Collier's 3/22/52

We noticed this recent blog entry about Man Will Conquer Space Soon!:

http://blogs.smithsonianmag.com/paleofuture/2012/07/wernher-von-brauns-martian-chronicles/



Right: Walt Disney, left, and Wernher von Braun, right. Dr. Werhner von Braun, then Chief, Guided Missile Development Operation Division at Army Ballistic Missile Agency (ABMA) in Redstone Arsenal, Alabama, was visited by Walt Disney in 1954. In the 1950's, von Braun worked with Disney Studio as a technical director, making three films about space exploration for television. A model of the V-2 rocket is in background. 1 January 1954. Image source: Wikipedia. Image credit: NASA.

Right: This note is from page 90 of the March 22, 1952 issue, the first of eight issues of Collier's in this series. Image credit: Douglas Yazell. Thanks to UNZ.org for making this page visible to everyone.

***Collier's Editorials** normally appear on this page. This week, however, our editorial– dealing with the need for immediate federal action on a projected station in space– is an integral part of the special symposium on space travel that is a feature of this issue. It will be found on pages 22 and 23.*

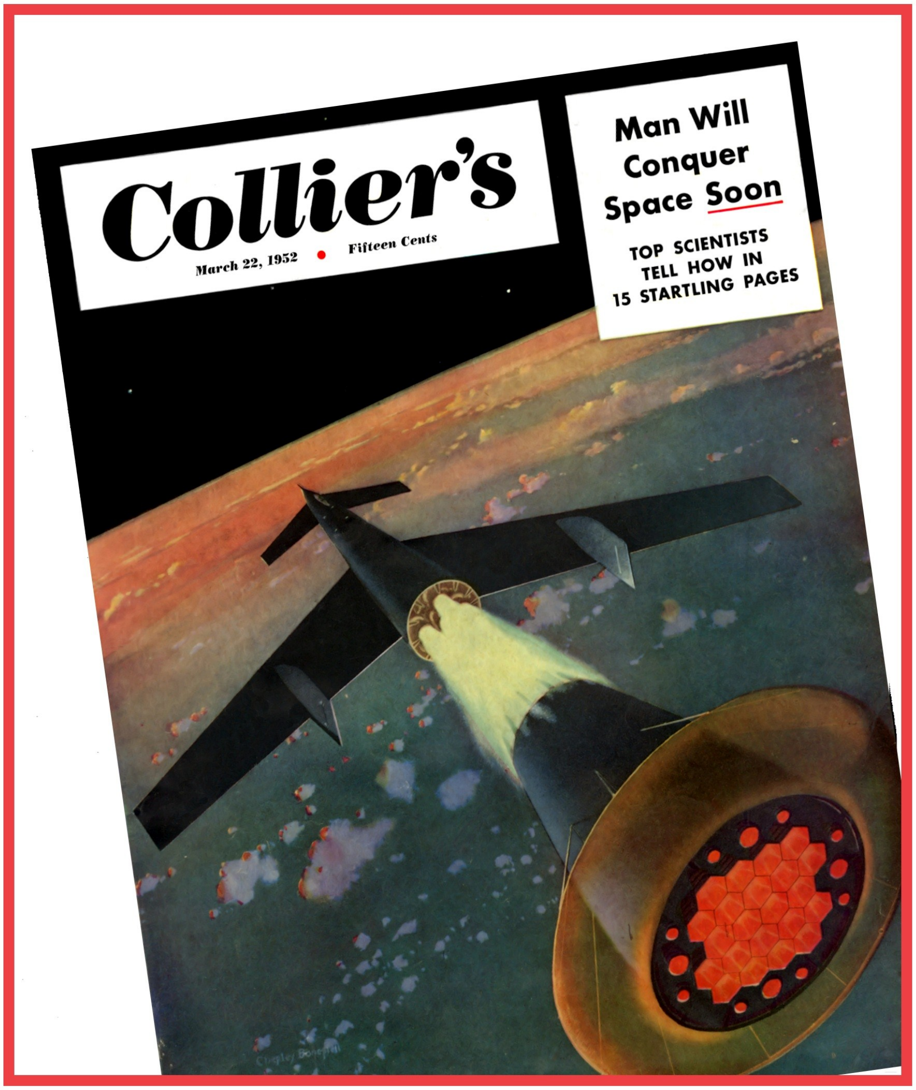
Right: A recreation of "The Cover," a text box from page six of the March 22, 1952, issue of Collier's. Image credit: Douglas Yazell. Thanks to UNZ.org for making this page visible to everyone.

The Cover

Accurate to the last, minute specification, the cover painting that is this week's frontispiece shows the staggering climax of man's first flight into the unknown reaches of space. At this precise moment in its journey, the nose section (third stage), containing crew and cargo, has disengaged itself from the second booster rocket unit. While the nose soars on and up in a northeasterly direction from this point 40 miles in the air, the steel mesh parachute of the second booster has opened and begins the long drop into the Pacific Ocean below. For the full story of man's inevitable invasion of the heavens, dramatically illustrated and simply told, turn to page 22.

On the following page is a reproduction by Scott Lowther of a full-page editorial from page 74 of the October 11, 1952 issue of Collier's. It is a preview of the second of eight issues of Collier's containing articles in the series, "Man Will Conquer Space Soon!" That second issue was the October 18, 1952 issue, a long wait after the first issue of March 22, 1952. Thanks to UNZ.org for making that page visible for everyone.

Also on the following page is a preview of the October 18, 1952 issue. The preview appeared on page 32 of the October 11, 1952 issue. Since the last paragraph of the editorial was not related to space exploration, it is a good place to present this small peek at what is coming next in Horizons. Reproduction of that preview was done by Douglas Yazell, who was born between the first and second issues in this series. Thanks to UNZ.org for making this visible to everyone.



Next Comes the Moon

THE ILLUSTRATION for this week's editorial will be familiar to most Collier's readers, for it was the cover of our issue of March 22, 1952, which contained a number of articles under the collective title Man Will Conquer Space Soon. Since that issue appeared, some things have occurred which we believe lend strength to our slogan, Collier's Makes Things Happen.

For one thing, an expanded version of those March 22d articles appeared last week as a book called Across the Space Frontier (Viking Press), and already its sales are right up there in the hot-cake category. For another, the Third International Congress on Astronautics met in Stuttgart, Germany, a few weeks before to discuss the conquest of space.

Now, we don't say that Collier's made this Stuttgart conference happen. But our March 22d issue did anticipate and deal with the very same subjects that the 200 scientists from 13 countries discussed in Stuttgart, from the cost, design and time factors involved in constructing a space rocket, to the technical problems of building an artificial satellite in outer space and the legal problems regarding possession and "ownership" of that space. And while Dr. Wernher von Braun, who wrote our leading article on space travel, was not able to appear in person at the astronautical congress, his paper on Space Travel: A Common International Task, which was read before the conference, was one of the key documents of the discussion.

The very fact that the word astronautical exists in our language seems proof enough to us that space travel has passed from the realm of conjecture to the field of rather imminent reality. There are many difficulties to overcome. But the technical details have been worked out beyond the point of doubt or failure. And in working them out the astronauts have succeeded in making science fact vastly stranger and more intriguing than science fiction. The fanciful activities of the space travelers met in comic books, television and movies can't compare with what actual men will accomplish within the lifetime of many of us.

For man *will* conquer space. There is no longer any real question about it. It is the last great frontier that challenges human intelligence, ingenuity and courage. And, as the title of Dr. von Braun's paper states, the meeting of that challenge is a common international task. It is also a disturbing international problem.

The development of rockets, upon which space travel depends, was born of the desire for destruction and conquest in World War II. It might now—and in a happier period of world history it surely would—become an instrument for opening vast new horizons to the traditionally nonpolitical, non-nationalistic, peaceable brotherhood of world scientists. But, in the Soviet Union, political theory has long since taken over science and warped and perverted it to political uses. Thus true international co-operation in the conquest of space is impossible.

Whether the free world's scientists will pool their wisdom, or whether the United States will have to go it alone in the conquest of space, remains to be seen. But Collier's believes that it behooves this country to start some real activity. For the first power that builds and occupies a space satellite will hold the ultimate military power over all the earth. This the Soviet government knows, too, and it is not idle.

In the hands of a peaceful country like ours, a space satellite would be the first step in a series of infinite and perhaps unimagined possibilities. For it must be remembered that an artificial satellite, though a staggering accomplishment, would be only a beginning. Beyond this threshold of outer space lies the moon, and beyond the moon the nearer planets.

Collier's told you the details of the first step last March, but we haven't neglected outer space in the meantime. In next week's issue and the issue following we shall bring you the story of Man on the Moon, by the same scientists who conducted our first symposium. It's a feasible, technically accurate story and a highly important one, too, because it is someday going to come true.

Next Week

MAN ON THE MOON

Scientists Tell How We Can Land There In Our Lifetime

AIAA Houston Section

P.O. Box 57524

Webster, TX 77598

The American Institute of Aeronautics and Astronautics

Above and below: AIAA Houston Section leadership retreat, August 15, 2012. Left to Right: Christopher Davila, Eryn Beisner, Irene Chan, Tom Horn, Clay Stangle, Michael Frostad, Dr. Larry Friesen, Daniel Nobles, Julie Read, Sarah Shull, Jennifer Wells, Robert Plunkett, Alicia Baker, Dr. Steven Everett, Melissa Kronenberger, Dr. Pamela Loughmiller, Ryan Miller, Svetlana Hanson. Several others attended but do not appear in the photos. Image credits: Douglas Yazell.

AIAA Mission & Vision Statement

The shaping, dynamic force in aerospace - THE forum for innovation, excellence and global leadership. AIAA advances the state of aerospace science, engineering, and technological leadership. Core missions include communications and advocacy, products and programs, membership value, and market and workforce development.

The World's Forum for Aerospace Leadership

Become a member of AIAA!

You can join or renew online at the AIAA national web site: www.aiaa.org.