Horizons

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

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TABLE OF CONTENTS

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

2004 2005 2006 2007

Cover: Morpheus testing. Image credit: NASA.

Looking Back at our 2011-2012 Year

From the Chair

SEAN CARTER, CHAIR

Wow! What a year! It's gone by too fast. This month of June 2012 marks the last month of my term as your AIAA Houston Section Chair. It has been a wild ride to be sure. This year we've heard from members of Congress, the JSC Center Director, and an impressive cadre of distinguished speakers.

This spring alone, our section hosted the…

- 2012 AIAA Region IV Student Paper Competition
- Yuri's Night Houston 2012 Fun Run and Celebration Event
- 2012 AIAA Houston Section's Annual Technical Symposium
- AIAA Houston Section's 50th Anniversary Gala Celebration

It's been a busy and fun year. We also marked our 50th year anniversary. To celebrate, we brought back members from throughout our history to share stories and give recognition of all that came before us. JSC Center Director Mike Coats attended with his wife and shared warm memories of AIAA and wishes for the next 50 years of our partnership with JSC.

Please accept my thanks for allowing me to serve as your Chair for this great 2011-12 year. I would like to sign off by recognizing those who have been our most consistent members through the years! Congratulations!

60 Years with AIAA

Dr. Angelo Miele

Left: Dr. Angelo Miele in 1987 from our 25th anniversary booklet.

50 Years with AIAA

Roy W. Meinke

Above: Roy Meinke on March 27, 2012, at the dinner meeting with guest speaker Douglas Terrier. At left is Wes Kelly. Image credit: Douglas Yazell.

40 Years with AIAA

Thomas E. Diegelman

Anita E. Gale

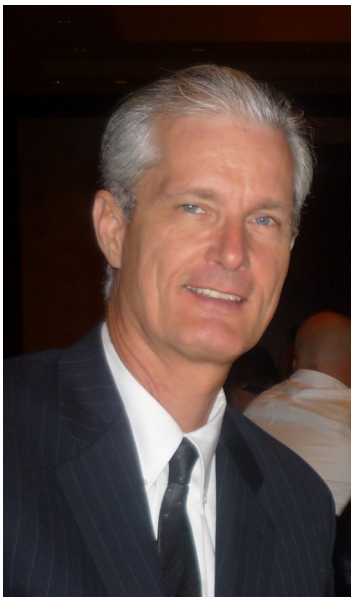
25 Years with AIAA

Walter J. Barnett
Charles H. Campbell
Lee A. Coggins
Toby B. Martin
Norman N. Parker
Donald H. Peterson, Sr.
Dr. James H. Stramler
Timothy D. Suit
Dr. J. Olusegun Thomas
Victor H. Treat, Jr.
Keith D. Zimmerman
Larry S. Bell
Dr. Tak Kahto
Jeffrey S. Osterlund
Dr. Eric L. Petersen

From the Editor

Weather, Climate, Special Editions & Dreams

DOUGLAS YAZELL, EDITOR



E-mail: douglas.yazell[at]me.com

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

Starting July 1, 2012, our new web site will be www.aiaahouston.org, but it might not be fully populated right away. Thanks to our new webmaster Irene Chan!

Corrections to page 10 of last issue: See this issue's Section News page!

Right: Skylon is a design for an unpiloted space plane by the British company Reaction Engines Limited (REL). Specifications (Skylon C2): Capacity: Potential for up to 30 passengers (in a special passenger module). Caption and image: Wikipedia. Image attribution: GW_Simulations. Since we have a Houston connection, maybe this will make a good Horizons article one day soon?

"We can say with high confidence that the recent heat waves in Texas and Russia, and the one in Europe in 2003, which killed tens of thousands, were not natural events — they were caused by human-induced climate change."

That is a quote from a New York Times article, "Game Over for the Climate" from "op-ed contributor" James Hansen. The New York Times wrote at the end of this article, "James Hansen directs the NASA Goddard Institute for Space Studies and is the author of *Storms of My Grandchildren*."

Since we have a French sister section (www.3af-mp.fr) and other European contacts, that quote about Europe sticks in my mind.

Eric Berger is an outstanding science, space and weather reporter for the Houston Chronicle. His Chronicle SciGuy blog addressed these claims about Russia and Texas, but not Europe, and Eric concludes:

"Here's the real problem. Hansen is entirely correct in saying that climate change is happening, that humans are a principal driver, and some extreme weather will get worse. But to obtain political movement and public support for this issue, there needs to be more than dire warnings about the future. We need to see effects now in order to spend money to improve the future.

"That's why there's a great desire among climate activists to tie climate change to extreme weather events. That provides a good reason in the pragmatic world of politics to address a pressing need.

"Unfortunately the science of climate change and extreme weather isn't quite yet up to the task, and Hansen, here, appears to be overreaching some."

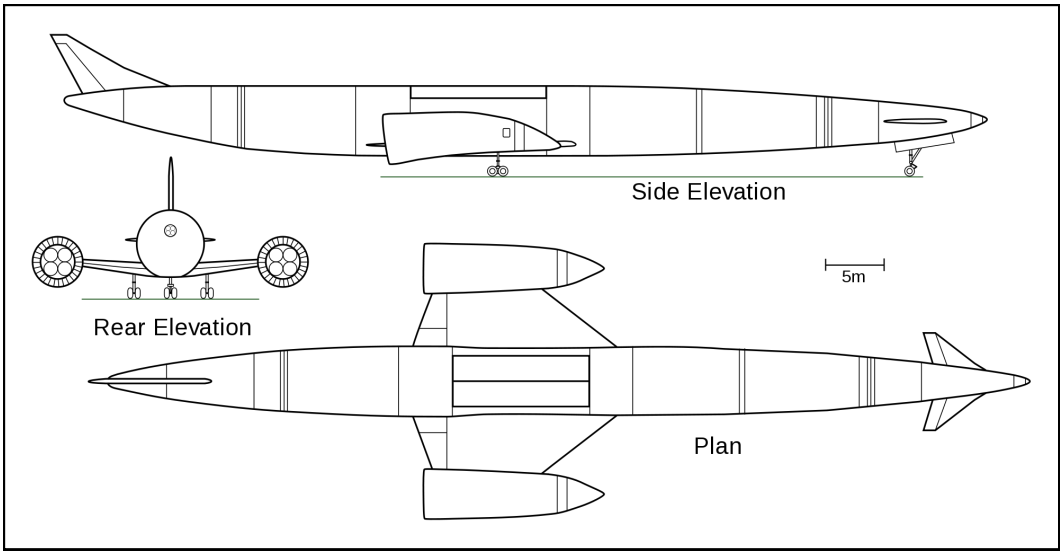
In other news, we produced a special edition of Horizons for the 50th anniversary of AIAA Houston Section, a 15 MB PDF file with 46 pages, extending the 20-page 1987 booklet that celebrated our 25th anniversary. This is on our web site, and our new web site is www.aiaahouston.org instead of www.aiaa-houston.org, as of July 1, 2012, but it will take a while to fully populate the new web site.

Thanks to Dr. Jon Olansen and the Project Morpheus team for this issue's cover story! They are doing inspiring work. (Morpheus is the god of dreams and dreamers.)

Additional links:

http://ec.europa.eu/dgs/clima/mission/index_en.htm

http://www.eea.europa.eu/themes/climate



Project Morpheus

DR. JON B. OLANSEN, NASA/JSC

Cover Story

It's early morning and numerous engineers, rocket scientists and various support personnel are already hard at work in the field west of JSC's building 14. The Morpheus team is preparing for another tether test – this time with a suite of instruments from the Autonomous Landing & Hazard Avoidance Technology (ALHAT) project integrated on board the vehicle. This scene has become a regular occurrence on site at the Johnson Space Center, as the Morpheus project has worked to fully characterize the performance of its vertical test bed in preparation for some approach and landing tests at KSC later this summer.

Left: Morpheus test preparation. Image credit: NASA/Joe Bibby.

The Morpheus Project began in earnest in June 2010, an offshoot of a concept development activity called "Project M" that envisioned demonstrating precision landing of a bipedal humanoid Robonaut on the lunar surface via a "green" propellant lander – all in 1000 days. Morpheus, named for the Greek god of dreams and dreamers (though Matrix fans may point to Lawrence Fishburne's iconic character), continues the lander technology development activity that could eventually support human and robotic missions to any surface.

The Morpheus Project provides an autonomous, reusable, rocket-powered, terrestrial Vertical Takeoff / Vertical Landing (VTVL) vehicle for testing integrated spacecraft and planetary lander technologies. The integrated Vertical Test Bed (VTB) platform provides a means to develop, mature, refine, and demonstrate advanced technologies promoting enhanced autonomy, reliability, safety, reusability, In-Situ Resource Utilization (ISRU), precision navigation and safe landing capabilities.

The four primary goals established for Morpheus include a) technology advancement; b) lean development; c) innovative partnerships; and d) education & outreach. Project team members diligently and continuously pursue all four goals. Pursuing these goals in support of NASA's strategic development has yielded a system capable of advancing the aforementioned technologies in an integrated flight system in the terrestrial environment.

NASA's strategic goal of extending human activities across the solar system requires an integrated architecture to conduct human space exploration missions beyond Low Earth Orbit (LEO). This architecture would include advanced, robust in-space transit and landing vehicles capable of supporting a variety of lunar, asteroid and planetary missions; automated hazard detection and avoidance technologies to reduce risk to crews, landers and precursor robotic payloads; and ISRU to support crews during extended stays on extraterrestrial surfaces and provide for their safe return to earth. NASA's Advanced Exploration Systems (AES) portfolio includes several fast-paced, milestone-driven pro-

(Continued on page 6)

Below: A banner from the Morpheus web site. Image credit: NASA.

Morpheus

(Continued from page 5)

jects that are developing these necessary capabilities. Specifically, the Morpheus Project and the ALHAT Project provide technological foundations for key components of the greater exploration architecture required to move humans beyond LEO.

Technologies offer promise; capabilities offer solutions

Our project mantra is: while technologies offer promise, capabilities offer potential solutions with application for future human exploration beyond LEO. Morpheus provides a bridge for evolving these technologies into capable systems that can be demonstrated and tested. Successful implementation of these capabilities will enable access to landing sites that were previously considered to be too hazardous to risk a robotic lander mission, much less a human mission.

Though designed and developed primarily by an in-house team at JSC, project personnel aggressively pursue partnerships across other NASA centers, commercial entities and academia in support of Morpheus development and test activities. Morpheus and ALHAT have partnerships with Kennedy Space Center (KSC) for flight testing; Stennis for engine testing; Marshall for engine development and lander expertise; Goddard for core software development; and Langley and the Jet Propulsion Laboratory (JPL) for ALHAT development. Commercial partnerships with enterprises such as Jacobs Engineering, Armadillo Aerospace, and Draper Labs have augmented the development and operation of many aspects of the project.

Technology Maturation

One of the primary technology components of the Morpheus Project is a liquid oxygen (LOX) / liquid methane (LCH4) propelled vehicle. The Morpheus LOX / methane propulsion system can provide a specific impulse during space flight of up to 321 seconds; it is clean-burning, non-toxic, and cryogenic, but space-storable. For future space missions, oxygen and/or methane could potentially be produced in-situ, depending on the planetary surface. The oxygen is compatible on-board with life support systems and oxygen / methane systems are being studied for power generation as well. These attributes make LOX/methane propulsion an attractive technology when the entire spacecraft system is considered. LOX and methane are also readily available and relatively safe and easy to handle, allowing for frequent, low-cost ground testing.

Right: Morpheus ignition environment characterization test. Image credit: NASA/Kris Kehe.

ALHAT, the primary Morpheus payload, provides the second key technology: autonomous precision landing and hazard avoidance. When landing autonomously on any planetary or other surface, the vehicle must be able to identify a safe landing site that is free of large boulders, rocks, craters, or highly sloping surfaces.

A primary objective of Morpheus in FY12 is to demonstrate and advance the Technology Readiness Level (TRL) of the precision landing and hazard avoidance capabilities developed by the ALHAT system. The ALHAT project has been developing an integrated Autonomous Guidance, Navigation and Control (AGNC) hardware and software system capable of detecting and avoiding surface hazards and autonomously guiding a crewed or robotic space vehicle to a safe touchdown within 90 meters of a pre-designated planetary or asteroid site. ALHAT uses an onboard laser altimeter, a Doppler velocimeter, and a flash Light Detection and Ranging (LIDAR) for the onboard sensors to perform surface relative navigation and hazard detection. Morpheus is designed to carry ALHAT sensors and software supporting tests that will demonstrate an integrated vehicle capability to perform these tasks.

(Continued on page 7)

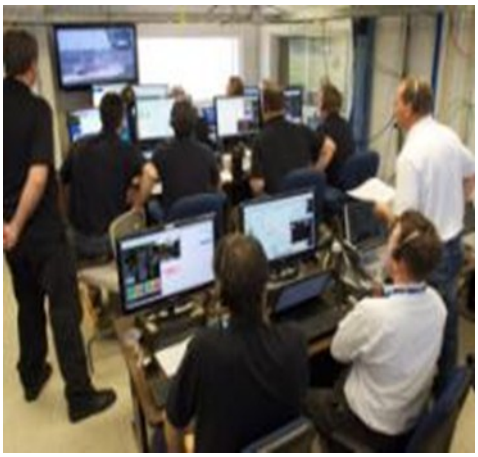
(Continued from page 6)

Vehicle Systems

Operation of a VTB encompasses a wide range of elements and disciplines that are common to a human spaceflight development, including the spacecraft, ground systems, payload integration, flight operations, logistics, and safety.

The Morpheus prototype vehicle sizing was predicated on a 500 kg payload lunar reference mission. The Morpheus 1.5 VTB is a "quad" lander design with four tanks, a single gimbaled engine and an aluminum structure beneath a top deck for mounting GNC, avionics and power components and payloads. The propulsion system uses an impinging element-type engine design, which is film-cooled and operates as a blow-down system. The engine is throttleable, producing up to 4300 lbf of thrust to control vertical ascent and descent rates. The vehicle is able to determine position to less than one meter, velocity to less than three cm/second, and attitude knowledge within 0.05 degrees.

A Thrust Termination System (TTS) is employed both for range safety and independent test termination purposes.



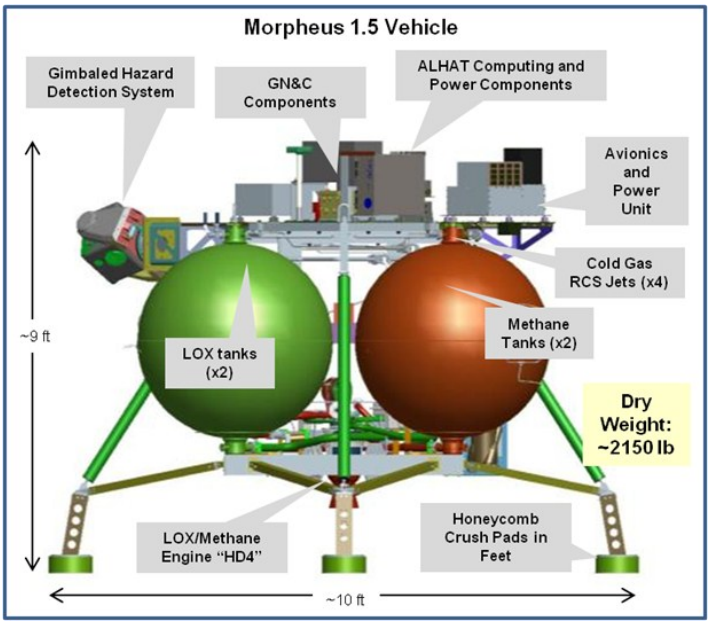
Closing either of two motorized valves in the TTS will shut off the flow of liquid oxygen and methane to the engine and terminate engine thrust. The commands to initiate thrust termination are sent from a control unit located in the operations center during any live engine testing.

In order to design and build rapidly, team members are always looking to leverage existing NASA resources wherever it makes sense. For example, our software developers built our vehicle software around Goddard Space Flight Center's (GSFC) Core Flight Software (CFS), a set of reusable software modules in a flexible framework that can be adapted to various space applications. Starting with CFS, we added custom application code unique to the Morpheus vehicle and mission design, enabling the vehicle to execute planned flight profiles completely autonomously, from the time that the operator sends the command for main stage ignition through vehicle landing and engine shutdown. Autonomous flight operations are required for robotic landers at remote destinations, and from the beginning, Morpheus has endeavored to keep the vehicle subsystems and software directly applicable to space flight.

Ground Systems

The VTB Flight Complex (VFC) at JSC includes a 20' x 20' concrete pad located on a section of the JSC antenna range near an old Apollo-era antenna tower. About 2000 feet away is the Morpheus control center for on-site field testing at JSC, the small two-story building 18 that was formerly used for rooftop

(Continued on page 8)



Morpheus

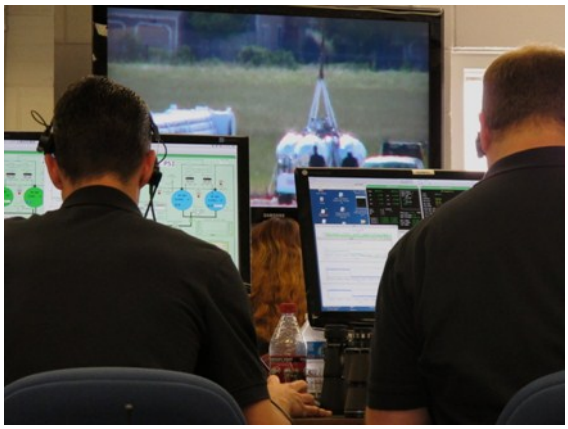
Left: Morpheus control room. Image credit: NASA.

Left: Morpheus 1.5 vehicle. Image credit: NASA.

Morpheus

(Continued from page 7)

GPS testing and storage. Inside this old building, our operator workstations use GSFC's Integrated Test and Operations System (ITOS) ground software. Like CFS, ITOS was developed as ground control and display software for GSFC space vehicles and is available to other NASA projects.



Right: Morpheus Prop and GNC operators at work in the Morpheus control room. Image credit: NASA/Joe Bibby.

Ground systems also include propulsion Ground Support Equipment (GSE). The consumables required for an engine test include liquid oxygen, liquefied natural gas, helium, liquid nitrogen, and gaseous nitrogen. A portable ground power cart is used for extended operations, minimizing the internal flight power needs.

JSC's Center Operations provides substantial support to test activities as well, from riggers, cranes and transportation assets to emergency services and fire protection.

Operations

The final element of the Morpheus system is Operations. Nine primary operator positions are staffed by team members: test conductor (TC), operator (OPS), propulsion (PROP), avionics, power and software (APS), guidance, navigation and control (GNC), ground control (GC), a range safety officers (RSO), and the flight manager (FM). During tests with payloads aboard, another position may be included, such as one for ALHAT. Each position is certified through specific training.

Certification is also required for three pad crew (PAD) positions. PAD-1 is the pad crew leader and is responsible for executing manual vehicle operations. PAD-2 and PAD-3 conduct all handling of cryogenic fluids and most other consumables.

Morpheus Testing

Morpheus testing includes three major types of integrated tests: hot-fire, tether, and free-flight. During hot-fire testing the vehicle is completely restrained from movement and the primary focus is to test the LOX/methane propulsion system. For tether tests the vehicle is suspended from a crane to enable testing of the propulsion and integrated GN&C without the risk of a vehicle departure or crash. Morpheus "free-flights" demonstrate the fully integrated flight capability of the vehicle with no restraints. Free-flight safeguards include both automatic on-board aborts and remotely commanded aborts, as well as the redundant and independent TTS that can be activated by spotters who visually determine trajectory deviations.

Right: Morpheus pad operations. Image credit: NASA/Kris Kehe.

As a small team, the Morpheus Project is able to try different management approaches and assess suitability for larger activities. Our lean development philosophy has been to prototype and test early and often, learn, improve, and repeat. This helps us avoid "paralysis by analysis" so that we can maintain our rapid pace of development. Learning from the last test and preparing for the next test in an aggressive test schedule is an important forcing function, promoting team focus on expeditiously understanding and improving subsystems and the integrated vehicle. The development model of refining the design through prototyping and testing, rather than through exhaustive requirements definition and analysis, has been highly effective for the Morpheus project.

Preparing for flight tests at KSC, we've gained a lot of operational experience in a short period of time, completing a couple of dozen field tests at JSC over the past year and a half. The test early, test

(Continued on page 9)

(Continued from page 8)

Morpheus

often philosophy has resulted in the team conducting 6 hot-fire and 17 tethered tests to date. The first several tests demonstrated the basic integrated vehicle capability and allowed the team to wring out the ground systems and operations. In late 2011, many upgrades were made based on lessons learned from the initial flight test campaign, and Morpheus 1.5 testing began in February 2012. Since then, tests have focused on tuning the GN&C performance and integrating the ALHAT sensors and components onto the vehicle. Most recently, we performed tether tests with ALHAT's gimbaled HDS active on top of the VTB, continuously moving to counteract the motions of the hovering VTB, enabling it to detect and track targets out in the field.

Left: Morpheus hot fire test. Image credit: NASA/Kris Kehe.

With outreach as a prime objective, we strive to connect with the public in multiple ways. During each test, we stream mission telemetry, voice loops, and video from the Morpheus testing control center to JSC's Mission Control Center (MCC). From there, data and video can be made available to internal and external networks for NASA personnel and the general public. Social media sites (Facebook, Twitter, YouTube, etc.) are also regularly used. We even have an iMorpheus app (developed by a co-op) that graphically depicts vehicle flights with live streaming data. I encourage readers to follow us online at our website http://morpheuslander.jsc.nasa.gov/live.

Several of the tests had notable results. Tether Test 2, conducted early in the project test campaign, experienced an avionics failure that caused the engine throttle to fail full open at ignition, and the resulting vehicle motion under the tether was much more dynamic than expected. It may have appeared as a test failure, but the team took the opportunity to critically review the throttle valve control and made a number of improvements in that design. Additionally, the GN&C team was able to collect dynamic motion data that would not have otherwise been available during a normal test. Just six days later, the team had made the repairs and conducted a well-behaved Tether Test 3. As originally envisioned, these videos were posted to the internet with a description of what happened during each test.

Every test has the potential to initiate small grass fires, primarily due to spalling of the concrete pad under engine thrust. Tether Test 5, on June 1, 2011, was the most stable hover at that time and so was a Morpheus test success, but made the news due to a grass fire that was ignited and spread through the dry field adjacent to the launch area. Fire Protection personnel were on the scene for this test as planned, but unfortunately had to split forces when a fire alarm was activated in another JSC building immediately

Left: Morpheus ignition. Image credit: NASA/Joe Bibby.

(Continued on page 10)

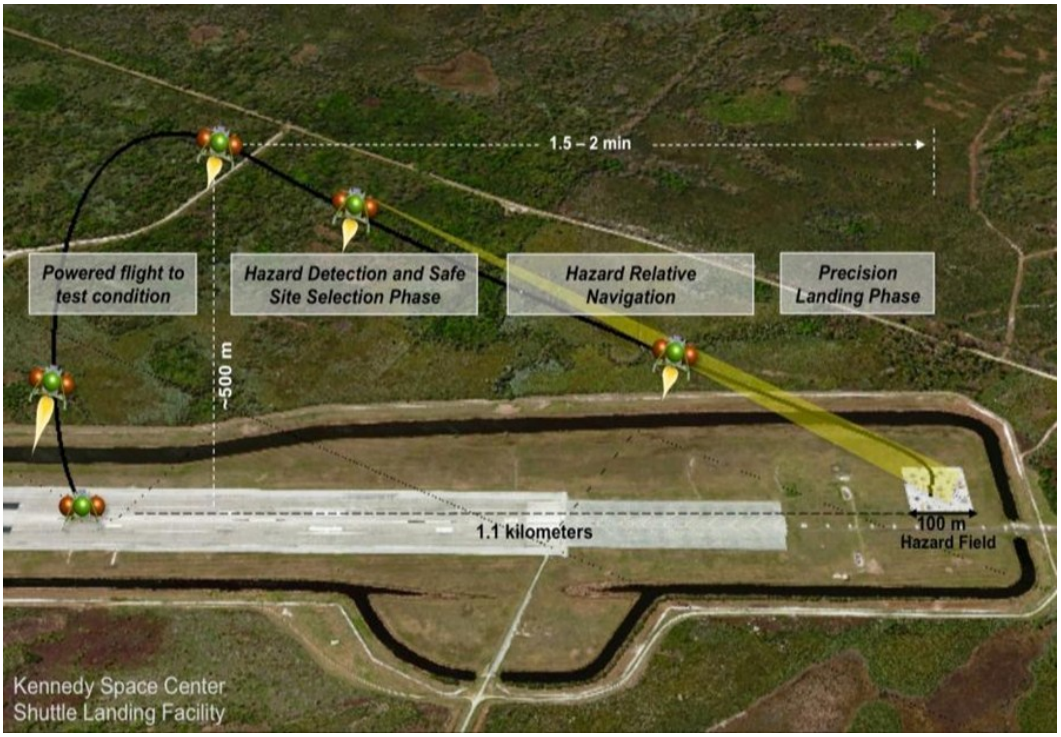
Morpheus

(Continued from page 9)

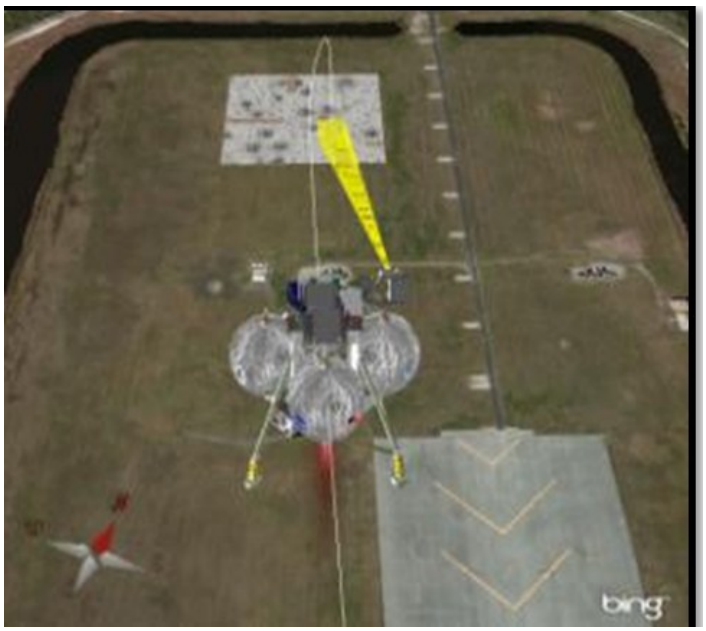
after the test completed. The fire was stopped with damage only to a number of hay bales, but the event led the team to reevaluate and improve our fire prevention and suppression approach, including adding a fire break around the perimeter of the test area, raising the tether height to reduce the potential for concrete spalling, and getting a pumper truck to have available for JSC's Fire Protection Services (FPS) personnel. Since Tether 5, only a handful of tests have resulted in small grass fires, all quickly extinguished.

Upcoming Tests

At this time, our higher performing HD5 LOX / methane engine is undergoing testing with tremendous support from our partners at Stennis Space Center. Integrated vehicle tests at JSC with the new engine, as well as new LOX / methane RCS engines, with final verification of dynamic stability, will complete our planned test series at JSC.



Right: Morpheus Hazard Detection Phase (HDP) trajectory. Image credit: NASA.



Right: Simulated Morpheus approach at KSC. Image credit: NASA.

Currently scheduled for mid-July, the team will transport the vehicle and ground support equipment to KSC to begin a free flight test campaign. Our partners at KSC have done an excellent job preparing for our arrival and are nearing completion of the flight test site preparation at the Shuttle Landing Facility (SLF). Preparation includes the buildup of a simulated planetary surface, complete with rocks, craters, and slopes, north of the SLF runway, to serve as the target landing site. The test cam-

(Continued on page 11)

(Continued from page 10)
paign will begin with short 30m x 30m "hops," and culminates in a two-minute Hazard Detection Phase (HDP) flight trajectory with a maximum altitude just over 500 meters and a range of one kilometer. The HDP trajectory simulates a landing approach phase that allows the ALHAT system and Morpheus vehicle to perform hazard detection and avoidance, scanning the hazard landing field, and redesignating the vehicle to a safe landing site within that field.

Beyond FY12

Morpheus will continue to spearhead innovative ways of doing business that streamline management overhead and maintain the flexibility to address the challenges of system development, while retaining what rigor is needed to expeditiously proceed toward a flight-capable design. Many of the Morpheus team members previously worked on large-scale NASA human spaceflight projects and programs such as ISS, Shuttle, and Orion. These large programs have thousands of geographically distributed team members, a high number of contractor organizations, and a multi-step governance model. Morpheus was challenged to evaluate ways to reduce overhead, create efficiencies in the team organizational structure, and improve team collaboration and communication, using methods that could potentially scale back up to streamline flight projects and programs. The team will continue this effort to improve the way that NASA executes projects, and will continue to share these innovations both within and outside of the NASA organization.

Beyond FY12, Morpheus will continue to mature the technologies and integrated capabilities to support a space-capable system. Under the AES program, Morpheus plans to evaluate alternate lander designs, including composite tanks and structure. The project will also develop a regeneratively cooled engine and increase vehicle reliability with redundant avionics, power, and GN&C components. In FY13-14, Morpheus plans to conduct even higher energy (6-kilometer slant range) landing profiles, simulating a complete surface approach trajectory, and carrying evolutionary ALHAT components that are smaller and higher performing, yet require less power. Morpheus will maintain a robust prototype and testing profile, ensuring that technologies and capabilities will have a high level of maturity when NASA is ready to on-ramp them for future spaceflight missions.

Above: Morpheus test operations. Image: NASA/Joe Bibby.

Morpheus

Author

Dr. Jon B. Olansen serves as the Project Manager for the Morpheus Project. Jon earned his B.S. in Aerospace Engineering and M.S. in Mechanical Engineering from the University of Notre Dame. He obtained his Ph.D. in Bio-Mechanical Engineering as a National Instruments Fellow at Rice University, where he specialized in biomedical experimentation in electrophysiology and cardiopulmonary hemodynamics. He has published several journal articles related to his research and authored a reference book on biomedical instrumentation. Jon began his career at JSC as a Space Shuttle flight controller (Mechanical, Maintenance, Arms and Crew Systems, or MMACS), supporting 32 missions and logging more than 4200 hours in Mission Control. Dr. Olansen has since held a number of positions of increasing responsibility including tours in Flight Crew operations, Safety & Mission Assurance, the Shuttle Program Office and the Exploration Systems Mission Directorate at NASA Headquarters. Jon recently left his role as the Manager of the Engineering Directorate Planning & Control Office at JSC to pursue the Morpheus activity full time.

Note the publication of a May 2012 conference paper:
Global Space Exploration Conference (GLEX)
AIAA and The International Astronautical Federation (IAF)
GLEX-2012.05.2.4x12761
Morpheus: Advancing Technologies for Human Exploration
Jon B. Olansen, PhD, lead author
Stephen R. Monday
Jennifer D. Mitchell
Michael Baine, PhD

Dinner Meeting

50th Anniversary of AIAA Houston Section

SHEN GE, CONTRIBUTOR AND DOUGLAS YAZELL, EDITOR

Right: Section Chair Sean Carter. Image credit: Douglas Yazell.

Thanks to the dinner meeting planning committee Alan Sisson (Programs Chair), Norman Chaffee (Panel Moderator), Irene Chan, Julie Read and Douglas Yazell. Also thanks to Treasurer Clay Stangle and adviser Michael Frostad.

Right: NASA artifacts on display at our dinner meeting. Image credit: Douglas Yazell.

The booklet given to each attendee is a Horizons special edition dated June 6, 2012, Volume 37, Number 6. It is published on our AIAA web sites along with other issues of Horizons.

Right: From left, Douglas Yazell (filling in for James C. McLane, Jr., talking mostly about Jim McLane's service to our Section), AIAA Fellow Guy Thibodaux, Norman Chaffee, Dr. Zafar Taqvi, Ellen Gillespie. Image credit: Julie Read.

Right: Past and current Section Chairs with NASA/JSC Director Mike Coats. From left, Daniel Nobles (Chair Elect), Douglas Yazell, AIAA Fellow Mike Coats, Sean Carter, Shirley Brandt, Ellen Gillespie, Norman Chaffee, Guy Thibodaux, Dr. Zafar Taqvi and Michael Oelke. Image credit: James C. McLane III using Douglas Yazell's camera.

A crowd of over 100 people enjoyed this special dinner meeting on June 6, 2012, at the NASA/JSC Gilruth Center Alamo Ballroom. JSC Center Director Mike Coats addressed the crowd before the panel discussion with five former Section Chairs. Panel moderator Norman Chaffee made a few introductory remarks, then Douglas Yazell spoke in place of James C. McLane, Jr., our 1971-72 Chair, and Douglas spoke mostly about Jim's service to our section during that 1971-72 year and, starting in 1987, Jim's leadership in starting up our (Shanghai based) Chinese sister section. The additional speakers made initial remarks in the order shown in the photographs, AIAA Fellow Guy Thibodaux, Norman Chaffee, Dr. Zafar Taqvi, and Ellen Gillespie.

Our Section started in 1962 as The Institute of Aeronautical Sciences (IAS) Houston Section. The American Institute of Aeronautics (AIAA) did not exist until 1963, but claims 1931 as its starting year, since it was created by merging The American Rocket Society (started in 1930 as The American Interplanetary Society) and the IAS (started in 1932).

Each paid attendee and guests of honor received a NASA commemorative medallion containing flown metal, a lapel pin created for this anniversary, and a 46-page anniversary booklet.

Happy Anniversary!

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

DOUGLAS YAZELL, EDITOR

Museum

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.

AIAA Houston Section almost had its dinner meeting of June 6, 2012, at this location! It was a celebration of the 50th anniversary of AIAA Houston Section. We rounded up the required funding, but other factors led us to use another venue.

There are various ways to support the museum: become a member, attend the monthly Wings & Wheels lunch programs (usually on the third Saturday of the month), become a volunteer, etc.

As you can see from the 2010 photograph, there are a few floors with rooftop pedestrian areas. They will be great for taking photos of aircraft, but for now, upper floors are closed to the public due to fire codes.

Now and then they talk about building a bed and breakfast facility on the second floor. Museum volunteers also envision a restaurant in the museum one day.

The art deco and art moderne building has been beautifully restored so far. The ground floor atrium is like new, restored to its majestic initial appearance like in 1940, when the facility was far larger than Houston's needs. By 1946 or 1948, it was too small for Houston's needs. Be sure to visit the museum soon!

Left: The museum in August of 2010. Image credit: Douglas Yazell.

Left: An image from the museum's web site from the May 2012 Wings & Wheels event, whose theme was, "Learn to Fly Day!" The raffle plane is surrounded by Mustangs from The Mustang Club of Houston. Image credit: Museum web site.

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

ATS 2012

Annual Technical Symposium (ATS 2012)

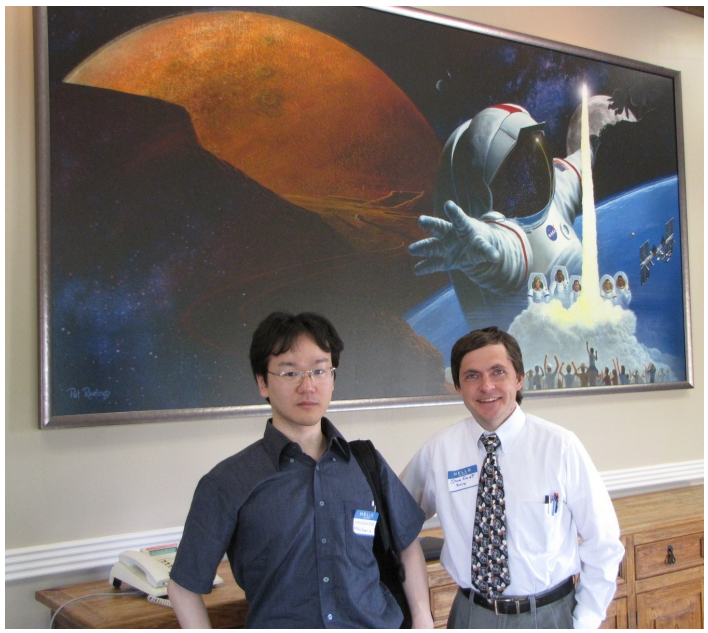
DR. STEVEN E. EVERETT, CHAIR, GN&C TECHNICAL COMMITTEE

The AIAA-Houston chapter held its 2012 Annual Technical Symposium at its usual Gilruth Center venue from 8:00 to 4:30 PM on May 18. Before an early crowd of 40 attendees which eventually grew to over 120 by day's end, our conference General Chair Satya Pilla introduced the morning's keynote speaker, NASA Orion Program Manager Mark Geyer.

Right: ATS 2012 General Chair Dr. Satya Pilla. Image credit: Steve Everett using Satya Pilla's camera.

Right: Dr. Satya Pilla (behind the podium) presenting a speaker gift to luncheon keynote speaker Christopher Ferguson, The Boeing Company, STS-135 Commander. Image credit: Steve Everett using Satya Pilla's camera.

Mr. Geyer began by describing the history behind the development of NASA's newest exploration vehicle. After the fly-off planned for 2004/2005 to decide on a Crew Exploration Vehicle (CEV) design proved too expensive, a subsequent Phase I competition for the Orion vehicle was executed and then cancelled in 2010. The design eventually evolved into the Multi-Purpose Crew Vehicle (MPCV) that is familiar today. Despite the volatility in the funding (and nomenclature) for the vehicle, the fundamental requirements have been relatively stable. Mr. Geyer went on to outline the manifest planned leading up to the 2014 flight test, and to explain the various roles the government currently plays in the development of the Orion vehicle, from overseer to government supplier to provider of engineering support.



Right: At left, Masataka Nishi of Hitachi Research Laboratory in Japan, vacationing in California and (for the AIAA / IAF GLEX event, Global Exploration event) DC, and making a detour before his DC visit, coming to Houston for our event. At right. Dr. Steven E. Everett. The mural in this lobby of the NASA/JSC Gilruth Center is by space artist Pat Rawlings. Image credit: Douglas Yazell.

The NASA open architecture design approach for the Orion was described briefly, along with the numerous trade studies that have already been completed and planned flight campaign. He stressed the difficulty in the abort system design, noting that this scenario is the loads driver and that every study performed supports the tractor (rather than pusher) approach. The CM structure design was described next. Among the components and systems described were the composite crew pressure vessel, the water drop test, acoustic testing, crew safety equipment, and avionics. Mr. Geyer continued with a brief description of the planned Exploration Mission Flight 1 (EFT-1). After launching on a Delta-IV Heavy, the vehicle will make two orbits up to an altitude of 3000 miles. Key separation

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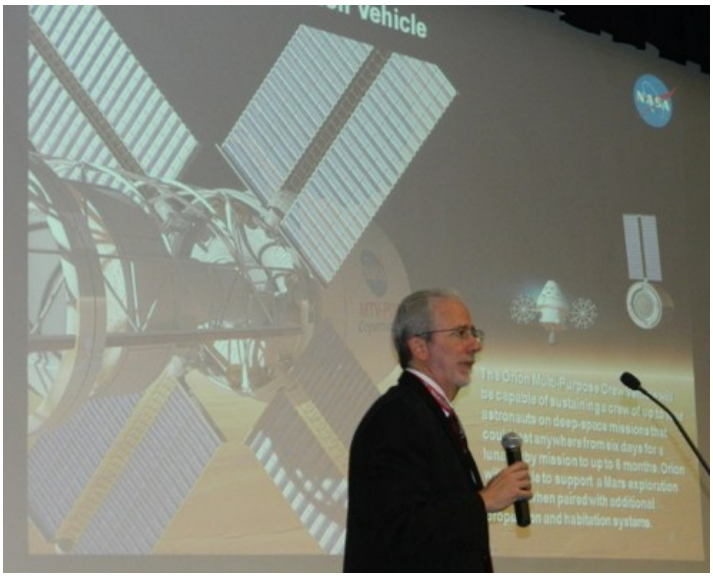
events will be tested, as well as an entry at near-lunar-return velocities. Additional abort and exploration mission tests were described, including a 7-day, unmanned, free return lunar mission and a 10- to 14-day crewed lunar mission.

Destinations for the Orion include the moon and asteroids, but Mr. Geyer also noted that the Orion is required by law to perform as a back-up for the International Space Station (ISS). It is being designed to accommodate ISS docking, although the detailed design for many of these functions has been deferred. He pointed out that since its design is not optimized for ISS docking, it cannot compete on a financial basis with transportation services provided by the Soyuz or those planned by other commercial providers. Mr. Geyer closed by encouraging those interested to follows the progress of the Orion design on social media such as Facebook and Twitter.

ATS 2012

Left: Dr. Satya Pilla, ATS 2012 General Chair (behind the podium) presents a keynote speaker gift to Andrew Thomas of the NASA astronaut office. Image credit: Steve Everett using Satya Pilla's camera.



Left: Keynote speaker Mark Geyer, NASA/JSC, Orion Multi -Purpose Crew Vehicle (MPCV). Image credit: Dr. Satya Pilla.

After the morning's parallel break-out sessions on topics such as aero/astro, propulsion, GN&C, systems engineering, modeling & simulation, and structures & mechanical engineering, a lunch of sandwiches and fruit was provided. The afternoon's keynote address featured astronaut speakers Andrew Thomas and Chris Ferguson. A former US Navy pilot, Mr. Ferguson flew aboard Space Shuttle flights STS-115, STS-126, and STS-135, and went to work in the Crewed Capsule Development program at Boeing after retiring from NASA in December 2011. He mused on how much KSC and JSC have changed in the year since the Space Shuttle has retired and how much the four emerging commercial competitors, Boeing, SpaceX, Sierra Nevada, and Blue Origin, have accomplished with the limited funding available. Of the three major components of the country's manned spaceflight

(Continued on page 16)

Left: The ATS 2012 keynote speaker gift and door prize, from the Official KSC Visitor Complex Space Shop. This crystal paperweight is affordable and available in this limited edition. Only 2011 will be made, in honor of the 1981-2011 history of the NASA Space Transportation System (STS). Image credits: The Space Shop.

ATS 2012

(Continued from page 15)

efforts, CCDev, the International Space Station (ISS), and Space Launch System (SLS), the ISS is the cornerstone and is serving as the development test bed for systems which will be required for a future Mars mission. Mr. Ferguson went on to describe Boeing's progress and its interaction with the Bigelow company, including showing a video of the company's concept. Having just completed PDR, Boeing is preparing for CDR and an eventual pad abort test, orbital flight test, and ultimately a crewed flight test after December 2015. After mentioning some of the remaining challenges and opportunities, he encouraged those of us working in human spaceflight to stay focused. He closed with the reminder that a flag which flew on STS-1 and was left on the ISS by STS-135 will someday be returned by one of the commercial vehicles now in development.

Right: Yvonne Vigue-Rodi in the NASA/JSC Gilruth Center Discovery Room, "Lunar Surface EVA Route Selection Optimization." Image credit: Douglas Yazell.

Right: Patrick E. Rodi, "Ring Wing Waverider Configurations." Image credit: Douglas Yazell.

Right: Dr. Paul Spudis, "Developing Cislunar Space from Lunar Resources." Image credit: Douglas Yazell.

Astronaut Andy Thomas continued the lunchtime presentation with his view of spaceflight today and tomorrow, and how we should move forward. Dr. Thomas, who flew aboard Shuttle flights STS-77, STS-89, STS-102, STS-114, is currently working issues for the Exploration Branch of the Astronaut Office. He said that although the Shuttle has given us so much, with its retirement we are left to rely on the Soyuz. Plans to have the Crewed Capsule Vehicle (CCV) developed by the commercial sector and online sometime in the middle of the decade have freed up NASA to develop heavy lift capability with SLS and reach destinations such as the Moon, asteroids and Mars. However, given the cancellation rate of the manned programs in the past few decades, a successful program will need the following attributes: relevance, affordability, perceptible progress, and acceptable risk. Culture has changed since Apollo, and

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programs in the future will have to be sustained based on their perceived relevance to the public, either through economics, national security, or spiritual security. A program must also be affordable given the consistent decline in the funding available to NASA. A lack of demonstrable and visible progress, such as that seen in the Apollo program, hurt the development of the Freedom Space Station and cast doubt on the Shuttle program. It is clear the US must be willing to accept risk, and Dr. Thomas noted that it was aversion to risk that motivated Kennedy to disallow John Glenn to fly again and caused the CAIB to question why Columbia was allowed to fly a mission based solely on science research. The new challenge for the manned space program is a shift to development of capability in the form of small steps toward short term goals. In answer to attendees' questions, Dr. Thomas denied the need for a "spectacle," such as a Chinese Moon landing, to motivate the space program, but that it should be realistically based on exploration, and that it is our job to communicate the appropriate messages to Congress and the public.

The afternoon general session ended with a presentation of a commemorative crystal to each of the speakers and to the lucky door prize winner Ken Lassmann, and then the symposium concluded with another set of parallel tracks in GN&C, systems engineering, communications and tracking, architectures, and flight sciences.

ATS 2012

Left: Zoran Milenkovic, "The Rendezvous and Proximity Operations Program Displays and Controls Capabilities." Image credit: Douglas Yazell.

Left: INCOSE presenter Bill Ithon, "MBSE in a Rapid Development Environment (a plan)." Image: Douglas Yazell.

Left: Molly White (at left) with session chair Dr. Albert A. Jackson IV. Image credit: Douglas Yazell.

ATS 2012 Planning Committee

Dr. Satya Pilla, General Chair
Ellen Gillespie
Dr. Albert A. Jackson IV
Dr. Steven E. Everett
Raphael Munoz
Matt Johnson
Sarah Shull
Douglas Yazell

Editorial

Planetary Resources: Flight of Fancy or Real Wealth?

SHEN GE, CONTRIBUTOR, JUNE 17, 2012

In recent times, the space industry has received a lot of coverage in mainstream media due to the high interest in space expressed by the rich and famous. So far, every private space company has been funded by a multimillionaire if not billionaire. When billionaires from backgrounds in technology such as Google co-founder and the developer of Microsoft Office team up with movie directors and politicians, naturally all eyes turn to this startup company. Planetary Resources (henceforth known as PR) certainly has a stellar cast of investors and advisers which the mass media has been repeatedly highlighting as well as their ambitious stated goal of mining asteroids.

However, two things need to be better defined: (1) the exact objectives of PR in mining asteroids and (2) how they propose to do it. PR specified the resources of water and rare metals. The justification of water as a resource is: "A single water-rich 500-meter-wide asteroid contains 80 times more water than the largest supertanker could carry and could provide. If the water were converted to rocket propellant, it would provide more than 200 times the rocket fuel required to launch all the rockets ever launched in human history."

The assumption of water as a valuable resource in space is fundamentally flawed for several reasons. First, PR assumes future spacecrafts will mostly use liquid oxygen/liquid hydrogen (LOX/LH2) as rocket propellant. Despite its high specific impulse, cryogenic systems are required for LOX/LH2 systems and these systems are known to be complicated, expensive, and occupying large volumes due to the low density of hydrogen. This is why more dangerous but denser and non-cryogenic systems are still often used. This also does not take into account other methods of propulsion such as electric propulsion or solar cells which do not require substantial fuel at all, if any.

Second and equally crucial, the current market size for spacecrafts is too small to justify mining for water as a sellable resource. With less than 50 new launches every year currently and perhaps 10% to use the LOX/LH2 systems if optimism is assumed, PR will be spending much more than it makes. The market size will only increase if there are more launches of spacecraft every year but that can only happen with reduced launch costs. Private space companies such as SpaceX will be ensuring this happens. However, with the reduction of launch costs, the value of water will also be decreased. Water is only a valuable resource since the current exorbitant rates of launch costs have the direct impact that any dense material, whether it be water or any payload, costs a lot to launch. Currently, even the cheapest heavy lift launch vehicle (heavy lift meaning more than 25,000

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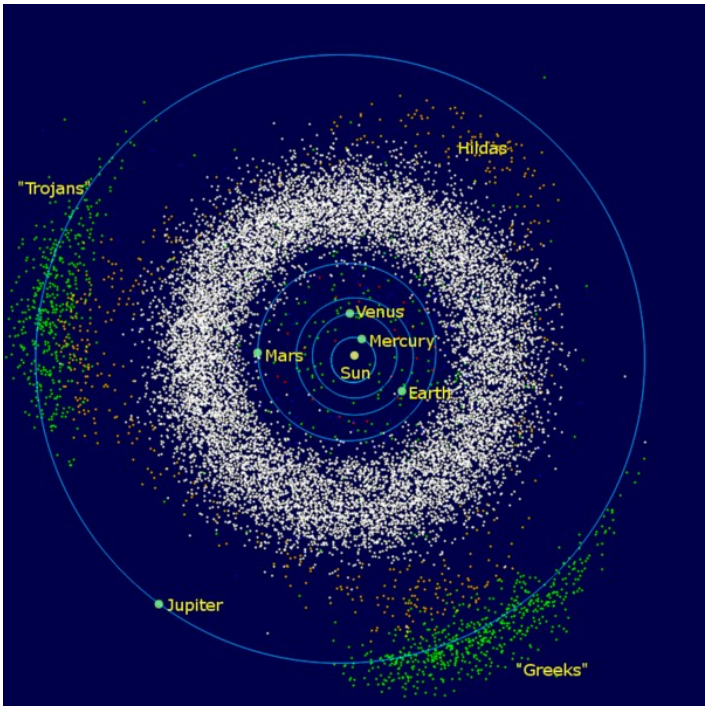

Right: The asteroid belt (white) and the Trojan asteroids (green). Image source: Wikipedia. Image credit: Public domain.

(Continued from page 18)
pounds), the Ukraine Zenit 2, launches payloads to LEO at an expense of $1000/kg.

So the chicken-and-egg problem is as follows. There's no market right now for water since there's not enough launches that need water as a fuel source. There's no market in the future for water since the launch costs will be low enough by then that bringing water from Earth will be cheaper than mining them from asteroids.

PR's second main target of resources is rare metals. As PR puts it, "In space, a single platinum-rich 500 meter wide asteroid contains about 174 times the yearly world output of platinum, and 1.5 times the known world reserves of platinum group metals."

Economics tell us that a resource is valuable if it's in short supply. Consider aluminum which was more valuable than gold when the creation of aluminum was not yet discovered. The Emperor Napoleon III used aluminum silverware only for his most highly esteemed guests in the 18th century. Consider a different story of rice with a different "emperor" called Emperor Norton in the United States in the 19th century. Joshua Norton, seeing that China placed a ban on the export of rice, which caused the cost of rice in San Francisco to skyrocket from four cents per pound to thirty-six cents per pound, bought all the rice in the market that was shipping from Peru to hike up the price. Unfortunately or fortunately, he failed to profit from his strategy, since more rice came in anyway, and rice came back down to the price of three cents per pound.

These simple stories illustrate the value found in scarcity. Rare metals such as gold and platinum are only worth a great deal because they are rare. Once PR floods the market with these rare metals, they will no longer be considered "rare." Instead, they may be even considered cheaper than iron or nickel given their abundance. Of course, PR can claim to have a monopoly of such resources and only dispense them at a trickle or sell them at a high price as out-of-space rare metals, but that would mean they will be a company with monopolistic intent. World governments would take action against them.

Aside from PR's vision statement, the implementation (the "how") also leaves much to be desired. The first project of PR's, the *LEO* space telescope, is a multipurpose telescope designed for looking outwards into space as well as looking inwards at Earth. As PR puts it, "*LEO* is capable of surveying for near-Earth asteroids during one orbit, [and] then [being] retasked for rain forest observation on the next. The possibilities for utility and engagement are only limited by the imagination of the user."

A payload for a spacecraft must have precise scientific requirements in order for instrumentation to be designed to accomplish these aims. A spacecraft meant only to look at the sun has a different set of configurations than an optical telescope to look at the universe such as Hubble. By generalizing the tasks of PR's planned telescope, they end up with two strikes against them. First, they will need an expensive and costly telescope with multiple instruments since they are all necessary to cover the different aspects of a very general mission. Second, they lose time in actually finding near Earth asteroids. When their telescope is looking at the ground half the time, half the time they won't be finding asteroids.

Clearly, the current agenda of Planetary Resources leaves much to be desired. Perhaps they have a more defined alternate agenda not shown to the public which is more sensible, but currently what I see is that they believe that having money is more important than having brains.

Editorial

Below: 243 Ida and its moon Dactyl. Dactyl is the first satellite of an asteroid to be discovered. Image source: Wikipedia. Image credit: NASA.

3AF MP

Our French sister section is 3AF MP, l'Association Aeronautique et Astronautique de France, Midi-Pyrenees chapter, www.3af-mp.fr. See our web page at www.aiaa-houston.org. Click on technical committees, International Space Activities Committee (ISAC). The ISAC is chaired by Ludmila Dmitriev-Odier. An update to the 3AF MP organization chart is on page 27 of our September / October 2011 issue.

Will Europe Participate in the Orion MPCV Project of the USA?

PHILIPPE MAIRET, 3AF MP AND DOUGLAS YAZELL, EDITOR

The Columbus laboratory module and the Automated Transfer Vehicle (ATV) are the two major contributions of Europe to the International Space Station (ISS). In order for the ISS to be continuously operational until at least 2020, each partner nation should participate in its operations, but also provide in-kind services. Three ATVs have been launched from French Guiana (using an Ariane 5 rocket each time): ATV-1 (Jules Verne) in 2008, the ATV-2 (Johannes Kepler) in 2011 and the ATV-3 (Edoardo Amaldi) in 2012. Coming next are ATV-4 (Albert Einstein) in 2013 and ATV-5 (Georges Lemaitre) in 2014.

The European Space Agency (ESA) and NASA were dis-

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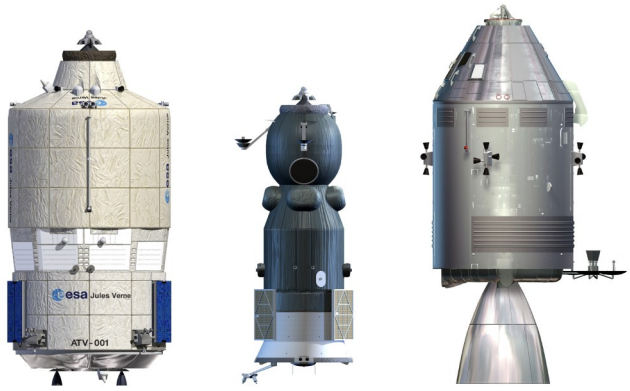
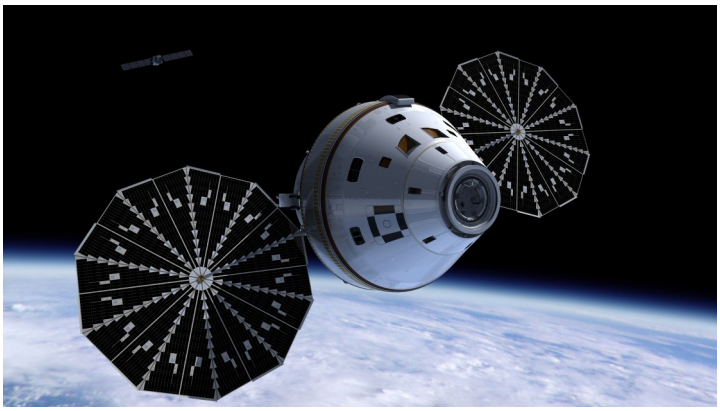
Right: Backdropped by the airglow of Earth's horizon and the blackness of space, the Jules Verne Automated Transfer Vehicle (ATV) approaches the International Space Station on Monday, 31 March, 2008, for its Demonstration Day 2 practice maneuvers. Image credit: NASA.

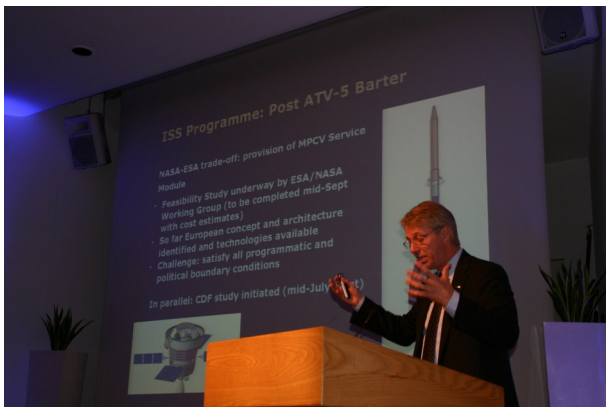
Right: The Automated Transfer Vehicle (ATV) is the first fully automatic re-supply spacecraft of its kind. ESA's Jules Verne ATV is the first European space supplier for the ISS. It was launched 9 March 2008 from Europe's spaceport in Kourou, French Guiana. Image credit: ESA - D. Ducros.



Far right below: A photograph from The Royal Aeronautical Society (RAeS) blog entry from the Aerospace Insight Blog. Thomas Reiter is shown speaking. Image credit: RAeS.

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





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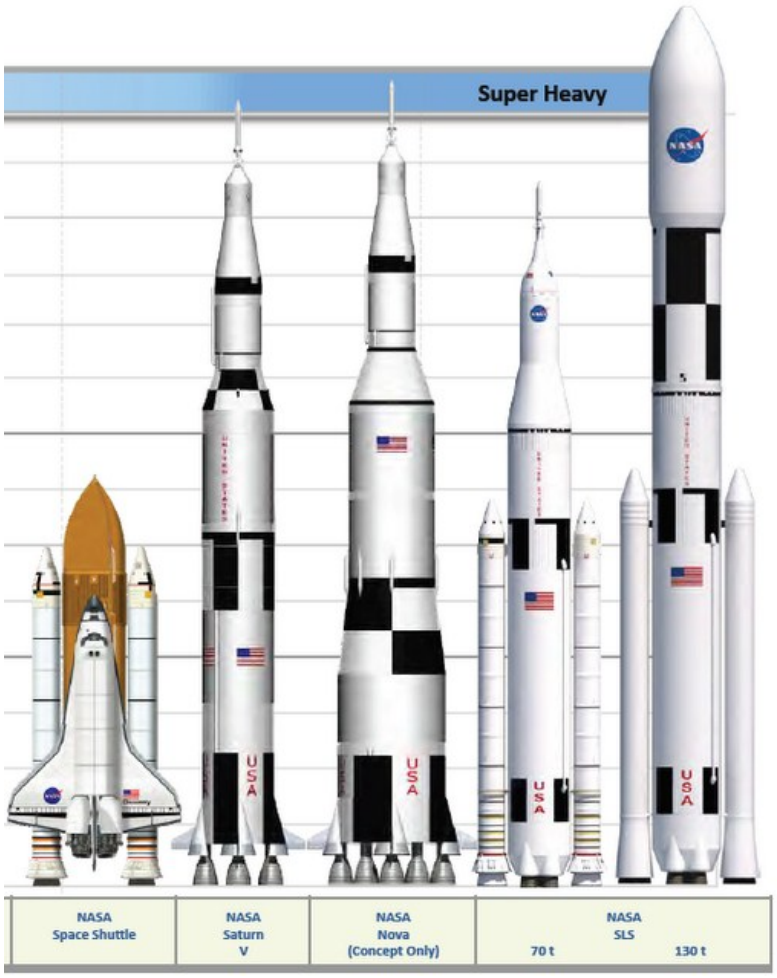
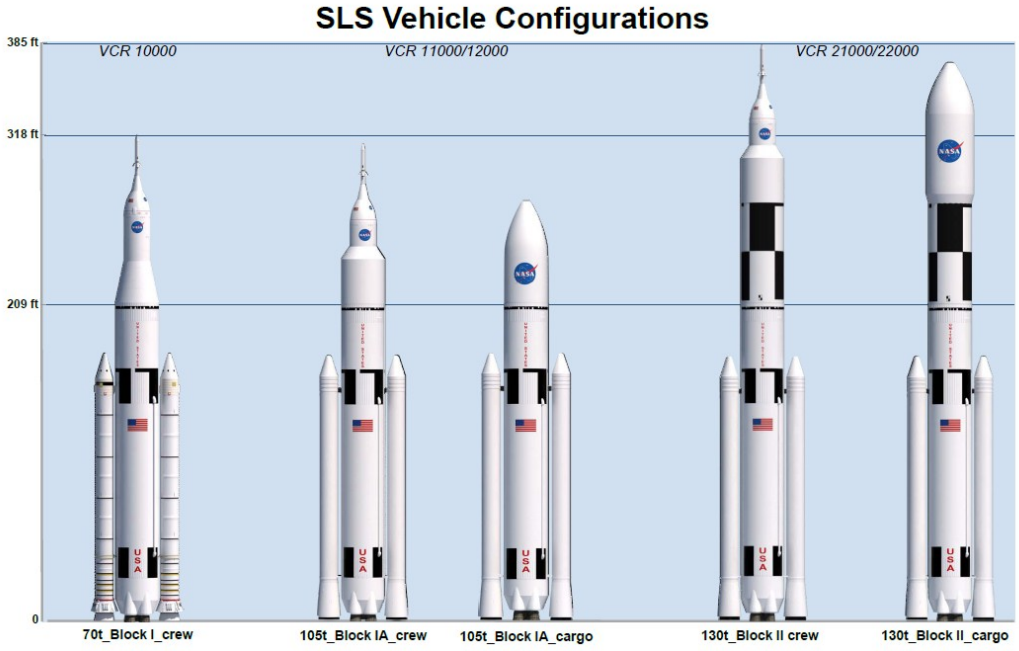
cussing, even recently, a possible contribution from ESA to the NASA Orion Multi-Purpose Crew Vehicle (MPCV) project (a subject already suggested in the 3AF MP newsletter *la Gazette*, issue number 22) by supplying services in order that Europe fulfills its "post-ATV" obligations. On January 16, 2012, the Director General of ESA reiterated to reporters his wish that this contribution take the form of elements of the Orion MPCV service module. For Europe, this would be a matter of making the best use of the expertise of the ATV program and Columbus. For the U.S., it would allow them to save time on the development of Orion, and to share the cost. Approvals from Europe remain to be obtained (after the next ESA ministerial meeting scheduled for late 2012), as well as approvals from the United States.

Unfortunately, in an article dated February 17, 2012, in Aviation Week and Space Technology (source: internet), titled "France, Italy Shun Orion Development," we learn the current position of the Presidents of the French National Center for Space Studies (CNES) and the Italian Space Agency (ASI) that reflects their opposition to their possible participation in the development of the Orion MPCV service module. So there is a disagreement currently existing between France and Italy on the one hand, and on the other hand, the barter (ATV as the service module for Orion MPCV, to be launched on NASA's planned heavy-lift rocket, the Space Launch System, or SLS) mentioned by Thomas Reiter (ESA) on September 19, 2011, before the British Royal Aeronautical Society (RAeS), described in *la Gazette* 3AF MP No. 22. *To be continued…*



Above: The NASA Space Launch System (SLS) compared to other NASA vehicles and an old NASA concept vehicle, a Nova-class rocket. Image source: A blog, The Remote-Controlled Vampire Cat, by J. M. Palmier. Image credit: NASA and www.NASASpaceflight.com.



Left: NASA Space Launch System (SLS) vehicle configurations. Image source: A blog, The Remote-Controlled Vampire Cat, by J. M. Palmier. Image credit: NASA and www.NASASpaceflight.com.

Ellington Airport

Ellington Field, Ellington Spaceport, & The Lone Star Flight Museum

DOUGLAS YAZELL, EDITOR

Mario Diaz, Aviation Director, Ellington Airport, made a presentation recently at the May 16, 2012 membership meeting of the Bay Area Houston Economic Partnership. Janice Larson alerted me to this surprising and exciting idea, "Ellington Spaceport!" Bob Payne at BAHEP supplied me with PDF charts from the presentation, along with PDF charts from another presentation from a different author about the military projects at Ellington Airport / Field.

I will continue to work on contacting the offices of these

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two presenters, in hopes of having detailed articles in Horizons about these AIAA-related activities in our back yard, so to speak. Meanwhile, here are a few images that will be of interest to our readers, thanks to Mr. Diaz.

Ellington Airport

Yuri's Night Houston 2012

Yuri's 5k Fun Run and Space Day 2012

MICHAEL FROSTAD

To celebrate Humanity's first steps into Space, specifically Yuri Gagarin's flight of Vostok-1 and STS-1 Space Shuttle Columbia's first flight, AIAA Houston Section hosted two events in April.

The first was the annual Yuri's 5k Fun Run held at Challenger 7 Memorial Park on April 7th. The Yuri's 5k, which supports the Challenger Center for Space Science Education, has grown to be part of the yearly runners tradition in the Houston Clear Lake area.

The activities began at 8am with a kids 1k run. The kids took off like rockets, each looking to lead the pack. As each one returned the crowd would erupt in applause encouraging them to finish strong. It was a fun activity for all.

Shortly after the Kids 1k run it was time for the main event, Yuri's 5k. Over 400 people came to run or walk the 5k on the near perfect morning at the park.

The course is a double loop through the park with the first loop adding in the obstacle of the Challenger Memorial Knoll. With volunteers, family members, and friends cheering people on throughout the varied terrain of the course, the race brings a smile to your face. Not to mention the medals for the winners, the free massages, and food.

The second event was held April 21st at Discovery Green in downtown Houston. The Society of Women Engineers (SWE) and Engineers Without Borders (EWB) joined AIAA Houston at the park with exhibits and water rockets.

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Volunteers spent the afternoon showing and discussing all the different aspects of Human Spaceflight and how some of that knowledge is helping to improve life on Earth. Posters describing many of the spacecraft in work, history of the liquid fueled rocket, International Space Station research, and future destinations allowed people to see the breadth of work being performed by the AIAA community.

Of course, the big hit with the kids on this very warm Space Day were the water rockets. Over 100 water rockets were created and launched throughout the afternoon thanks to SWE and North Forest High School volunteers.

AIAA Houston would like to thank all of the participants and sponsors for helping to make this years fun run and Space Day the best yet! A special thank you to Jacobs Technology for being a premier sponsor of the events. We would also like to thank ERC for their support as well as Odyssey Space Research, Walmart, Accord Texaswide and Motorala.

In addition, our Space Day partners and volunteers from the Society of Women Engineers and Engineers Without Borders, as well as North Forest High School, really are the ones who made it a great event at Discovery Green.

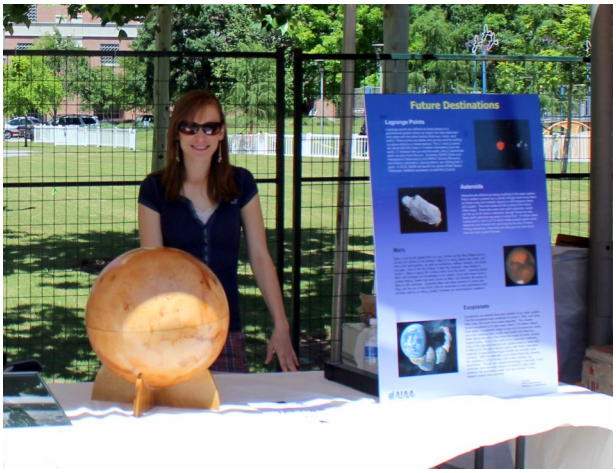
These two events gave us an opportunity to discuss space exploration with many in the Houston community and the large number of participants in the Yuri's 5k Fun Run combined with the great sponsor support for both events allowed AIAA Houston to make a $10,000 donation to the Challenger Center for Space Science Education! We hope to see you all again next year!

For more photos of the event please see the following links:

http://www.yurisnighthouston.net/

https://picasaweb.google.com/100078783678297762833/2012YuriS5kSpaceDay

Yuri's Night Houston 2012



Current Events

Launch of Chinese Astronauts, June 15, 2012

SHEN GE, CONTRIBUTOR & DOUGLAS YAZELL, EDITOR

Right: Liu Yang, the first Chinese woman to go into space. Image source: Enjoy Space. Image credit: CNSA.

Right: The crew of Shenzhou-9, from left, Liu Yang, Jing Haipeng and Liu Wang. Image source: Enjoy Space. Image credit: CNSA.

Right: The space station Tiangong-1 (right) on orbit with an approaching Shenzhou spacecraft (artist's image). Image source: Enjoy Space. Image credit: CNSA.

The Experimental Aircraft Association (EAA)

EAA Chapter 12 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 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 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.

EAA is the Experimental Aircraft Association. The Houston Chapter is #12, one of the earliest created among the hundreds of chapters.

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)

Left: RV9A on the ramp! This is a photo from the 1940 Air Terminal Museum web site, from the August 2011 Wings & Wheels monthly event, whose theme for that day was the annual Oshkosh Air Show and the EAA. Image credit: The Museum.

APR
E-Publication

Aerospace Projects Review

Aerospace Projects Review (APR) is presented by Scott Lowther, whose unique electronic publication is described as a "journal devoted to the untold tales of aerospacecraft design." More information may be found at the following address:

Scott Lowther
11305 W 10400 N
Thatcher, UT 84337
scottlowther@ix.netcom.com
www.aerospaceprojectsreview.com

Space Fighter: 1963

SCOTT LOWTHER

NASA wind tunnel reports are, as might be expected, excellent sources of information regarding certain aspects of a large number of unbuilt aircraft and spacecraft projects. What they tend to not be terribly useful for is programmatic or historical information about the designs they cover. It is not uncommon for a wind tunnel report to describe the aerodynamic characteristics of a very interesting vehicle, but provide precisely no information regarding who designed the vehicle (was it an internal NASA design, or produced by a contractor?), whether the

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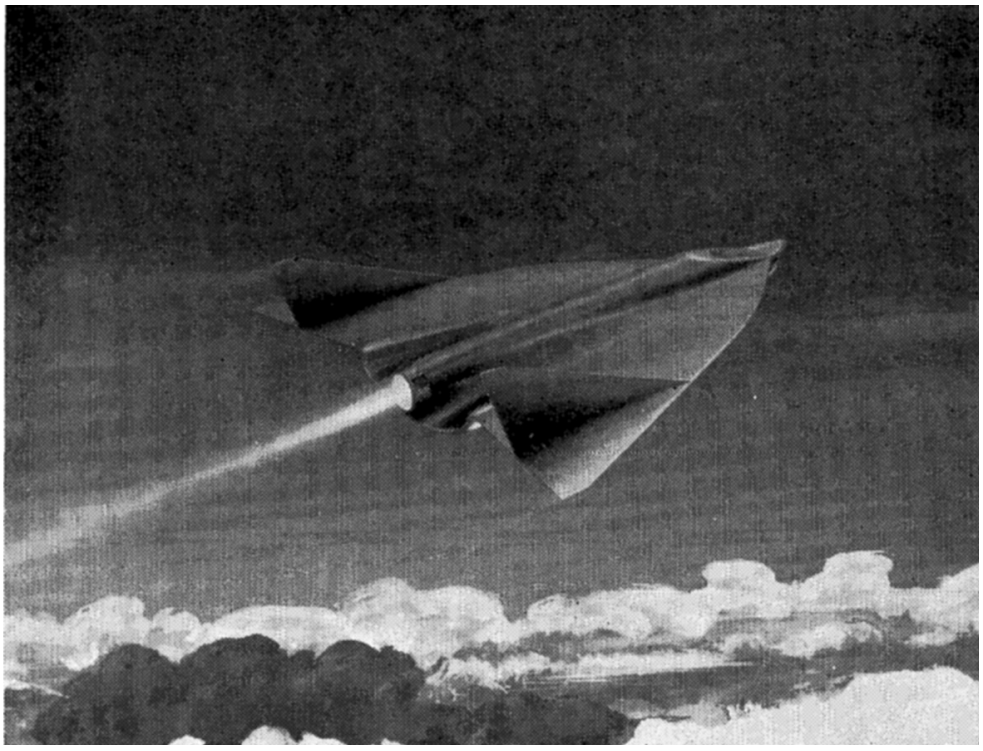
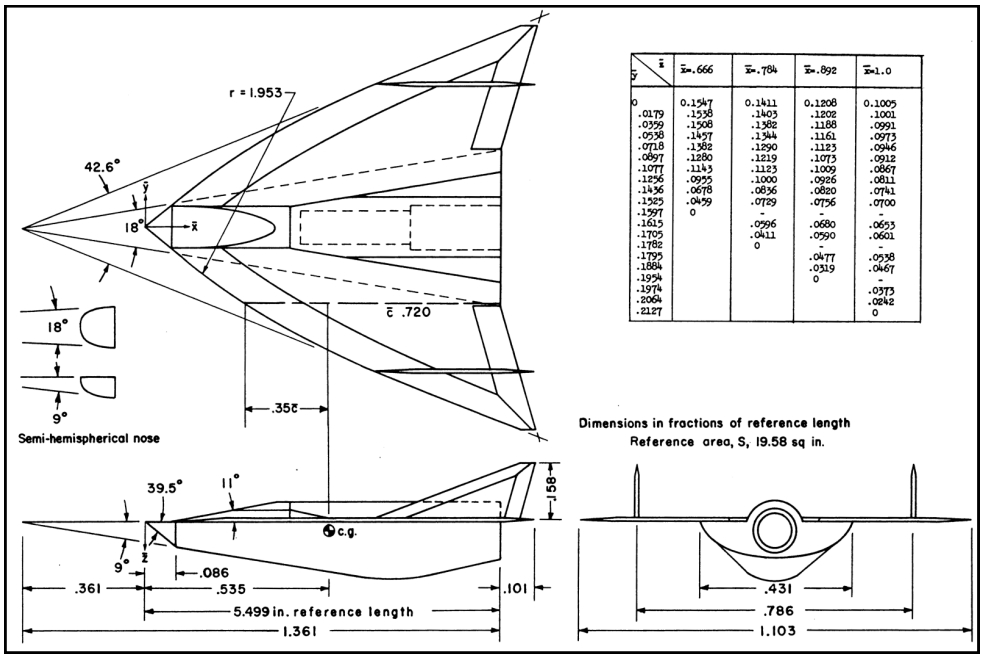


Right: Poor-quality reproduction of a painting of the basic concept under powered flight (NASA, 1961)



z̄/c̄	x̄=.666	x̄=.784	x̄=.892	x̄=1.0
0	0.1547	0.1411	0.1208	0.1005
.0179	.1538	.1403	.1202	.1001
.0359	.1508	.1382	.1188	.0991
.0538	.1457	.1344	.1161	.0973
.0718	.1382	.1290	.1123	.0946
.0897	.1280	.1219	.1073	.0912
.1077	.1143	.1123	.1009	.0867
.1256	.0955	.1000	.0926	.0811
.1436	.0678	.0836	.0820	.0741
.1525	.0459	.0729	.0756	.0700
.1597	0	-	-	-
.1615		.0596	.0680	.0653
.1705		.0411	.0590	.0601
.1782		0	-	-
.1795			.0477	.0538
.1884			.0319	.0467
.1954			0	-
.1974				.0373
.2064				.0242
.2127				0

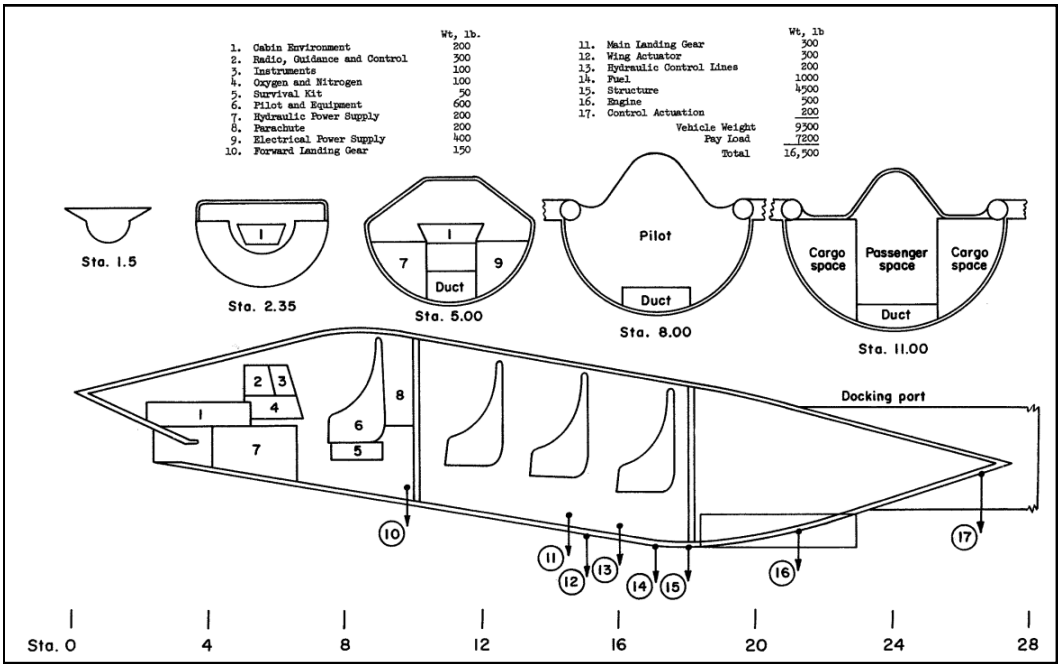
Right: Wind tunnel model general configuration (NASA, 1963)

(Continued from page 28)

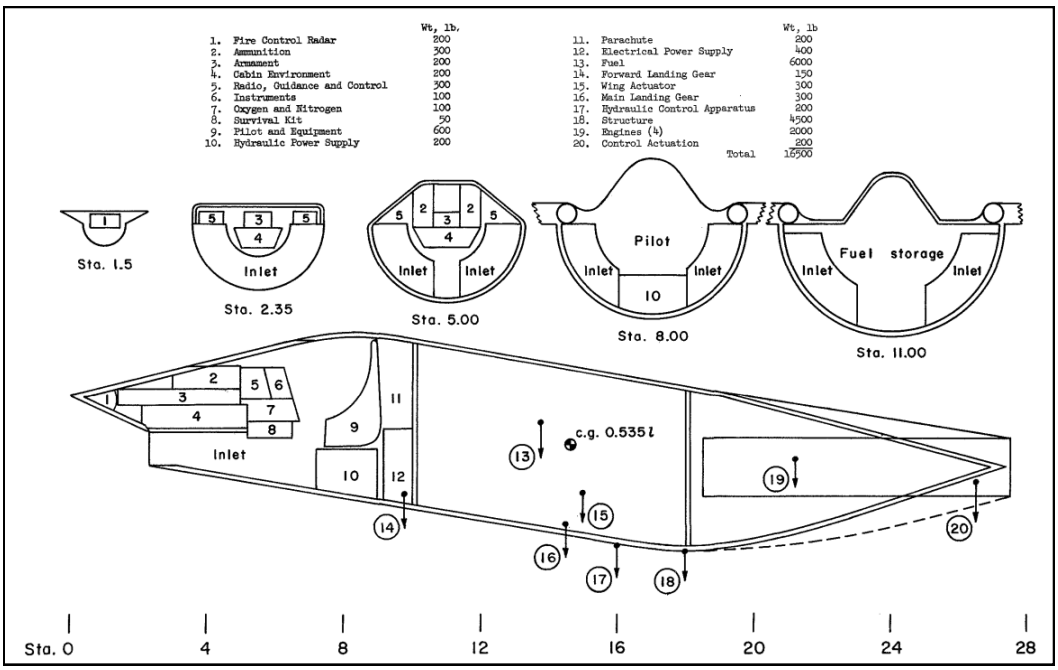
design was part of a larger design effort (was it part of a competition, or perhaps was it just a small aerodynamic study?), or what the prior and subsequent history of the design was. One such mystery vehicle is a winged re-entry vehicle reported on in NASA Ames reports from 1961 and 1963.

At the time, NASA and the rest of the American aerospace community were hard at work on producing designs for manned lifting entry vehicles – spaceplanes, in other words. The range of concepts was wide open; everything from darts to lifting bodies, from stubby capsules to variable geometry vehicles was studied. And generally, even without program information, the function of a design tested in a wind tunnel could be determined if only the scale of the model was known. But Ames wind tunnel tested a design that was suggested for two roles: the first, as an orbital "taxi" for the transport of crew into space (presumably to a space station); the second... as a fighter jet equipped with armament and

(Continued on page 30)



Left: Inboard profile of orbital version (NASA, 1963)



Left: Inboard profile of military version (NASA, 1963).

APR E-Publication

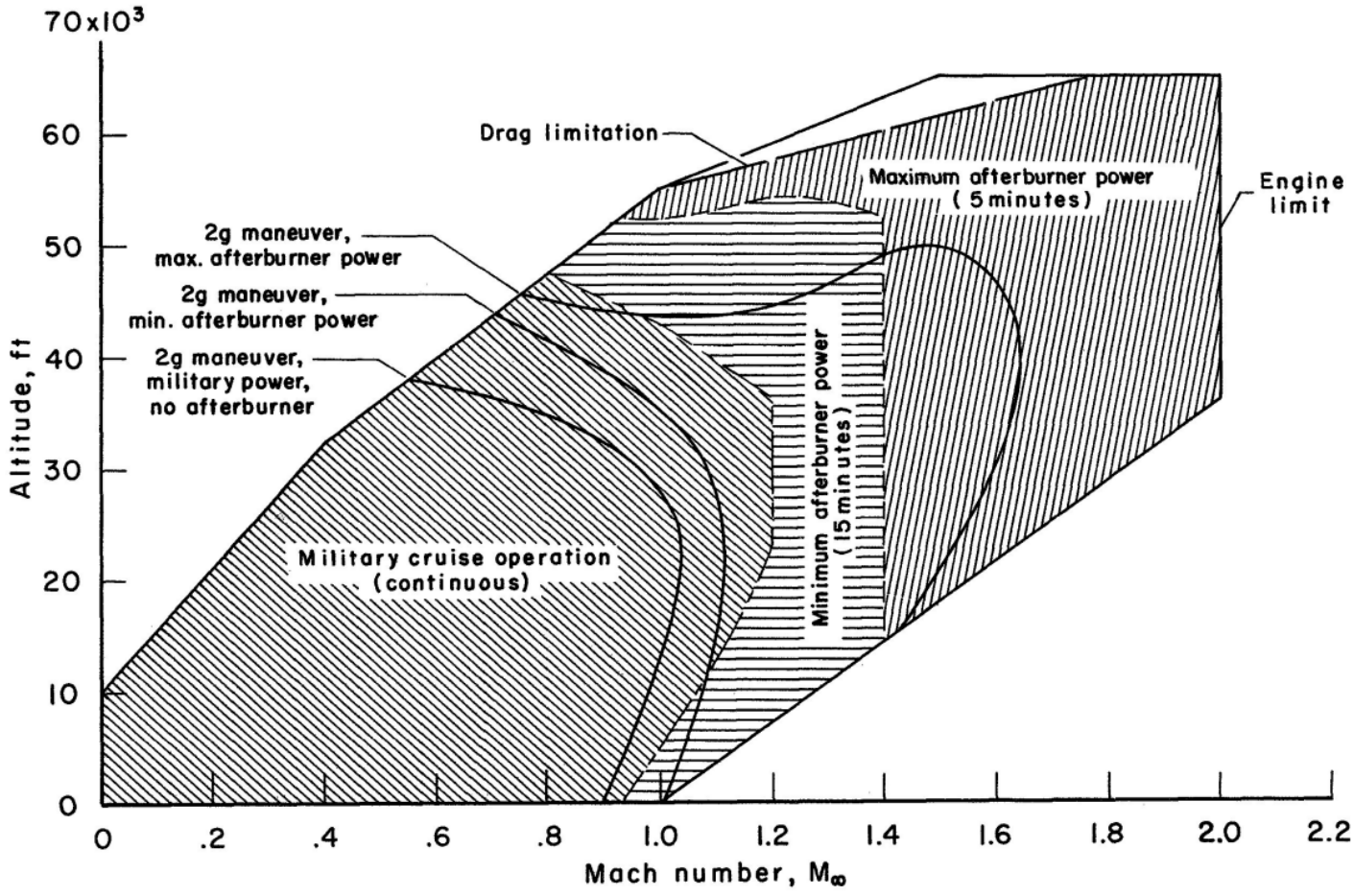
(Continued from page 29)
jet engines.

The basic vehicle was a variable geometry design that would stay folded up as a lifting body until well after reentry, but at low supersonic speeds would unfold large wings and eject a cover protecting an under-nose inlet for jet engines used for cruise. For the passenger version – which seemed to have room for a single pilot and three passengers, and some cargo capacity – a single jet engine was included, presumably for crossrange and/or go-around capability. But the second version replaced the passengers and cargo with added fuel capacity and more voluminous inlet ducts for four larger turbojet engines. In the nose ahead of the pilot was space for "armament" and "ammunition." No information is given as to what that armament was... presumably one or more machineguns, but also possibly a "rocket gun" firing guided or unguided missiles. Cruise Mach number was 2, but wing unfolding would begin at Mach 5 and 120,000 feet. The turbojets could be started at about 60,000 feet, between Mach 1 and 2. The four engines would produce 14,000 pounds of thrust. Launch weight of both the military and orbital versions was 20,000 pounds.

What was the role here? Sadly, the reports deal solely with the aerodynamics of the design, and do not provide that information. Was it a corporate design being tested by NASA, or was it a NASA design? The passenger version was of course meant to be orbital, so it's clear that the armed version would at the very least have been capable of global range, if given similar rocket boosting. But what was the idea behind shooting a dogfighter around the world in 45 minutes? Unfortunately, no information is available.

Pure speculation: the armed version may well have been a latecomer to the design. Orbital logistics was very likely always the prime mission; an armed version might well have been a last-minute addition to the roles the basic design could fulfill. But what

(Continued on page 31)



Below: Powered flight performance envelope of military version (NASA, 1963)

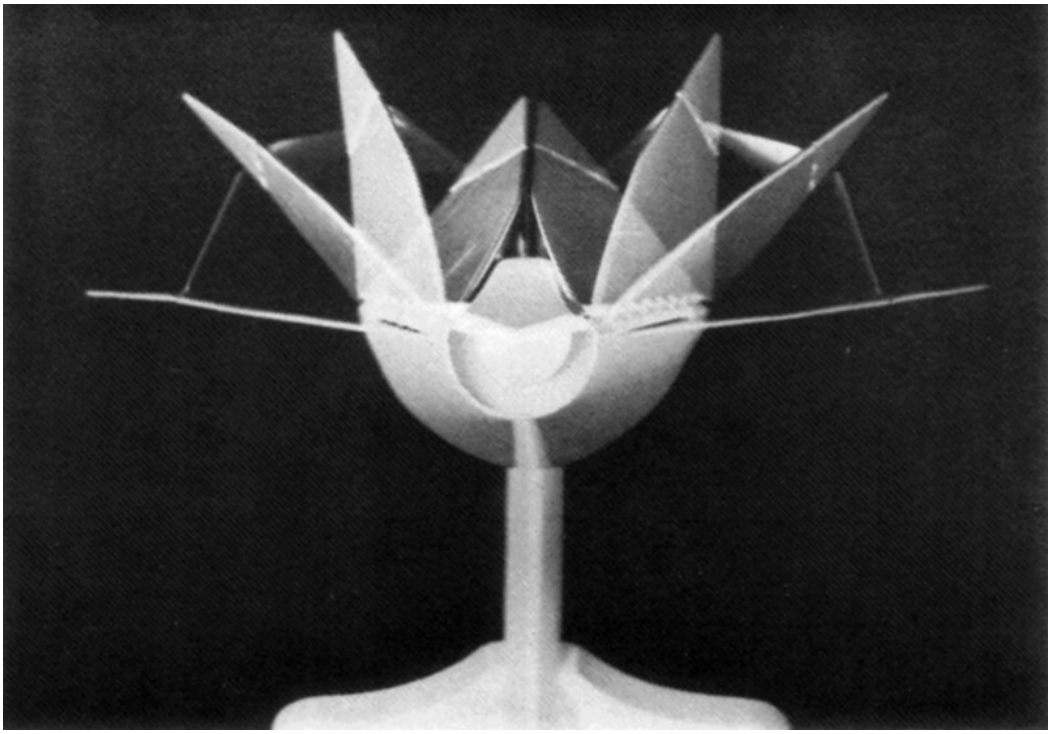
(Continued from page 30)

appears to have been a relatively mundane jet fighter with an extremely odd mission profile might have been suggested as an escort design for another concept.

In 1962, NASA was on the hunt for the "Post-Nova" (renamed "Post-Saturn" in 1963) launch vehicle, an advanced booster capable or orbiting around one million pounds of payload. Numerous companies tendered a great many designs, from multi-stage expendables to single-stage reusables. Douglas Missiles & Space produced the ROMBUS concept for a reusable single-stage to orbit vehicle, starting with a study that

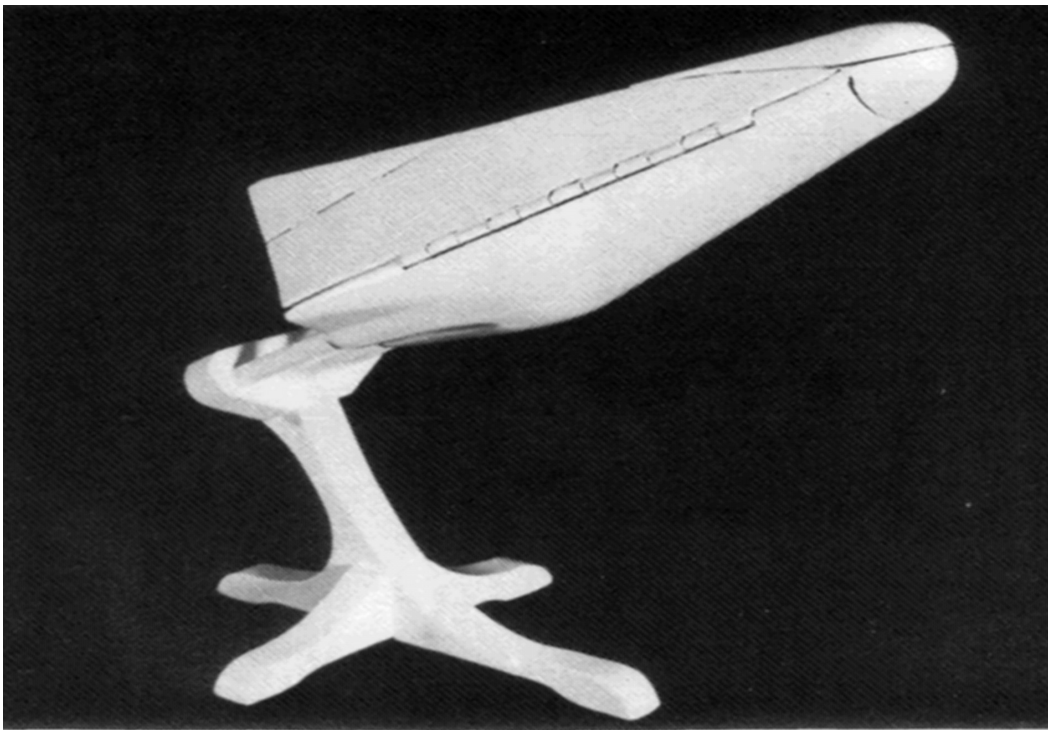
(Continued on page 32)

APR E-Publication

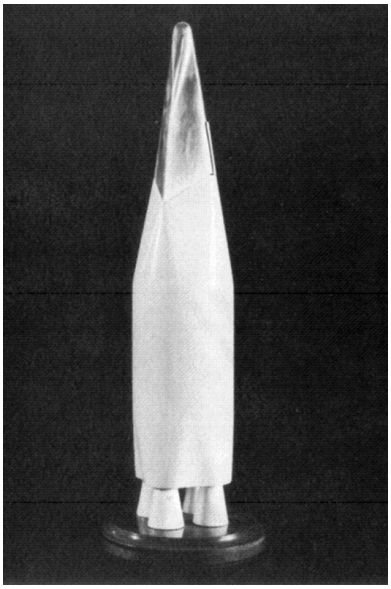


Left: Front view of model showing wing folding (NASA, 1963)

Below left: Display model showing wings folded (NASA, 1963)



Below: Display model of re-entry vehicle atop launcher – type unknown (NASA, 1963)



APR E-Publication

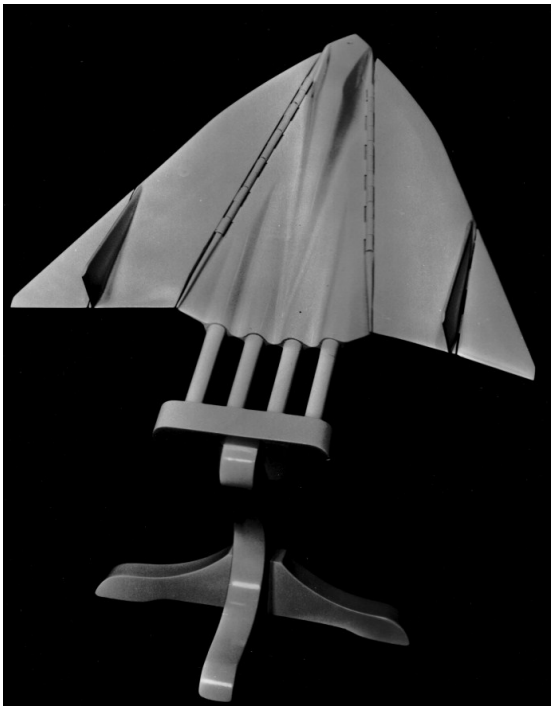
Below: Display model of folding-wing re-entry vehicle (via NASA Historical Archives)

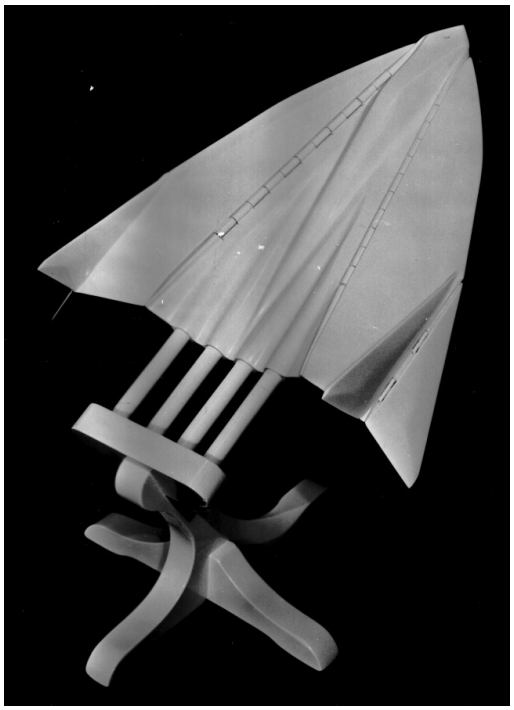
(Continued from page 31)

began in July of 1962. In 1963 Douglas began documenting alternate roles for ROMBUS and derivative designs, including point-to-point transport of cargo and passengers. In later 1963 Douglas unveiled the ICARUS, a ROMBUS derivative intended to transport 1,200 fully armed US Marines anywhere on Earth in 45 minutes.

The NASA-Ames "fighter" preceded official publication of the ICARUS concept. But it is just barely possible that there was some discussion between Douglas, USAF, USMC and NASA personnel prior to this leading to some interest being expressed by someone in the idea of a fighter jet that could be launched at the same time as ICARUS and either take out anti-ICARUS weapons systems prior to the ICARUS arriving, and/or provide air cover for ICARUS during and after landing, until conventional fighters could arrive. This is, of course, purest speculation.

If anyone has any further information on this concept, either on the design or the role, I'd love to see it!





References

Eggers and Wong, "Motion and Heating of Lifting Vehicles During Atmospheric Entry," American Rocket Society Journal, vol. 31 no. 10, Oct. 1961, pp. 1364-1375

Emerson, McDevitt and Wyss, "Aerodynamic Characteristics for a Booster-Launched Folding-Wing Entry Vehicle Suitable for Sustained Operation as a Supersonic Aircraft," NASA TM X-656, Ames Research Center, January, 1963

For information on the Douglas ROMBUS and ICARUS vehicles, see Aerospace Projects Review issue V2N6: www.aerospaceprojectsreview.com

Spirit of Apollo Scholarship Winner

RAFAEL MUNOZ, SCHOLARSHIP CHAIR

From Donya Ziraksari:

Dear Committee,

I want to thank the Apollo Scholarship committee for their generous award. I will be using the scholarship to continue pursuing my Bachelor's of Science degree in Mechanical Engineering with a concentration in Aerospace Engineering, which I plan on receiving in the fall of 2014 from the University of New Mexico. Soon after I complete my undergraduate coursework, I plan on attending graduate school to pursue my Master of Science in Mechanical Engineering.

I moved to the United States from Iran four years ago, where I was an honor student in Applied Mathematics and Physics. I have been studying here in New Mexico since I arrived and I am thankful for the opportunities to finish my education and work here.

In addition to my studies, I am currently working on research projects, such as satellite development, and laser-vibration experiments, with some of our Mechanical Engineering professors here at the University of New Mexico and in collaboration with the United States Air Force.

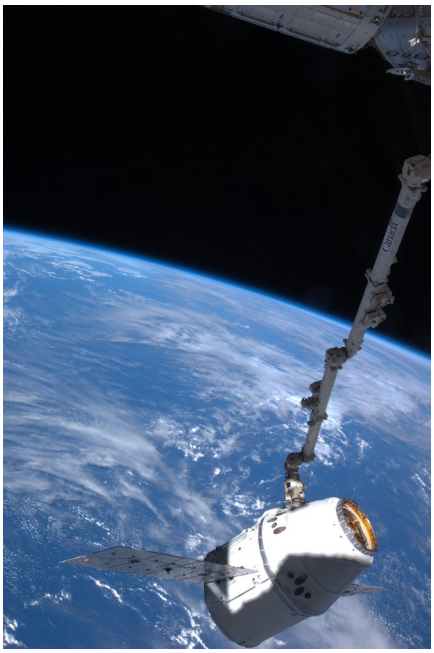
When I graduate I hope to work as a professional in an aerospace-related field that is beneficial to society. There are many recent developments and breakthroughs in our quest to understand and explore space beyond our own Earth, and I want to be in a contributing role in not only acquiring knowledge, but also helping to come up with new and useful products and innovative solutions that complement my strong desire to help people.

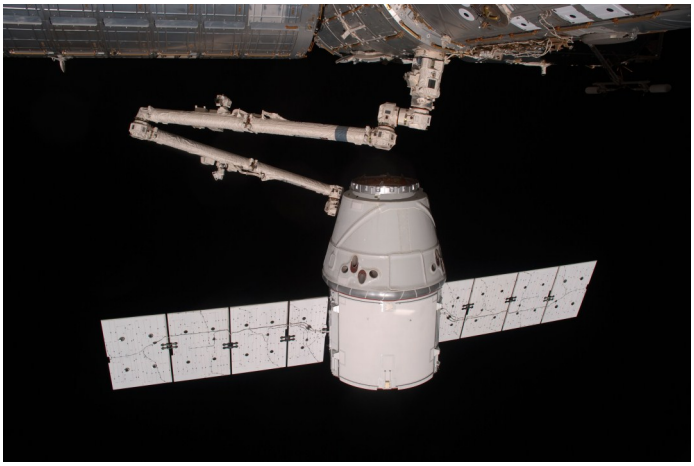
Upon completion of my B.S. degree, I would like to enroll in a M.E. graduate school program with a concentration in nanotechnology. As a professional in this area, my goal is to be able to come up with new and useful products and innovative solutions that would complement my strong desire to help people. Through my contribution in the field, I would like to prevent mechanical errors and make sure machines are safe for all users. My desire is to someday work for a company that cares about people's ideas and needs. I want to help disadvantaged communities within the U.S. and around the world maximizing all resources available. I believe that building strong collaborations with global corporations that share the same humanitarian mission is critical for all of us, considering the limited resources and lack of funding many countries have. I want to continue being open-minded about different ideas and methods that would enable me to grapple technical problems from around the globe.

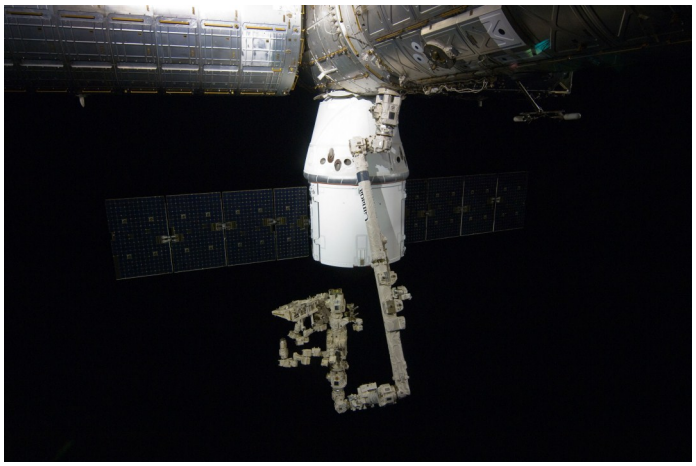
The 2011-2012 Spirit of Apollo scholarship from AIAA Houston Section is $1,000. Congratulations to our winner, Donya Ziraksari! Thanks to our Scholarship Chair Rafael Munoz.

Current Events

SpaceX Dragon capsule reaches The International Space Station (ISS) *and splashes down for a successful recovery. For this first arrival at ISS, the cargo was not essential. This was a SpaceX milestone in the NASA Commercial Orbital Transportation Services (COTS) contract. Launch: May 22, 2012, on a SpaceX Falcon 9 rocket. Splashdown: May 31, 2012. Image credits: NASA.*







Space Shuttle Replica Arrives at Space Center Houston from Florida

Images by Ellen Gillespie (two photographs below at Space Center Houston) and Douglas Yazell (at the Hilton Hotel on NASA Parkway, with fireworks going off as the space shuttle barge docks.) The space shuttle replica arrived by the Hilton Hotel on June 17, 2012.

Staying Informed

Rest in Peace
John Llewellyn

Images are from the AIAA Houston Section Lunch-and-Learn of December 19, 2008, celebrating the 40th anniversary of Apollo 8 (launch date, December 21, 1968).

John Llewellyn quotes are from the NASA DVD video of this event. Our section created a supplementary CD after this event.

John Llewellyn died May 8, 2012. [NASA Watch]

"My name is John Llewellyn and I am a recovering person from flight control. […]

"I went down and stayed down at the Cape because that was the only simulator that was working. The one up here, as usual, was "behi-i-i-nd schedule!" [Laughter] […]

"Look, the good thing about it is I'm so glad to be here and we could talk about this stuff, I could run it off and tell you things, and I'd like to do it. Like I say, I'm recovering from it. I never got over it. It's kind of like PTSD! [Laughter] […]

"I am so lucky to be American and being able to work on Apollo Program. Because we did it. We took, in 1958, I think […] We took that thing and went to the Moon, and landed, and got the guy, and brought him back! And we did it in ten years! And we *didn't* get any help from anybody. […]

(Continued on page 37)

Above: from left: Marianne Dyson (moderator), Hal Beck, Rod Rose, Marty Jenness, Ken Young, John Llewellyn, Glynn Lunney, Dr. Christopher Kraft and Emil Schiesser. Images: Douglas Yazell.

(Continued from page 36)

Staying Informed

"So I am really proud of NASA, and I hope you do [sic]. And we do [sic] going to leave you a legacy, and I would appreciate it if you would do something with it! Thank you."

Editor's note:

I recalled a memorable mention of John Llewellyn in Sy Liebergot's book about Apollo 13, so I was all ears when John Llewellyn spoke at this 2008 event. Those last two sentences seem to show a bit of an accent or a dialect, something I imagine stuck with him since his youth. There is a certain poetry to his way of speaking, so I do my best to report those last two sentences just as he said them.

The 40th anniversary of Apollo continues in 2012. Apollo 17 is next (launch date, December 7, 1972). The NASA commemorative medallions containing flown metal are a set of 13 medallions, all showing that Apollo 40th anniversary logo on one side. One shows the NASA logo on the other side. The others show the mission patches for the twelve human space flight Apollo missions, Apollo 1 and 7-17. Released for sale (very affordable) so far are the NASA logo and Apollo 11, 12, 13, 16 and 17 medallions. Apollo 15 will be the next to be available for purchase.

The Spring 2009 issue of Horizons contains an article about this 2008 lunch-and-learn event on pages 25-29.

Above: From the left, Marianne Dyson (moderator), Dr. Albert A. Jackson IV (event organizer & former lunar module crew instructor), Hal Beck, Rod Rose, Marty Jenness, Ken Young, and John Llewellyn. Image credit: Douglas Yazell.

Above: Back row, from left: Marty Jenness, Dr. Christopher Kraft, John Llewellyn, Ken Young, Glynn Lunney, Emil Schiesser and Dr. Albert A. Jackson IV (event . From row from left: Hal Beck, Rod Rose, and Marianne Dyson (moderator). Image credit: Douglas Yazell.

Links from our French Sister Section for Staying Informed:

http://www.esa.int/esaEO/SEMTLZ2VQUD_planet_0.html
http://www.esa.int/esaEO/SEM5GGZTIVE_planet_0.html

http://smsc.cnes.fr/Fr/oceans.htm
http://smsc.cnes.fr/IASI/Fr/

'ESA-Sentinels' satellites web site: http://www.esa.int/esaLP/SEM097EH1TF_LPgmes_0.html

'Pleïades' web site: http://www.cnes.fr/web/CNES-fr/3227-pleiades.php (Pleïade-1 is already flying)

Cryosat-2 web site: http://www.esa.int/esaLP/LPcryosat.html

SMOS web site: http://smsc.cnes.fr/SMOS/Fr/
DLR Institute of Atmospheric Physics web site: http://www.dlr.de/pa/en/desktopdefault.aspx/tabid-2342/6725_read-26662/

Calendar

AIAA Houston Section events & other events related to aeronautics & astronautics.
This May / June 2012 issue of Horizons is scheduled to be online by June 30, 2012.
All items are subject to change without notice.

AIAA Houston Section council meetings: for info, email secretary[at]aiaa-houston.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.
The new AIAA year starts July 1, 2012.

July 2012: Annual Honors and Awards dinner meeting. Postponed from June 2012 to July 2012 because of the June 6, 2012 dinner meeting celebrating the 50th anniversary of AIAA Houston Section, and to give us time to conduct our election on about Friday, June 8, 2012.
Date: TBD
Venue: TBD

August 2012: Annual leadership retreat.
Date: TBD, probably after the Regional Leadership Conference (below)

AIAA National & International Conferences

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

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

Cranium Cruncher

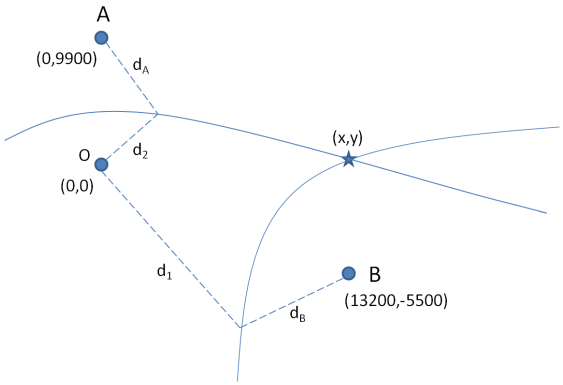
Challenge

DR. STEVEN E. EVERETT

In last month's puzzle, the problem was posed of computing the location of a lightning strike given the times heard from the thunder in three different locations. Let's assume your office is at the origin of the reference frame, Alex's office is at (0,9900) and Benny's office is at (13200,-5500), where distances are in feet.

The time between hearing the thunder over Benny's phone line and hearing it outside was 7 seconds, i.e., the difference in distances is given by

$$d_1 - d_B = 7 * 1100 \text{ ft/s}$$



Likewise, the time between hearing the thunder outside and over the phone at Alex's office was 3 seconds, i.e, the difference in distances is given by

$$d_A - d_2 = 3 * 1100 \text{ ft/s}$$

Note that the locus of points for which the absolute value of the differences of the distances to two fixed points is constant is called a hyperbola. Thus, the problem above reduces to finding the intersection of two hyperbolas. Setting d1=d2, the distance from O to the point of the lightning strike (x,y) we get two simultaneous equations that can be solved. After some math, we find the point (13200,0) is a distance of 5500 ft from B, 13200 ft from O, and 16500 ft from A, so that the traversal time taken for sound travelling at 1100 ft/s is 5 sec, 12 sec, and 15 sec, respectively. In other words, when the lightning strike happened at 5 seconds before noon, Benny and the others heard it at 12:00, it was heard outside 7 seconds later, and then it was heard by Alex and the others 3 seconds later.

This month, you are doing an engineering design and realize the problem may have been solved years ago. You find yourself digging through some old engineering notes that a retired colleague had stored away in his garage, and in them is a handwritten page of calculations on just the problem you are solving. However, one of the long division problems has become so smeared, only one digit, a "7", is legible. Can you fill in the missing values based only on the knowledge of the location of the remaining digits?

```
        *7***
    ---------
***) ********
     ****
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      ***
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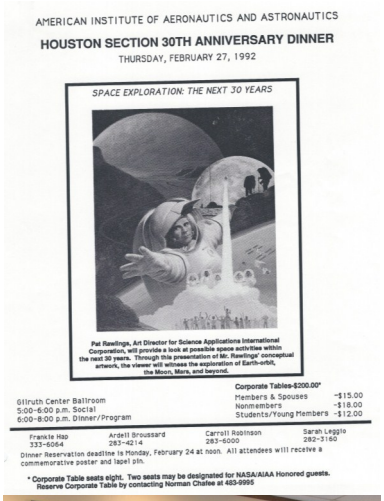
Send solutions to steven.e.everett at boeing.com.

Section News


AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

HOUSTON SECTION 30TH ANNIVERSARY DINNER

THURSDAY, FEBRUARY 27, 1992

SPACE EXPLORATION: THE NEXT 30 YEARS

Pat Rawlings, Art Director for Science Applications International Corporation, will provide a look at possible space activities within the next 30 years. Through this presentation of Mr. Rawlings' conceptual artwork, the viewer will witness the exploration of Earth-orbit, the Moon, Mars, and beyond.

Gilruth Center Ballroom
5:00-6:00 p.m. Social
6:00-8:00 p.m. Dinner/Program

Corporate Tables-$200.00*
Members & Spouses -$15.00
Nonmembers -$18.00
Students/Young Members -$12.00

Frankie Hap 333-6064
Ardell Broussard 283-4214
Carroll Robinson 283-6000
Sarah Leggio 282-3160

Dinner Reservation deadline is Monday, February 24 at noon. All attendees will receive a commemorative poster and lapel pin.

* Corporate Table seats eight. Two seats may be designated for NASA/AIAA Honored guests. Reserve Corporate Table by contacting Norman Chafee at 483-9966

Above: Artist Pat Rawlings used this image for the flyer for our 1992 dinner meeting. The mural in the entrance area to NASA/ JSC Gilruth Center was updated a few months ago to use this image in place miniature reproduction of the Robert McCall mural which still remains in NASA/JSC Building 2, The Teague Auditorium.

AIAA Wichita Section
Air Capital of the World

AIAA The World's Forum for Aerospace Leadership Wichita Section

AIAA Houston Section Since 1962

Above: Examples of AIAA section logos from an AIAA manual. With help from AIAA national, we are now creating a logo for AIAA Houston Section. One version above uses a blue marble Earth.

Newsletter submissions: Friday, August 10, 2012, for the July / August 2012 issue. That will be online and publicized by Friday, August 31, 2012.

Student Paper Conference (SPC): AIAA Houston Section hosts this Region IV (a four-state region: Texas, Oklahoma, New Mexico, and Arkansas) every other year. This year it took place at NASA/JSC on Friday, April 6, 2012. Thanks to organizers Daniel Nobles, Irene Chan, and others, it was a great success.

The new AIAA year: The new year starts on July 1, 2012. Our updated 45-person council will take effect on that date. As shown on our organization chart, 20 of those are elected, and they are the voters when votes are required. Since our hands were full with the dinner meeting of June 6, 2012 (our AIAA Houston Section 50th anniversary event), our annual honors and awards dinner meeting will take place in July instead of June 2012. The ballot went out via e-mail a few days ago as of today, Wednesday, June 13, 2012.

The new web site: Starting July 1, 2012, Irene Chan is our new webmaster. It may take some time to fully populate the new web site, www.aiaahouston.org, which replaces www.aiaa-houston.org. Thanks very much to outgoing webmaster Gary Cowan and Curbside Multimedia! He updated our web site the past few years to give it a very colorful and modern look, after our use of phpwebhosting for a few years.

The weekly astronomy lunch: It's amazing to think that for years, Dr. Albert A. Jackson IV (our section's current astrodynamics technical committee Chair) hosted an informal astronomy lunch lecture almost every week for almost every year for years! The lecture speakers and topics were listed in Horizons. That tradition started in about 1975 at JSC with astronomer (and author) Thornton Page as host. The tradition continues today, though Al Jackson and others moved it to The Colosseum on El Camino Real just north of Bay Area Blvd, at 11:00 AM on Wednesdays. There are no more lectures, but the tradition is still there, and it is in Al's genes! He still consults for NASA. Come join the group anytime. Contact douglas.yazell[at]me.com if you have questions before attending.

The 100 YSS (The 100 Year Starship Project) is not an AIAA project. It started in late 2011 with a symposium in Orlando, Florida, organized mostly by DARPA (The Department of Defense Research Projects Agency), with some help from NASA/Ames. They held a competition to award $500,000 to a team that would organize this human space flight to another star system in the next 100 years without using any more government money. But the 2012 Public Symposium is coming to Houston! It will take place September 13-16, 2012, in Houston. See www.100yss.org. Former astronaut Mae Jemison is a member of the winning team, so we have a Houston connection.

Correction for the March / April 2012 issue: We published three photographs of Neil Armstrong on page 10 of that issue, but some captions were wrong. Dr. Ryan Kobrick tells us that Professor David Klaus took the second photo and Dr. Kobrick took the first. The third photo is from Dr. Kobrick's camera, taken by Luis Zea.

This issue of Horizons is Volume 37, Number 7, as shown on the cover. Next issue, the July / August 2012 issue, will be Volume 38, Number 1. The AIAA year starts on July 1, 2012, for most purposes. This May / June 2012 issue will be online and publicized by June 30, 2012.

We created a new logo for our dinner meeting of June 6, 2012 (the 50th anniversary of AIAA Houston Section). We added a blue marble Earth to the traditional logo, and a few words such as "Houston Section" and "Since 1962." Douglas Yazell, Alan Sisson, and Michael Frostad worked on that, and your inputs are welcome as we work on a new logo for AIAA Houston Section. Horizons art contributor Don Kulba might have advice for us, too. In place of a blue marble Earth, maybe an ISS silhouette or an Orion MPCV silhouette would work better?

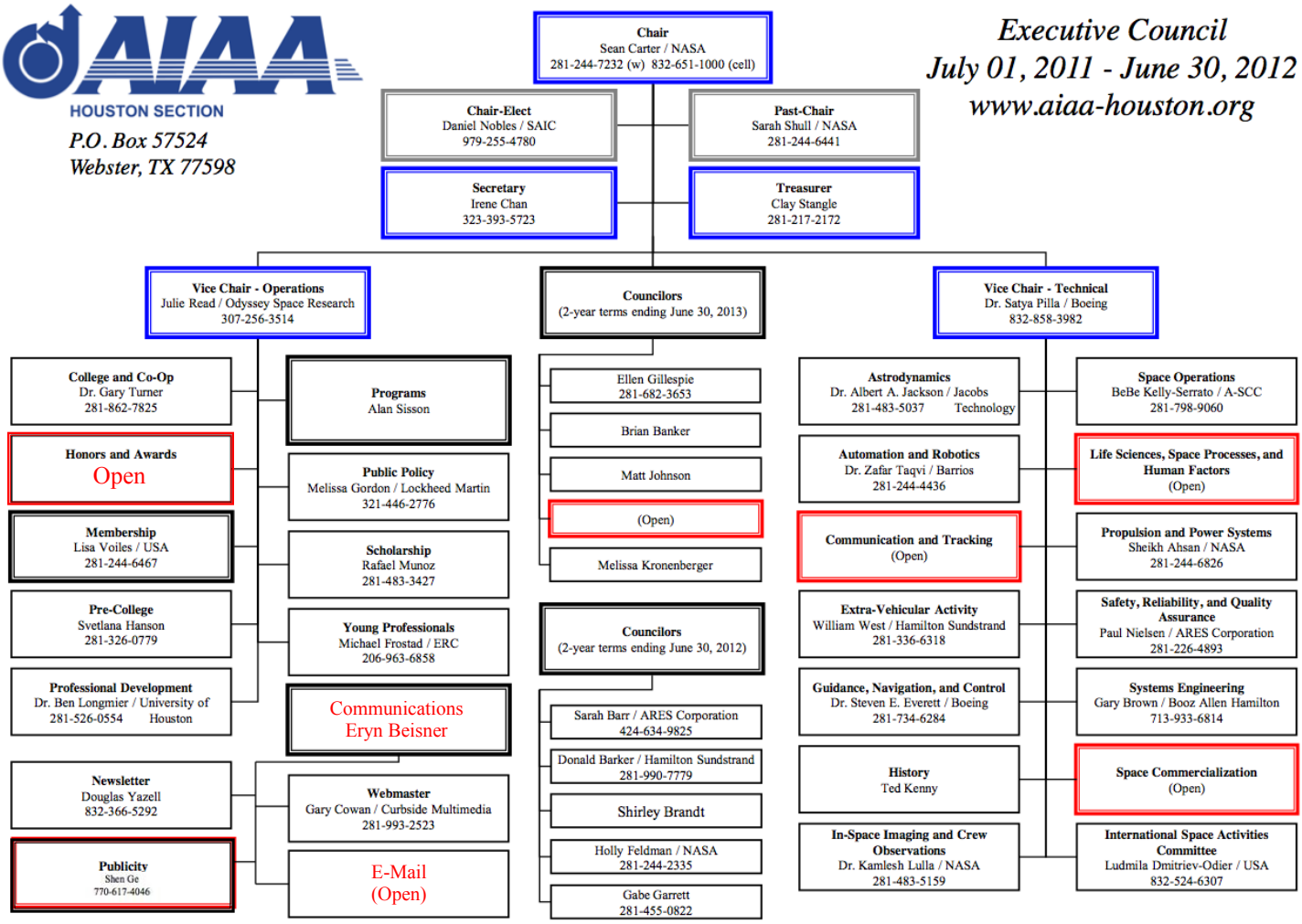
The Lunar and Planetary Institute (LPI) Cosmic Explorations public lecture took place on Thursday, June 7, 2012, featuring Dr. Stephen Clifford of LPI, "Mars Discoveries and Insights from 50 Years of Robotic Exploration." They sometimes post the video, so watch for that!

The American Institute of Aeronautics and Astronautics

Section News

HOUSTON SECTION
P.O. Box 57524
Webster, TX 77598

Executive Council
July 01, 2011 - June 30, 2012
www.aiaa-houston.org



Updated November 8, 2011, Executive Council Voting Members (20) are identified by:

Candidates for the annual election of June 12 - 25, 2012 (see the organization chart above):

Chair: Jonathan Sandys
Vice Chair Technical: Brian Banker & Dr. Satya Pilla
Vice Chair Operations: Michael Frostad & Michael Martin
Secretary: Robert Plunkett
Treasurer: Clay Stangle
Councilors:
1) Shirley Brandt
2) Dr. Larry Friesen
3) Sarah Shull
4) Christopher Davila
5) Alan Sisson

Above: The web site above used www.aiaa-houston.org and was provided by Gary Cowan / Curbside Multimedia. It will be replaced starting July 1, 2012, though it might take time to fully implement the new web site using www.aiaahouston.org.

www.aiaa-houston.org

That will change to
www.aiaahouston.org
Starting July 1, 2012

AIAA Houston Section
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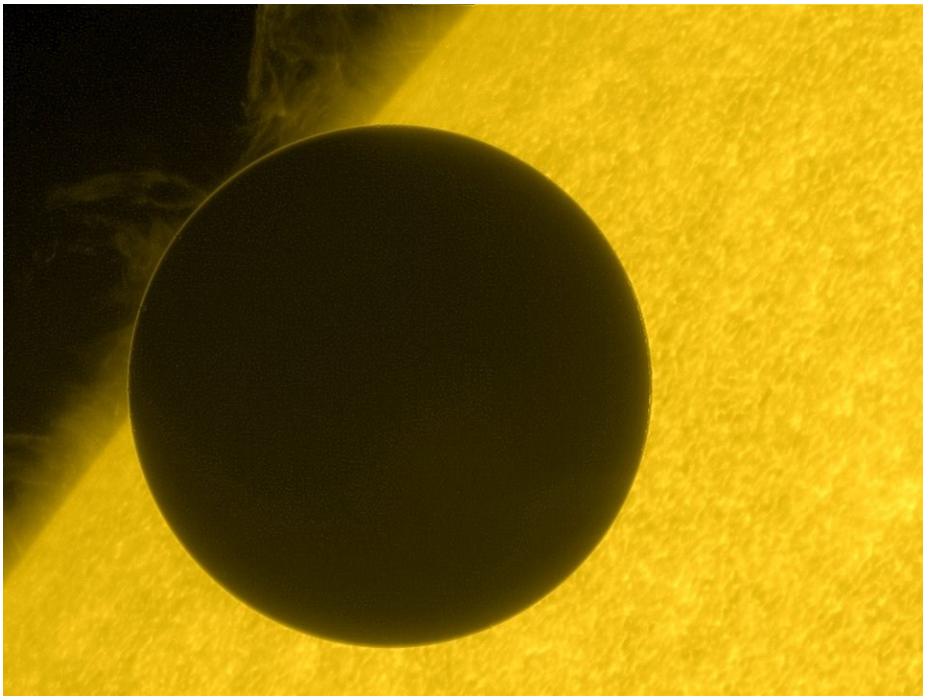
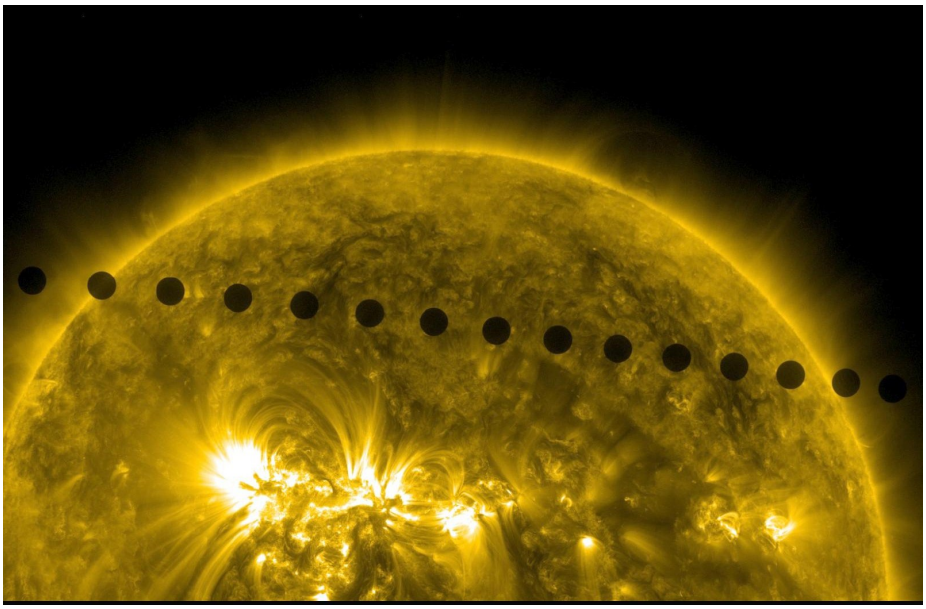


Left: Hinode Views the 2012 Venus Transit

On June 5, 2012, Hinode captured these stunning views of the transit of Venus -- the last instance of this rare phenomenon until 2117. Hinode is a joint JAXA/NASA mission to study the connections of the sun's surface magnetism, primarily in and around sunspots. NASA's Marshall Space Flight Center in Huntsville, Ala., manages Hinode science operations and oversaw development of the scientific instrumentation provided for the mission by NASA, and industry. The Lockheed Martin Corp. in Palo Alto, Calif., is the lead U.S. investigator for the Solar Optical Telescope.

Image credit: JAXA/NASA/Lockheed Martin



Left: Path of the 2012 Venus Transit

On June 5-6 2012, NASA's Solar Dynamics Observatory, or SDO, collected images of one of the rarest predictable solar events: the transit of Venus across the face of the sun. This event happens in pairs eight years apart that are separated from each other by 105 or 121 years. The last transit was in 2004 and the next will not happen until 2117.

Image Credit: NASA/SDO, AIA

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