Horizons

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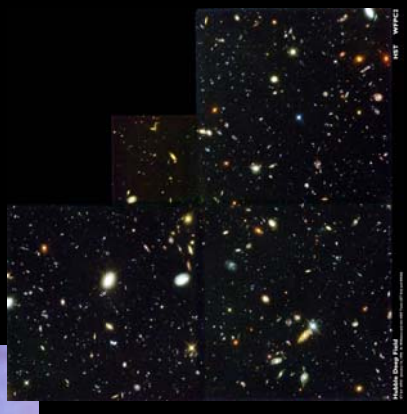
Final Visit to Hubble



Spring 2009

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Cover: STS-400 crew picture and Hubble photo montage.

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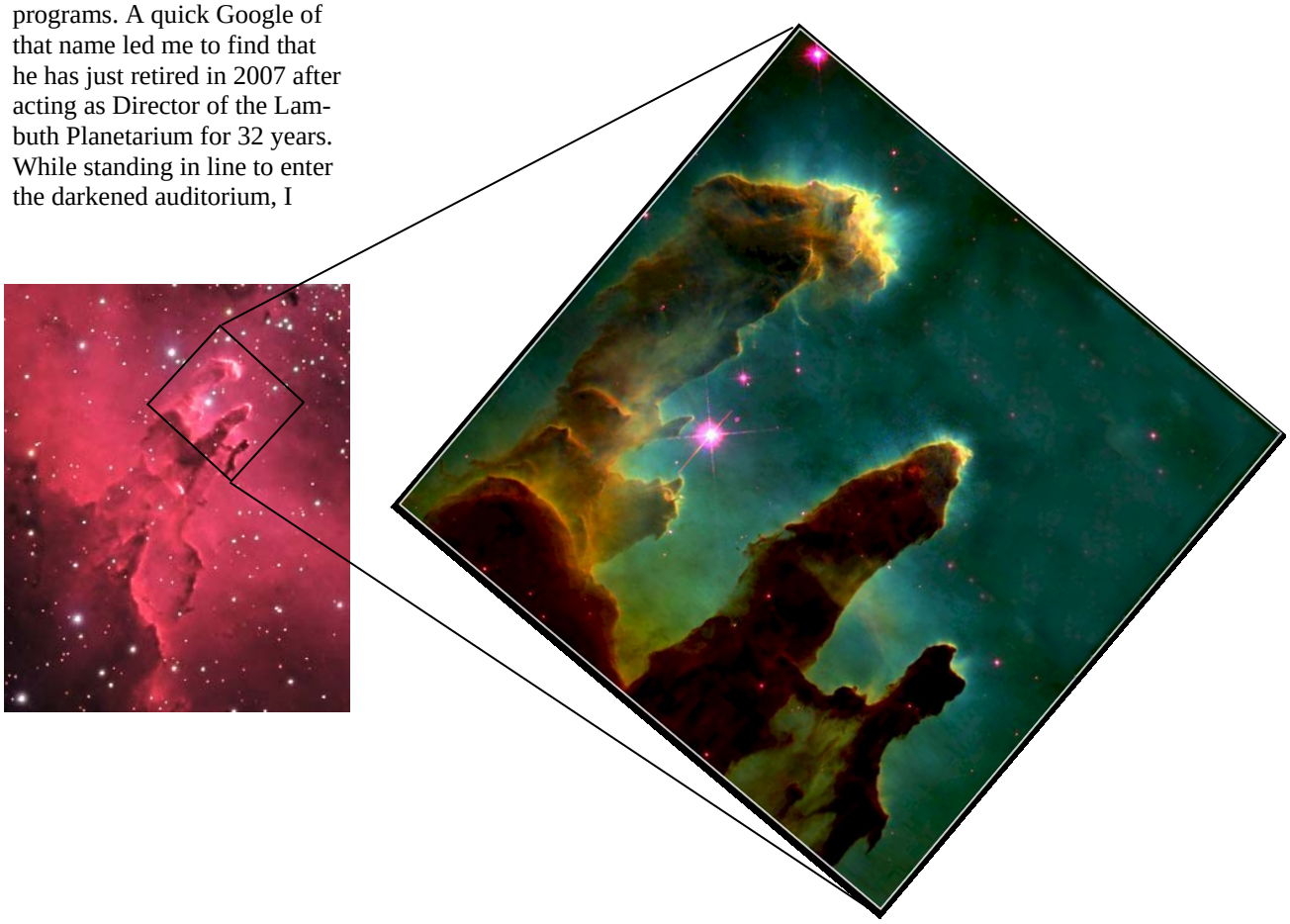
STEVEN E. EVERETT

From the Editor

It is appropriate that during this, the International Year of Astronomy, we are also conducting what will very likely be the last manned visit to the Hubble Observatory. I believe that we in the spaceflight community have much to owe the field of astronomy since the magnificent and mysterious pictures of the night sky have done more the ignite the interest of the general public for space travel than any other field, and none more so than those generated by the Hubble telescope. I recall as a boy being taken to the Lambuth Planetarium in Jackson, Tennessee, on several occasions where a young professor of astronomy named Ronnie Barnes directed the programs. A quick Google of that name led me to find that he has just retired in 2007 after acting as Director of the Lambuth Planetarium for 32 years. While standing in line to enter the darkened auditorium, I would study the backlighted slides inset along the wall. One of those was a reddish, grainy image of the Eagle nebula, similar to the one pictured on the left, below. (I had always harbored a different name for that nebula in my own mind, the "Superman nebula," because of the head, cape and outstretched arms I could see extending toward the upper right.) I can still remember the sense of awe I felt once we were seated as the lights dimmed with a glow like twilight, the music played, and the projected stars began to appear. I still remember the dizzy feeling that I would get when the projector was repositioned to display a specific season and time and the stars wheeled around the sky. I was fascinated by the director's projected arrow bouncing around on the ceiling, tracing circles and lines along each constellation. That I remember so much of the detail of these visits is a testament to the impact it had on me at the time, and I am sure these experiences contributed to my eventual career goals. I daresay most of us in the aerospace field could relate similar recollections.

In this issue of Horizons, we get the perspective of amateur astronomer and Mission Director Chuck Shaw on the upcoming Hubble mission, as well as an insight into preparations for a hopefully unnecessary rescue scenario for that mission.



The Eagle nebula, then and now

1940 Air Terminal

Wings & Wheels Program for January 2009

DOUGLAS YAZELL, PAST CHAIR

The date for our national AIAA Historic Aerospace Site ceremony for the 1940 Air Terminal Building is now set for Saturday, April 18, 2009. That's a third Saturday of the month, when the museum always presents its monthly Wings and Wheels event. But once a year, it's a bigger event called Hobby Fest. A good arrival time is typically 11:30 am or noon. Lunch with chips, water, sodas, and items like hot dogs or hamburgers are included. Admission on these special monthly days is $10 for adults and $5 for kids, but for Hobby Fest, it's $5 and $2, respectively.

Right: The building's old control tower is often toured now but is not in operation. A runway is just behind the building. The new control tower is shown below. With that same black SUV for reference, we can see that it is farther from the runways.

Right: Some antique cars were on display for the monthly Wings and Wheels program.

Right: Mr. John M. Coale gave a presentation about his 2004 round-the-world flight. A related web site is http://www.earthrounders.com His web site is: http://www.n30ew.com/

Photos by Douglas Yazell

Interview with Chuck Shaw: Parallel Perspectives on Hubble

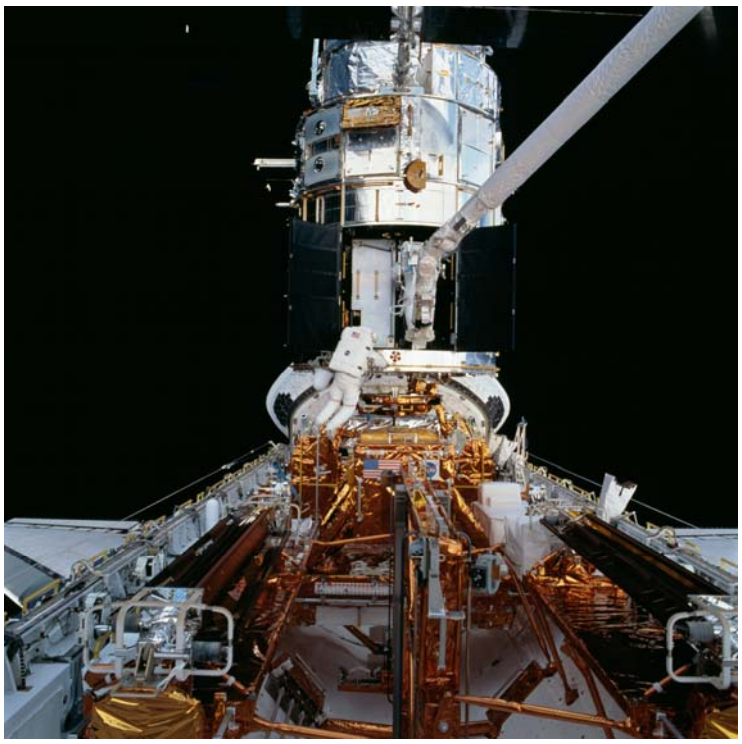
Feature Article

SEAN KEEFE, ASSISTANT EDITOR, HORIZONS

Hubble Servicing Mission 4 (SM4) was originally scheduled for liftoff on September 11, 2008 aboard Space Shuttle Atlantis. The 11-day mission was first postponed from September to October of 2008 due to lost training time from Hurricane Ike's impact. The mission was again postponed—this time until spring of 2009—due to a data transmission anomaly detected on Hubble in late September. A redundant data channel is being used on Hubble now as NASA considers additional repairs and training of crew to address the malfunction. When STS-125 launches, Space Shuttle Endeavour will be on the launch pad and ready for the next ISS assembly mission, 2JA/STS-127. [At the time of this writing, Space Shuttle Atlantis is scheduled to launch on May 12, 2009, a month before the launch of Space Shuttle Endeavour. Mission managers at NASA are evaluating the increased risk to the SM4 Hubble Servicing Mission crew and Space Shuttle from debris left behind by the recent Iridium satellite/Russian satellite collision. The SM4 mission may be delayed again from May 12 or cancelled."]

The main tasks of SM4 are to replace batteries and gyros; install new thermal blankets and a fine guidance sensor; repair both the Advanced Camera for Surveys (ACS) and the Space Telescope Imaging Spectrograph (STIS); and install the ultra-sensitive ultraviolet Cosmic Origins Spectrograph and the Wide Field Camera 3 (WFC3). The WFC3 is a high-resolution, wide-field camera covering wavelengths from ultraviolet to near-infrared. The astronauts will also attach a soft capture system designed for the eventual safe disposal of Hubble.

Chuck Shaw, NASA's Mission Director for STS-125 and quintessential amateur astronomer from the JSC Astronomical Society, provides parallel perspectives on the next Hubble Space Telescope servicing mission in a virtual interview, below. Chuck confirms that public support for Hubble was a key factor in NASA's approval of this fifth and most controversial servic-



Top: Astronauts repair Hubble in the Columbia PLB during SM3 (NASA photo)
Left: Before-and-after Hubble images of galaxy M100 illustrate the value of the SM1 repairs in 1993 (NASA Great Images Collection)

Above: Comet Hyakutake
Right: Comet Hale-Bopp
(Wikipedia photos)

Below left: Hubble reveals stellar fireworks accompanying galaxy collisions (NASA HST Collection)

Below right: Cat's Eye Nebula

[For more stunning, selected images like these with information about Hubble's discoveries, go to http://hubblesite.org/gallery/album.]

ing mission.

Servicing missions SM1, 2, 3A and 3B were completed between 1992-2002. After the 2003 Columbia accident, former NASA Administrator Sean O'Keefe cancelled the fifth servicing mission scheduled for 2005 because the Shuttle would not be able to reach the "safe haven" of Station if it was unable to land. The massive letter-writing campaign by American children in 2004 and public hearings led by Senator Barbara Mikulski resulted in Congressional support to review the feasibility of a fifth Hubble servicing mission. After several years of study, NASA reversed its decision. In a press conference held at Goddard Space Flight Center, new NASA Administrator Mike Griffin announced the plan to go ahead with the fifth and final Shuttle-based Hubble Servicing Mission before the planned retirement of the Space Shuttle fleet in 2010.

Where did all of that public support for Hubble come from? Global awareness of Hubble's superlative images peaked in the mid-1990's during a fortunate convergence of technologies and circumstances. The surge in the Internet's expansion (see Bill Gates's 1995 Internet Tidal Wave memo), the popularity of the World Wide Web, expanding bandwidth, and easy-to-use web browsers provided the means to find and quickly download large Hubble images. PCs with faster processing chips, high-res computer monitors, and standard image processing software provided a means of accurately viewing and manipulating those images. The correction of Hubble's mirror aberrations during a 1993 servicing mission and the resulting sharp, stunning images—coupled with their distribution via the web soon after capture—provided broad public access to top-quality astronomical images. Just as importantly, the appearance of two bright comets in 1996 inspired a renewed interest in astronomy.

In late March of 1996, a new object appeared in the heavens. Bright, blue-green Comet Hyakutake and its long

tail delighted naked-eye observers worldwide. Two months later, comet Hale-Bopp showed up and brightened considerably, eventually growing a yellow dust tail and a blue gas tail. This second comet was visible for eighteen months and dominated the evening sky throughout 1997—even in bright, light-polluted cities. These astronomical phenomena amplified Hubble's popularity. People logged on to the World Wide Web to learn more about astronomy and share comet photos…and found the Hubble web site. Gorgeous images of galaxies, nebulae, and other deep-sky objects were downloaded by an appreciative public who spread the word via new email services such as AOL. Hubble images provided the inspiration for computer geeks to go outside and ponder the stars…and see the comets.

This was the first wave of public consciousness about Hubble, but today's Millennium Generation has grown up with Hubble and its ever-expanding gallery of superb astronomical images at their fingertips. What would Gen Y do if they popped open their wireless computers one day and found that Hubble had run out of new images? Luckily, we won't find out for another few years, thanks to Hubble's next servicing mission.

Aside from providing breathtaking views of the cosmos, Hubble has been used for rigorous and important astrophysical research by scientists around the globe. Hubble helps astronomers count Cepheid variables and narrow the Hubble constant, thus helping measure the age and expansion of the universe. Hubble has also been used to study the connection between galaxies and black holes and to study proto-planets, extra-solar planets, and gamma ray bursts.

Hubble's rejuvenation should facilitate a plethora of new data and research that will expand scientific knowledge beyond the next five or more years of Hubble's observing life. That new data should stimulate new generations of Hubble supporters.

With a bit of luck to go along with their training and talent, the STS-125 crew will increase Hubble's performance and expand its lifetime during their five spacewalks. Read on to find out more about SM4 from a "mission insider" and amateur astronomer. Chuck Shaw's fascinating parallel perspectives—both the technical and the philosophical—will give you a deeper appreciation for Hubble and the significance of this servicing mission. What Chuck worries about most will surprise you: it's not what you think!

Q. Your positions as Mission Director of the next Hubble Servicing Mission and Amateur Astronomer in the JSC Astronomical Society give you two unique perspectives on the subject. Is it more exciting for you to direct this mission, since you already have a strong interest in astronomy?

A. Hubble stirs the imagination of all of us, no matter whether we are amateurs or not. However, as an amateur astronomer, I am really ex-

Top: Chuck in action in the JSC Mission Control Center (NASA photo)

Bottom: Chuck sets up his 'scopes at the Texas Star Party((photo courtesy Chuck Shaw)

Above: Chuck in his back yard observatory (Photo courtesy of Chuck Shaw)

cited to be associated with any and every aspect of servicing the HST! I am an avid Amateur Telescope Maker (ATM'er), observer, and Astro-imager. So, having built a number of my own telescopes and mounts, and also having built my first CCD camera, becoming familiar with HST's systems, instruments, and operation is a dream come true! On top of that, the scientific discoveries made possible with the telescope are simply mesmerizing to me!

Q. What particular aspects of astronomy interest you? Are you an astrophotographer? What type of telescope do you use? Did you make/assemble it yourself? Do you "look up" to look back in time? Do you peer into the sky for aesthetic reasons and/or are you interested in cosmology?

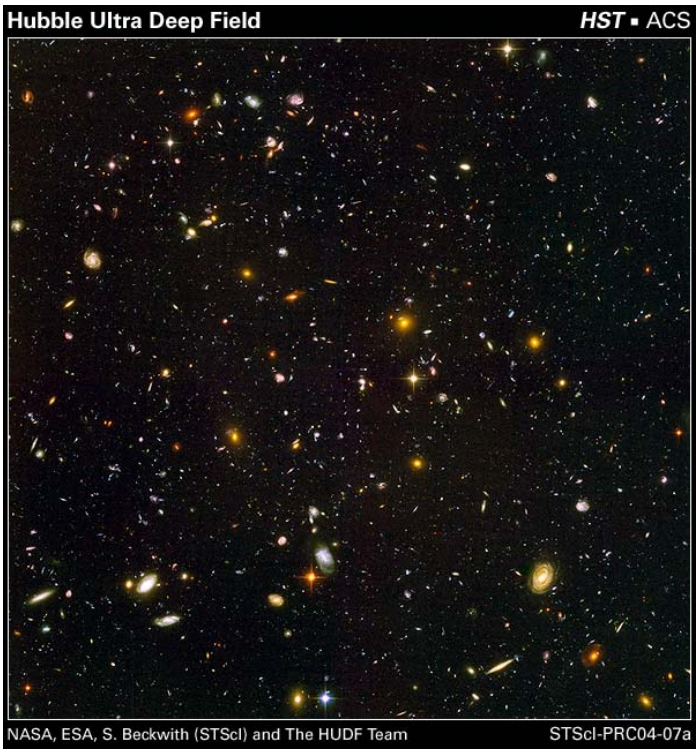
A. My interests are probably equal parts of telescope building, observing, and CCD imaging. I have a number of different scope and mounts, depending on what I am trying to do. My imaging systems are on German Equatorial Mounts that I have built or highly modified to be computer controlled, with the optics being an SCT and a refractor. For observing, I prefer Newtonians and have a 14.5-inch and a 10-inch (both of which I built). Both are on Alt/Az [Altitude/Azimuth] mounts I also built, with the 14-inch being computer controlled, and the 10-inch riding on an equatorial tracking platform I designed. I also like to observe through large binoculars, and sometimes I love to simply sit and ponder the enormous-ness of what I can see. I especially like to do that out at the Texas Star Party as the Milky Way is rising. Cosmology astounds me… The HST's new Cosmic Origins Spectrograph, combined with the new Wide Field 3 imaging camera is going to open up totally new chapters in studying the cosmos!

Q. Is there a "Chuck Shaw" asteroid out there as yet undiscovered by you?

A. No, I have not discovered any new objects out there, and with all the new automated searches and living in a light polluted area like Houston, I probably won't. However, it is awe-inspiring and very sobering to observe (and image) near-Earth crossing objects, realizing one day we may have one not just cross our path…

Q. To date, what have been your favorite images coming from Hubble? How/which Hubble images changed your perspective on the universe? How do the Hubble images inspire and inform you as an astronomer?

A. Boy, that's like asking which of your kids you like the best! Probably the one that overwhelmed me the most was the Hubble Ultra Deep Field, as I thought about the number of objects in what was a reasonably "blank" area of sky that showed up. And to then think of the number of stars (and planets?) associated with all those galaxies! And now with the much, much deeper capability, especially in near infrared,



that the Wide Field 3 camera will provide, the past deep fields may end up being "snapshots" in comparison!

Q. Did you have a voice in deciding which of the STS-125 mission objectives would have a first priority for EVA scheduling? As an amateur astronomer, which Hubble instrument, either present on Hubble or going up on STS-125, is your favorite? What do you hope to see/learn from the new instruments?

A. The mission objectives are really determined by the Science Mission Directorate. They are a balance of extending the useful life of the observatory and of enhancing the science productivity of what is already considered the most scientifically productive instrument ever made, and doing that on a mission that only has a finite amount of time available due to the consumables on board. Our task is to take the resources of the Shuttle Program and combine them with the resources of the HST Program, to plan out a mission that has the best chances of achieving those expectations, train for it, and then go execute it, making whatever adjustments are required in real-time if we encounter something unexpected.

Q. Have there been many changes to the planned servicing objectives since the crew began training for the mission? What are the most recent changes/additions? Aside from two experienced crewmembers, none of the other five astronauts have been involved directly with Hubble servicing, is that correct? How was the crew chosen? Were they simply next in line, or do they have other key skills that ideally suit them for this mission, such as robotics experience?

A. The basis for this mission was actually laid out back before the Columbia Accident. The relatively recent failure of the Advanced Camera for Surveys (ACS)—which was the highest resolution imaging system aboard—resulted in adding that repair task and really challenging the planning and mission integration process (for figuring out HOW to repair the ACS, and then building the very specialized tools to perform the task, and developing highly orchestrated timelines to get it all done in the time available…)

The crew of seven actually has three HST veterans. Scott Altman, the Crew Commander flew the orbiter to HST on the last servicing mission, and of course John Grunsfeld and Mike Massimino have been outside working on the telescope before [in separate servicing missions]. Meaghan, Drew, Mike, and RayJay (Greg) are the new crewmembers, but all have been involved in Shuttle operations and planning for years, even though they have not flown.

As far as the selection process, well, there are a lot of [unflown] astronauts that would like to hear the secret answer to that!!! However, each has key skills that are required on the mission and have shown superb mastery of those skills. Each Shuttle mission requires that, not just the HST mission! If this was easy, anybody could do it, right?

Q. This servicing mission relies heavily on robotic devices. What are some of the newest/most interesting additions to SM4 in terms of those devices?

Above: Astronaut Kathryn Thornton installs new solar arrays during SM1 (NASA photo)

A. Actually the only really robotic device we are using is the Remote Manipulator Arm that Meaghan will use to capture the telescope and to move the Extra Vehicular Activity (EVA) crew members around outside that are doing the servicing tasks. However, there are a LOT of very specialized tools for doing the tasks. The telescope was designed to have "black boxes," able to be removed and replaced for most of its systems and scientific instruments. That's still challenging, moving instruments that are the size and weight of a baby grand piano around in Zero-G and being very careful with them!!

However, the repair of the Space Telescope Imaging Spectrometer (STIS) and the Advanced Camera for Surveys (ACS) are like nothing we have ever done in space before! These repairs will not

replace the instruments, but will actually partially disassemble them, replacing failed internal electronics in them. They were not designed to be able to do this by an EVA crewmember in a bulky spacesuit with thick clumsy gloves on and looking through a bubble helmet, all while floating in space, where every action causes a reaction! Try putting the bulkiest gloves on you own, and a huge heavy coat, and reach down under your desk and disassemble your computer, and change out the computer cards in it (which have tiny little locks on them to resist launch vibrations). Oh, the covers on each of the instruments are attached with over a hundred tiny, tiny machine screws that are not captive (they can float away when unscrewed), and if that happens, they can get into places in the telescope where they can potentially cause a lot of problems! The special tools that were designed and fabricated by the repair team at the Goddard Space Flight Center have done a magnificent job on developing the capability to do this!

Q. How much influence do you think the public has had on the congressional support for NASA's fifth Hubble servicing mission? Do you get the sense that students and astronomers are going to be watching this mission closely more so than others? Have you personally been involved in the educational community's involvement with Hubble? What can you share with us about that?

A. Without question, the public support, as well as the scientific community's support, played a huge role in NASA's decision to re-visit the decision about servicing the HST with the Shuttle. I was very honored and excited to have coordinated the team that performed this reassessment and presented it to the NASA Administrator. It was clear that the Return-to-Flight environment for the Shuttle had matured to the point that the risks associated with returning to the HST were far outweighed by the benefits. That is not to say flying Shuttles or any other manned spacecraft into space will ever be "safe," but we each take calculated risks every day when we drive on crowded highways, or fly in airplanes, or any number of other things that allow us to do something we feel is worth doing. The trick is to make those risk versus gain trades intelligently, doing what is possible and reasonable to mitigate those risks.

Q. Aside from cosmological and astronomical benefits, are there other benefits from Hubble in terms of technology spinoff that help justify the service mission? What are some of the benefits to humanity aside from astronomy that can be attributed to Hubble, either directly or indirectly?

A. Spinoffs from the Space Program, in general, come from a lot of different areas. Sometimes, just the mere threat of being able to do something from space easier and cheaper is all it takes to spark creative minds on Earth to find better ways of doing things. Even problems in space have served to motivate. The issue with HST's primary optics was a good case-in-point, where before the first servicing mission—when the COSTAR was installed [and] provided correction of the spherical aberration in the system on-orbit—many new optical processing algorithms were developed to correct for aberrations. The results are incorporated in the image processing software I use on my home computer for images I take! Sure, these capabilities probably would have been eventually developed, but sometimes it just takes a need to get things going! I recently had an MRI, and was fascinated at how many similarities in the image processing on the results that were done that are similar (and some are identical) to astro image processing. And, even though the primary focus of the servicing mission is the HST, we are carrying an important National Laboratory Payload that is to study vaccines needed for illnesses affecting people right now…

Q. What excites you most about this mission? What worries you the most? Can you talk a little about the contingency planning for this mission? What is the plan?

A. Boy, simple questions, but no short simple answers!! The idea of enhancing by many, many times the scientific productivity of the most astounding scientific instrument we have, and having those enhancements open up discoveries we cannot even think about yet is incredibly exciting! Anything as complicated as an HST servicing mission is subject to a lot of things that may not go as you expect.

What worries me is [that] people may fixate on what does not go as we expect and lose sight of what does get accomplished. That would miss the whole point of what we have been working towards! The nominal and off-nominal timelines, malfunction procedures, and workarounds are robust and always have an eye towards getting as many pre-flight planned objectives completed as possible without taking un-

warranted risks. These off-nominal plans may be mostly out of public sight in check-lists, etc, or may be totally visible to everyone, like when we roll a second Space Shuttle out to Launch Pad B in case we would need to mount a rescue mission for the Hubble servicing crew. All the things we put in place as part of bringing the Space Shuttle back to flight readiness after Columbia are in place and have steadily improved our risk posture.

So, what is "the" plan? Well, there isn't just a single plan, other than to use our collective manned spaceflight and engineering and scientific experiences in the best ways we can to service the HST as well as we can and as safely as we can.

Q. Have you been involved with other Hubble servicing missions, and if so, in what aspect? Can you describe a memorable moment or accomplishment from that mission, and compare it to how you feel about this mission?

A. I was the Flight Director for "Team 4" for the HST deploy Mission, and was the Planning Team Flight Director for the second servicing mission [SM2]. All the HST servicing missions are memorable, but I remember watching the HST float free after it was initially deployed and thinking to myself that this is the start of probably one of the most grand adventures mankind will experience…I think I was right!

Q. What are your thoughts about the service that Hubble data and imagery has done for science, astronomy, amateur astronomy, and awareness of the cosmos? What do you think Hubble has contributed to our society overall? What is Hubble's value?

A. This is best answered by my passing on some statistics compiled by my friend and Chief Scientist for the HST, Dr. Dave Leckrone…On August 11th of 2008, the HST will have completed 100,000 orbits of the Earth. During those orbits, 4385 different scientists have been awarded observing time or funding for archival research that includes 860,000 exposures on 27,000 targets, and those exposures comprise 33 terabytes [in SI terms, 33 x 1012 bytes] of science data. There are 8821 scientists worldwide that are registered users of the Hubble data archive, and 7724 different authors have written refereed papers using HST data. In fact, on average, 14 scientific papers per week that are based on HST data currently appear in refereed scholarly journals. So, what's the bottom line? The collective brainpower of thousands of astronomers around the world uses the HST's cutting-edge tools to revolutionize our understanding of the universe!!! And the pride and awe felt by all of us in such an accomplishment stands as a fine example of what we collectively can do when we all cooperate towards a common goal. I would say that's a success story worth learning from!

Q. What are your thoughts about this fifth and final Shuttle-based Hubble servicing mission—and possibly final Hubble servicing mission ever? Are you hoping that there will be a sixth servicing mission to Hubble? Are there currently hopes/plans for such a mission? Which spacecraft might be involved—CEV or other Constellation craft? What would such a mission look like? Could it involve a European vehicle?

A. I want everyone to watch the mission, enjoy and share our triumphs, and understand what a monumental feat building and then servicing the Hubble Space Telescope has been. Most things will go well; some may cause us to struggle. Everyone should strive to put all of those things into the perspective they deserve! Will this be the last HST servicing mission? For Shuttle-based servicing missions, I think the answer is yes. We are attaching a device to the aft bulkhead of the telescope call the Soft Capture Mechanism. It is basically the passive side of the docking system [which] the next generation of spacecraft are planning on using.

Why are we doing this? The standard answer is to provide a capability for spacecraft that are yet to fly to dock with the HST, to assure we have the ability for a controlled de-orbit over un-inhabited areas when the time comes that the telescope is no longer functional or its orbit has decayed too much. Are people already unofficially thinking about how that docking ring could be used for servicing the HST using one of those spacecraft that are still on the drawing boards? They are doing that just as sure as the sun will rise tomorrow on a new day of scientific achievement by the HST, and will continue to do so just as certainly as those achievements will continue...Hang on, its going to be a GREAT ride!!!

Seminar

LPI Seminar Series: Asteroid Threat Mitigation

SEAN KEEFE, ASSISTANT EDITOR, HORIZONS

Right: Dr. Thomas Jones speaking at LPI (photo by Sean Keefe)

Dr. Thomas D. Jones from the Association of Space Explorers (ASE) presented a lecture on January 15 at the Lunar and Planetary Institute (LPI) titled *Asteroid Threat Mitigation: A Call for International Decision-Making*. The lecture was attended by approximately 30 members of the Houston aerospace and planetary science communities.

Dr. Jones has extensive experience in space science, space exploration, aeronautics, and astronautics. As a planetary scientist, he has researched the remote sensing of asteroids, meteorite spectroscopy, and applications of space resources. Dr. Jones is a retired NASA astronaut and former US Air Force pilot. As an astronaut, he participated in four space shuttle missions. He has studied Earth remotely using space-based radar on the Space Radar Laboratory SRL-1 and SRL-2 missions. He is also a noted speaker and author of several books, including a book recently published by National Geographic titled *Planetology: Unlocking the Secrets of the Solar System*.

In his presentation, Dr. Jones described the need for international cooperation to mitigate potentially catastrophic asteroid threats. He described three key elements of the asteroid threat mitigation process: first, an early detection and warning network; second, deflection technology; and third, a mitigation decision process. This last key element—the decision process—is ASE's current focus. Dr. Jones is a member of the ASE's Committee on Near Earth Objects (NEOs), which has been working for the past four years on a proposal for coordinating a global response to asteroid impact threats to Earth. Jones described the committee's findings and outlined some of the complex political, technical, and bureaucratic challenges to the international cooperation necessary for such a coordinated global response. The ASE has been an official observer on a UN panel studying the NEO hazard. In September 2008, the ASE's Panel on Asteroid Threat Mitigation presented a report—*Asteroid Threats: a Call for Global Response*—to the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS).

Dr. Jones described the state of the art in detection of kilometer-sized objects in the inner solar system by NASA-funded searches such as the Spaceguard Survey. He displayed a graph of approximately 6000 known Near-Earth Asteroids (NEAs) cataloged between 1980 and 2008. Approximately 1000 of those NEAs are considered potentially hazardous to Earth due to size and Earth minimum orbit intersection distance (MOID). Of that subset, approximately 140 are greater than one kilometer in size.

Dr. Jones anticipates a flood of new NEO discoveries in the next ten years from new telescopes and other newly deployed instruments. This new data will result in an apparent increase of asteroid threats to Earth. Deflection of serious potential impactors will require coordinated global decision-making as well as disaster response planning, warning systems, and timely consensus. The ASE's goal is to help establish some well-planned risk and decision-making processes and to encourage proactive agreements between space-faring nations to avoid panic and delays that might preclude successful threat mitigation.

To illustrate the seriousness of NEO impacts to Earth, Dr. Jones highlighted some large and well-known impacts: the 5 km crater at Gosses Bluff, Australia with its estimated 1

km impactor and original 22 km crater; the 1.2 km Barringer Crater in Arizona and its estimated 50 meter diameter meteorite and 2.5 megaton blast; and the Tunguska, Russia impact and its estimated 5-10 megaton blast. Finally, he mentioned the unlikely yet possible impact on Earth by the 350-meter 99942 Apophis asteroid in the year 2036, which is also predicted to closely approach our planet in the year 2029.

To illustrate that NEOs can be accurately detected and predicted, Dr. Jones described the discovery of asteroid 2008 TC3. The asteroid, estimated between 1-5 meters in diameter, was first detected on October 6, 2008 by the Catalina Sky Survey less than 24 hours before impact. The asteroid was then extensively observed by astronomers around the world, and NASA's Jet Propulsion Laboratory (JPL) predicted the asteroid's time of atmospheric impact and the location of the fireball—in specific coordinates over northern Sudan. Subsequently, the fireball was detected over the Sudan within a minute of the predicted time.

Dr. Jones briefly outlined some of the potential asteroid deflection technologies now under discussion: gravitational tractors, or nudging by a small spacecraft near an asteroid; using kinetic energy impacts; and using nuclear explosives to break up or vaporize the surface layer of NEOs and effectively make them rockets and thereby changing their orbits. He also discussed the risk of changing an asteroid's orbit: a successful deflection could lead to an unpredicted impact to Earth by the same NEO in the future.

Dr. Jones reported that Congress recently directed NASA and the NRC Space Studies Board to form a panel on NEO detection and to examine NEO survey thresholds and the technologies required for deflection. Jones said that limited NASA budgets have prevented NASA from expanding its search and impact analysis capabilities.

Left: Refreshments and discussions in the LPI atrium (photo by Sean Keefe)

After the presentation, the audience asked Dr. Jones several questions about the policy, prediction, politics, and deflection of NEOs. The discussion continued for another hour in the LPI atrium while refreshments were enjoyed.

Left: Gosses Bluff, Australia impact crater (photo by NASA Earth Observatory)

For further reading:

- ASE Committee on Near Earth Objects: http://www.space-explorers.org/committees/NEO/neo.html
- ASE Report—*Asteroid Threats: A Call for Global Response* (http://www.space-explorers.org/committees/NEO/docs/ATACGR.pdf)
- Catalina Sky Survey homepage: http://www.lpl.arizona.edu/css/
- Gravity Tractors – a NASA JPL Report: http://neo.jpl.nasa.gov/neo/B612_Final_Report_111608.doc
- NASA's Near Earth Object Program: http://neo.jpl.nasa.gov/
- Predicting Apophis' Earth Encounters in 2029 and 2036: http://neo.jpl.nasa.gov/apophis/
- Space Studies Board Review of Near Earth Object Surveys and Hazard Mitigation Strategies: http://www7.nationalacademies.org/ssb/NEO_surveys_mitigation.html
- Tom Jones' homepage: http://home.comcast.net/~skywalking/index.htm
- Tunguska Event: http://science.nasa.gov/headlines/y2008/30jun_tunguska.htm

Feature Article

Preparing for Rescue

DARYL SCHUCK

Not only has NASA gone to great efforts to prevent damage to the Orbiter during ascent, the space agency has also taken some measures to detect damage once it arrives on orbit. Tools and techniques have been developed that provide some ability to execute repairs to a damaged orbiter. NASA realizes that, despite its best efforts, there still remains the possibility that damage could occur that may not be adequately reparable to ensure safe return of the crew. Therefore, a means to rescue the crew using a second shuttle has been developed.

A potential rescue mission would be carried out should it be discovered that an Orbiter was unable to return due to irreparable damage sustained during ascent. In order to differentiate these rescue missions from the regularly scheduled missions, but still include them on the flight manifests, they are numbered as STS-300 series and are paired with nominal missions. These "Launch on Need" missions would involve having the shuttle crew stay on the International Space Station (ISS) for an extended period while the rescue orbiter could be readied for flight. With ISS used as a staging point for the crew of the damaged orbiter, ample time should be available to initiate and complete training of the rescue crew after the determination that the original orbiter was not fit for return.

However, in the case of STS-125, the next and final Hubble Space Telescope (HST) servicing mission, the rescue scenario changed significantly. Since HST is in a completely different orbit from ISS, it is not feasible to use ISS as a 'safe haven' while a rescue mission is readied. The damaged orbiter would only be able to sustain the crew for a maximum of 23 days (as compared to ISS, which could serve for double that time). For HST, the "on need" approach no longer worked, and the rescue orbiter, along with its crew, would have to be prepared to execute the rescue even before STS-125 launches, launching in as little as seven days after the STS-125 launch. Therefore, a much more immediate response would be required to rescue the HST crew.

In that case, two orbiters have to come within close proximity to one another on orbit. Once STS-400 (Endeavor) arrives, the STS-125 orbiter (Atlantis) is approached with payload bays perpendicular to each another in order to minimize possibility of impact. Endeavor would then utilized the Shuttle Remote Manipulator System (SRMS) – or robotic arm – to grapple onto the grapple fixture of the inspection boom on Atlantis. Both orbiters would then enter free drift, and they would be reoriented relative to one another and subsequently assume a combined 'gravity gradient' attitude, conserving precious fuel.

Once the two shuttles were mechanically linked via the SRMS, the crews would have to be transferred to the rescue orbiter individually in EVA suits. Those suits might not be optimally sized for all the crew, but they would serve the purpose of allowing them to be transported by "prime" EVA crewmembers with properly sized suits.

Once the HST crew was transferred, the STS-400 mis-

Special thanks to AIAA Houston Section webmaster Amy Efting who arranged a NASA tour for Daryl Schuck, Steve Everett, and Douglas Yazell. We toured the Systems Engineering Simulator (SES) to start preparations for this article.

Right: (Unofficial) mission patches for STS-400

sion would return with seven crewmembers in the middeck, and four on the flight deck. The combined crews make up a larger group than those that usually fly on an orbiter, but is a necessary exception if a rescue were required. Time spent on orbit prior to deorbiting would be kept to a minimum.

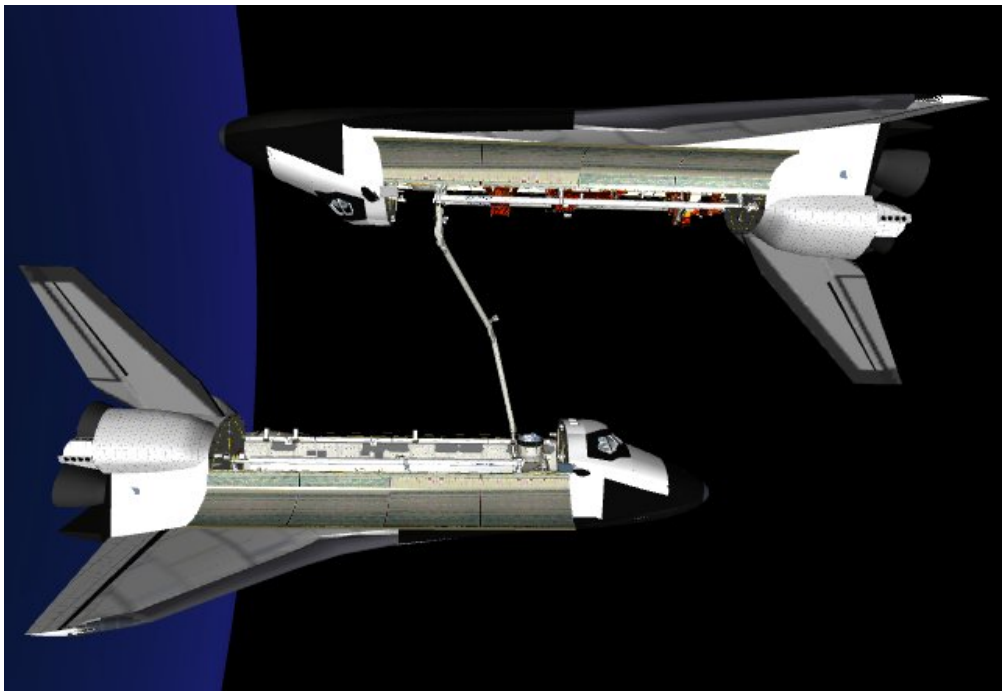
The fate of the damaged orbiter remains somewhat unknown, although there have been some considerations for allowing the orbiter to return unmanned. The default plan is for the damaged orbiter to be disposed by ditching it into the ocean, although there have been some efforts made to provide a more palatable alternative. In order to provide the capability to command the orbiter to perform the deorbit burn and reentry sequence to a landing site (the preferred landing site is White Sands Test Facility in California), an approach called the "Remote Control Orbiter" (RCO) has been devised, including a newly fabricated wiring harness which would have to be installed. One of these cables already exists on ISS, but a second cable may be readied to be available for the HST mission. The RCO cable enables commands essential to the re-entry and landing sequence, such as deployment of the air data probes and landing gear, to be sent and executed via ground commands.

A primary facility for preparing the STS-400 crew (which is made up of crewmembers already preparing for STS-126, the next scheduled mission) is the Systems Engineering Simulator (SES) at NASA-JSC. Rescue mission training conducted in the SES facility includes the end to end mission rendezvous and grappling phases of the rescue mission. The SES provides an environment where interaction of the crew during these critical phases, requiring well orchestrated cooperation on the flight deck, can be practiced. The facility includes "out the window" visuals projected by an array of eight projectors onto a dome-shaped screen, provide a high fidelity simulation that combines with the flight deck environment.

The Shuttle flight deck is a very constrained space in which the crew needs to practice working together in order to smoothly progress through the complex sequence of operations of the approach and grapple and subsequent ungrapple and departure. The crew utilizes simulated handheld LIDAR to collect range information during the approach. Once within reach, the crew operates the SRMS for which the flying characteristics have been realistically modeled. Also modeled is the Trajectory Control Sensor (TCS) that is typically used for ISS rendezvous and docking. Crews would also use the Payload and General Support Computer (PGSC) laptops throughout the sequence.

The SES complements other training facilities, most notably the Shuttle Mission Simulator (SMS), which provides a much more comprehensive simulation of the shuttle's systems, and the Dynamic Skills Trainer (DST), which provides the same high fidelity operation of the SRMS as the SES cockpits, but in a desktop platform.

Combined with a suite of other training facilities, the crew will be well prepared to perform well in such a challenging and time critical scenario. Should it occur, it could be NASA's finest hour, perhaps rivaling Apollo 13 – rescuing 7 crewmembers, and demonstrating once again that NASA is ready to step up to the challenges that human spaceflight will inevitably present.



Above: Endeavour and Atlantis in crew transfer configuration. (image provided from the Systems Engineering Simulator)

CLASP Lecture

Astronaut Training: What It Takes To Be An Astronaut

ALAN SIMON

The Clear Lake Association of Senior Programs (CLASP), in association with the University of Houston Clear Lake (UHCL), presented its first 2009 program on January 8, "Astronaut Training: What it Takes to be an Astronaut."

Mr. Glynn Lunney, Vice President of United Space Alliance (USA) and former NASA engineer, flight director, Apollo-Soyuz Test Project and Space Shuttle Program manager, introduced the guest speaker, Mr. Henry Lampazzi. Mr. Lampazzi, NASA Simulation Supervisor, said that the most important quality of a successful astronaut does not appear on a resume. Above all, the candidate must know how to get along with peers and adapt to all kinds of environments and situations.

Mr. Lampazzi has seen many astronauts come and go. He joined the Shuttle program as a NASA contractor in the early 1980's, and became a USA employee when the company was formed in 1996. He trained astronauts and shuttle flight controllers on the Control and Propulsion systems, then moved on to become a lead instructor, training ascent and contingency abort scenarios. He has been a simulator supervisor (Sim Sup, pronounced "Sim Soup") for several years, responsible for training an integrated team of astronauts and flight controllers. In fact, he was the Sim Sup for the last shuttle mission, STS-126.

Mr. Lampazzi explained that, of the 114 individuals who have trained as shuttle astronauts, 87 are currently active, 27 hold management positions in NASA, contractors, the private sector, and academia. Of the active corp, 74 have flown, and 13 are still waiting to fly—even one person from the Astronaut Class of 1998! So, among many important qualities that are needed to be an astronaut, patience ranks high. The astronauts who fly the vehicle are typically former military pilots and graduates from test pilot school, having thousands of previous hours in numerous types of aircraft. Those who serve as flight engineers, mission specialists, and space walkers typically are scientists and engineers with advanced degrees, leaders in industry, or medical doctors. Their backgrounds typically span a wide area of technical areas; though, more often, they are experts in a specialization.

Paraphrased from former astronaut, John Blaha, "If you'd like to become an astronaut, become qualified in the career you would most like to pursue. If the opportunity is presented, apply, and if you are accepted, great. If not, you'll still be qualified to do the things you love to do. If you instead pursue qualification you think NASA might want, you may find yourself poorly qualified and in a job you hate." Similarly, Mr. Lampazzi cited former astronaut and retired USMC Major General Charlie as saying, "God put us on this planet to do something. We need to figure out what that something is and then go do it, whatever it is."

Once individuals have been selected to a new astronaut class—about every two years--they begin a regimen of classroom training on shuttle systems, and put some of that knowledge into operation using single system trainers (i.e., simulators). As their knowledge base grows, they begin to learn the interaction of all systems in one of the several shuttle mission simulators. Progressing further, these astronauts in training are teamed with flight controllers in an environment where systems knowledge and mission timelines are integrated, much like a real shuttle mission.

At the same time, these individuals are typically assigned areas of responsibilities within the NASA Astronaut organization, following future payloads, vehicle modifications, and flight rules and procedures. They are oriented to the Kennedy Space Center organizations and facilities, and subjected to launch abort training. When they have finally completed all of the various training objectives identified in a crew training catalog—perhaps two years after selection—they can finally be considered astronaut candidates, and moved into the pool of flown and unflown astronauts who are waiting for mission

assignments. Once assigned to a crew, much of the training is repeated as a team, over a period of eight to twelve months. No individuals have ever failed to meet all of the required training objectives. However, several never went on to fly because of various other reasons.

Astronauts maintain their flight proficiency by flying several types of training aircraft. Leadership and teamwork proficiency is honed through their work in the NASA organizations, and during harsh environment and survival type training.

Successful astronauts are often distinguished by unique, stand-out qualifications, leadership skills, and commitment. So, following their retirement from the Astronaut Office, they are frequently sought by NASA, private companies, and universities. Those who were on loan from the US military often find high ranking positions upon returning.

The Neutral Buoyancy Lab (NBL) (or the Sonny Carter Training Facility) provides another type of training experience for those who will be performing space walks. The NBL is a huge swimming pool that provides an environment that attempts to simulate the weightless condition, and is essential for pre-flight training to better understand the dynamics of body motion, tool operation, and task performance. Additionally, it simulates the extreme environment of space, and helps integrate the complex operations of extravehicular tasks with limited communications and visibility.

International astronauts complete the same training as their counterparts, and are usually assigned to a flight in order to support a particular national asset (e.g., installation of the Japanese Experiment Module), or when one of these individuals has a specific skill or expertise that is required for executing mission objectives.

For US astronauts, typically each will come to a point in the training flow where some will continue with International Space Station training versus Shuttle training. As the Constellation Program is still in its infancy, Constellation training objectives have not been identified. However, the NASA training organization is leveraging existing training tools and processes from the Space Station and Shuttle programs.

While Mr. Lampazzi holds most astronauts in high regard for their talents, commitment, and capabilities, he cited their families as an important component of their success and that of a successful space program. Astronaut families must be exceptionally committed and very patient.

More information on NASA and international astronauts can be found at www.jsc.nasa.gov/Bios. Also, more information about CLASP and its 2009 program series, “Visions in Our Midst,” is available at www.uhcl.edu/

Left: Glynn Lunney (left) talks with Henry Lampazzi after the lecture (photo by Alan Simon)

Space Center Lecture Series

Planetology: Unlocking the Secrets of the Solar System

ALAN SIMON

Former astronaut, Dr. Thomas Jones, provided an enlightening lecture on January 9, "Planetology: Unlocking the Secrets of the Solar System," the second installment of the Space Center Lecture Series, cosponsored by the local chapter of AIAA, Ad Astra Rocket Company, and the University of Houston at Clear Lake. The theme of Dr. Jones' briefing was on a newly created adage, that, "If dinosaurs had explored space, they wouldn't be extinct today."

Only about 40 years ago did Earth inhabitants finally have the first opportunity to see their entire planet fill a single photo. The Apollo 8 mission was a first for many accomplishments including capturing the first Earthrise. During that mission, we were able to see that Earth really has no boundaries. Our tiny planet appeared to float in an infinite of darkness, as if it were a Christmas ornament, delicate and fragile. That image, among other firsts, made us realize that we as inhabitants need to take care of our precious planet.

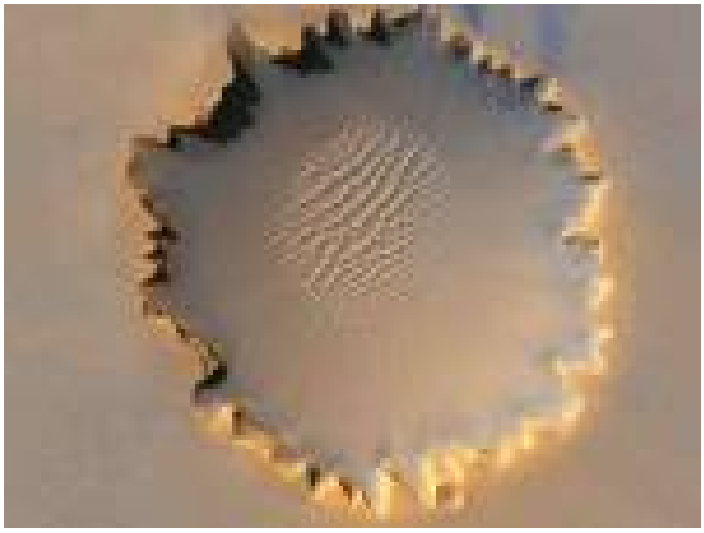
What can we learn of our neighbors, Venus and Mars? Although we often joke that males and females differ as though they must have come from these different worlds, why did these two planets take such different evolutionary paths?

Dr. Jones began to answer that evolutionary question by explaining that, from space, Earth may appear serene, quiet, and unchanging. In reality, however, the surface is quite dynamic. There are tectonics at work that are constantly pushing and stretching the surface structures, causing fault lines to open, molten rock to surface, land masses to separate and sink. Hawaii surfaced from the Pacific Ocean floor only about a million years ago. Winds have eroded mountains and built up dunes of sand over time. Water continues to carve huge holes in rock, leaving canyons and caverns in its wake. And perhaps even more destructive are Earth's inhabitants who deforest large areas, and turn landscapes into cityscapes. Regardless of the source of these dynamics, the Earth is changing.

Apollo 16 returned photos of the far side of the Moon, providing a pictorial of the violent impacts that have resulted in so many craters and gouges to its surface. But these are not unlike the Barringer meteor crater in Arizona that occurred perhaps 50,000 years ago, leaving an impact nearly a mile wide, and 570 feet deep, with meteoric iron material scattered over a 10 mile radius. Nor are these ancient impacts different from the Victoria Crater on Mars, which the Opportunity rover visited in 2006. Victoria is about a half-mile wide, and 250 feet deep. Perhaps not as noticeable, but just as notable, the Chesapeake Bay Crater, only discovered in 1983, covers an area twice that of Rhode Island and nearly as deep as the Grand Canyon, though much of it is filled with sediment today.

Actually, more than 100 tons of dust bombards the Earth daily, according to Dr. Jones. The Near Earth Orbit (NEO) neighborhood holds

Below: Barringer meteor crater in Arizona
Right: Victoria crater (Mars)



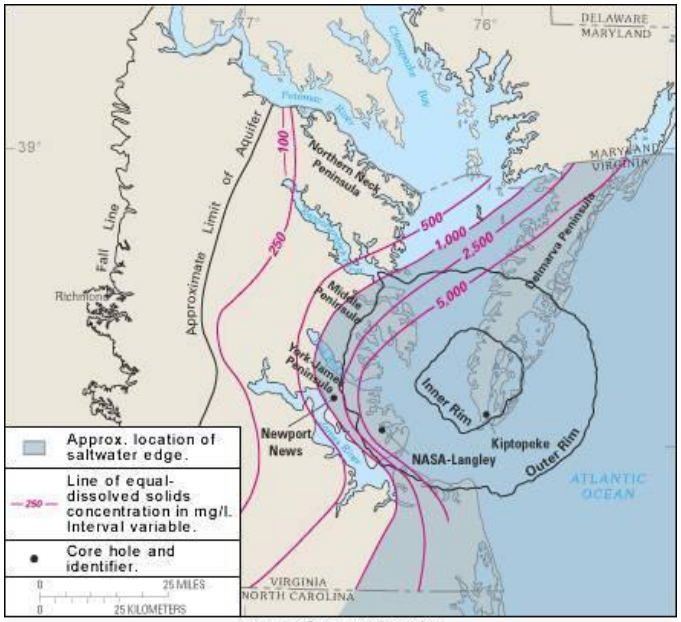
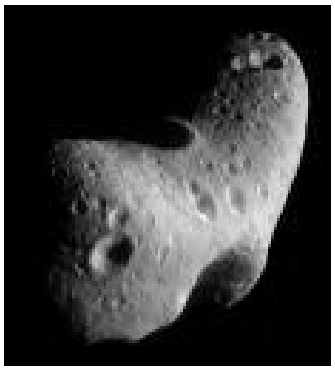


Image from Wikipedia

Left: Chesapeake Bay crater
Left, below: Eros, Earth's largest Near Earth Asteroid (NEA)



potential hazards for spacecraft and humans who venture into space. More alarming are the thousands of near Earth asteroids (NEAs) that have been discovered—almost 6,000 over the past ten years! And new and more powerful telescopes will only help to raise our anxieties in the coming years. Perhaps millions of NEAs may be discovered by 2020.

So, what are our chances of one of these objects creating another Barringer crater site, and what can we do to circumvent such an event? Well, recently, a group of astronauts (the Association of Space Explorers) submitted a plan to the United Nations (Asteroid Threats: A Call for Global Response), urging the establishment of a warning system, a communication system, and executive authority to call for a response that would include mission planning capability. Technology exists today, using spacecraft that could be used to deflect a NEO or NEA. In fact, a study was even conducted to see if an Orion type spacecraft could by used to visit one of these objects within the next 10 to 15 years. The results suggest that a mission to Asteroid 1999 A010 could be possible in 2025, requiring only a several month expedition, using systems that are on the design board today.

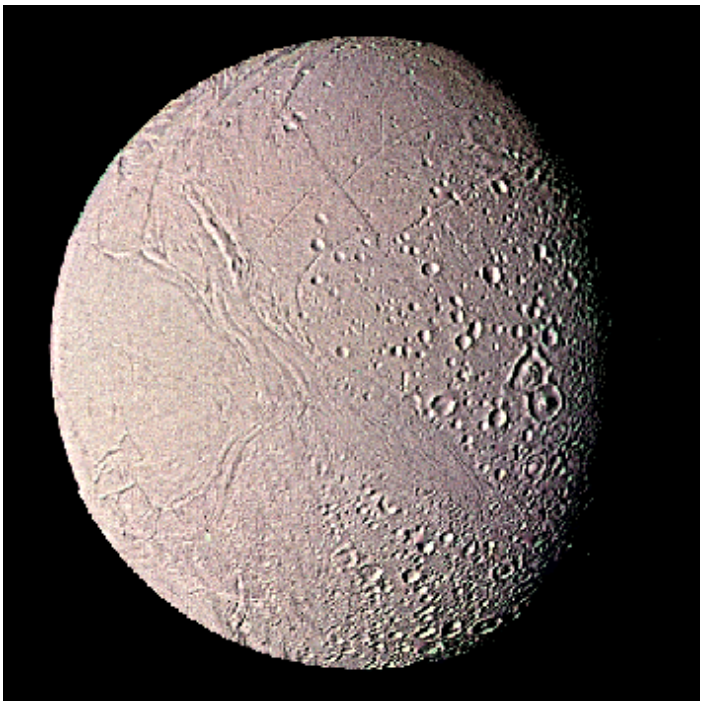
Dr. Jones supposes that the most likely asteroid/Earth conjunction would provide 10 to 20 years of warning and preparation. The need for a nuclear detonation to avert an impact would likely be overkill.

Life started on Earth about 3.8 billion years ago, when the universe was highly active. On Earth today, life is so prolific, even after meteor and asteroid impacts have caused great destruction. So, Dr. Jones reasoned that life on Earth may have actually started and stopped multiple times over its history. The last major impact was about 2 million years ago off the cost of Chile, in the Pacific Ocean.

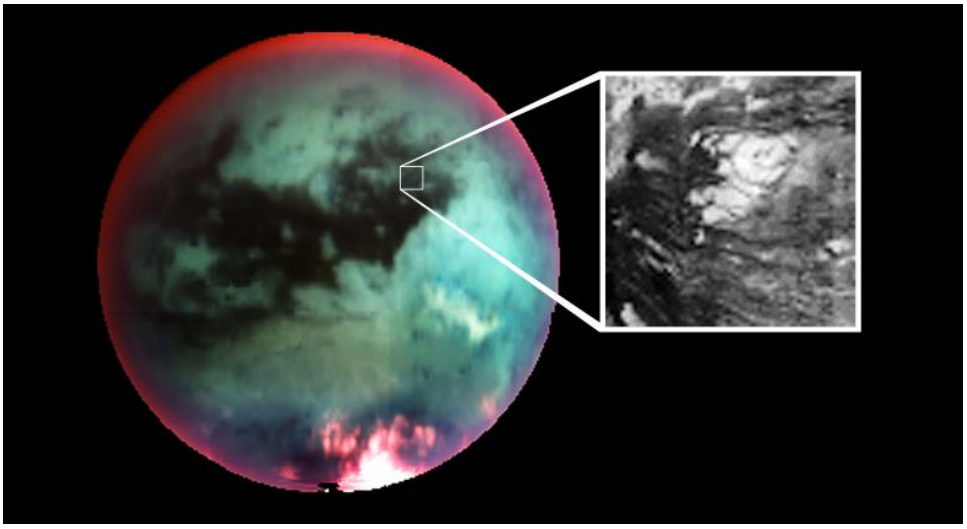
So, the search for life on other worlds continues. Jupiter's Europa has ice volcanoes and fissures similar to the Earth. Europa has organic materials (i.e., carbon, oxygen, and hydrogen), and it also has heat sources. Could there have been water at one time?

Many other worlds have stark similarities to Earth as highlighted by a series of intriguing planetary photos that Dr. Jones presented. Across the galaxy, one of the moons of Saturn, Enceladus, has exactly the same type of crust motion, even though the temperature is only about -300°F. Jupiter's moon, Io, has hundreds of active volcanoes. Its surface is flexed with each orbit of the giant planet. Mars

Below: Enceladus, Saturn's cleanest moon



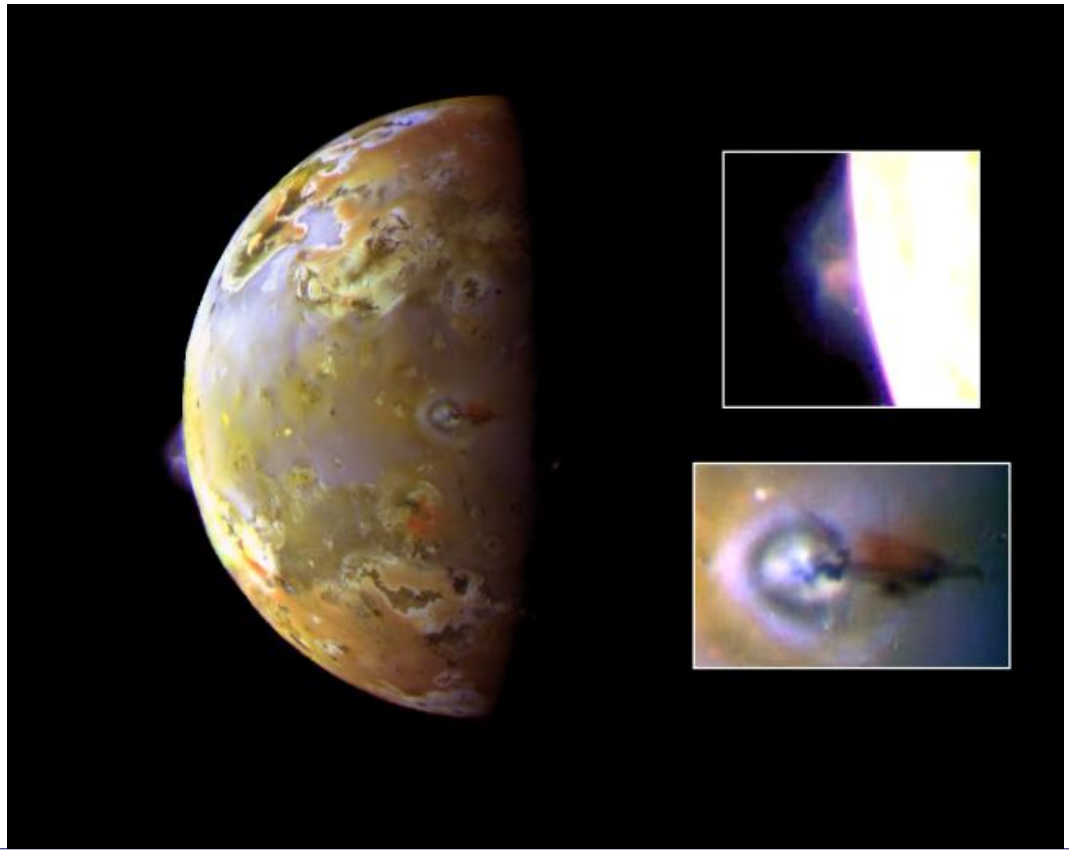
More information can be found at www.astronauttomjones.com, http://www.space-explorers.org/committees/NEO/neo.html, and estofan@yahoo.com



exhibits water runoff erosion just like Death Valley and the Grand Canyon. Deposits from this erosion are deposited in areas, just as they are in areas like Houston and Bolivar. Titan, the largest moon of Saturn, has a surface temperature of about -300°F, where methane and ethane rain and flow, carving and eroding. Glaciers on mars and other bodies carve the surfaces just as they do on Earth. Dust storms on mars shape the same type furrows that are sculpted through Iran. The sand dunes on Mars could easily be mistaken to those on Earth.

So, while Earth, Venus, and Mars are the only terrestrial planets of our sum that have retained atmospheres, are similar in size, are about the same distance from the sun, and may have been on the same evolutionary path at one time, we can only begin to address the reasons for the significant differences by understanding the evolution of our own planet and those of distant worlds.

Above, right: Ice volcano on Jupiter's Europa
Below: Volcano on Jupiter's Io



Former NASA Administrator, Mike Griffin, said three years ago, "In the long-run, a single-planet species will not survive." Similarly, Steven Hawking said, "The long-term survival of the human race is at risk as long as it is confined to a single planet." "If our long-term survival is at stake," quipped Carl Sagan, "we have a basic responsibility to our species to venture to other worlds." So, although the average person may not appreciate this group of contemporary writers and leaders who have argued that only multi-planet species survive, that ideology is growing, and one that Dr. Jones believes. He reasoned that, in 1000 AD, the Vikings had no clue that Carnival Cruise Lines would be cruising the Earth's oceans. So, reaching out to a distant planet may not be reaching too far at all.

Continental Airlines: Aircraft Operations for Today and Tomorrow

Dinner Meeting Report

ELLEN GILLESPIE, CHAIR ELECT, AND NICK PANTAZIS, DIRECTOR OF OPERATIONS

The Houston AIAA aerospace community was treated to a presentation by Mr. John Wiitala, Senior Director of Engineering at Continental Airlines on December 9, 2008. Approximately 40 AIAA members and guests attended the event at the NASA Johnson Space Center's Gilruth Center. Mr. Wiitala is responsible for cabin systems, avionics, systems, and propulsion engineering. His presentation entitled "Aircraft Operations for Today and Tomorrow" provided an overview of Continental Airlines, what Continental Airline engineers do and a perspective of the industry.

Mr. Wiitala began his presentation with an overview of Houston-based Continental Airlines. As the fifth largest U.S. airline, it performs about 25 thousand takeoffs per day in order to serve 265 domestic and international destinations. This is the most of any U.S. carrier. Continental's 351 aircraft include Boeing 737, 757, 767, and 777 aircraft. Seventy to eighty percent of the aircraft maintenance is done in Houston, Orlando, and Los Angeles.

Mr. Wiitala explained that the role of an engineer at Continental is project-based and includes making sure the aircraft are continually airworthy and operate within FAA restrictions. Some of these operations include major and minor modifications and repairs. One of the logistical challenges is managing the number and types of spare parts stored at each airport maintenance facility. Aircraft engine maintenance is a major consideration and can run hundreds of millions per year. In addition, engineers make sure that aircraft continually meet all FAA standards. Additional projects focus on automatic trend and reliability monitoring. One of the recent updates enables trend data and fault codes to be instantly sent to an engineer's e-mail or pager. These upgrades are allowing engineers to bring the right parts when they go out to repair an aircraft, thus reducing costs.

The global economic slow down and the rise in fuel prices and the influx of low cost providers has dramatically affected the industry according to Mr. Wiitala. He noted that Continental's "Go Forward" plan focuses on the business fundamentals and helps it stay competitive in today's economy. Flying a young fleet of Boeing aircraft in the best condition with the best service possible allows Continental to supply a quality commercial airline service. In addition, Continental manages its costs through fuel efficiency initiatives such as adding winglets to 737 and 757 and improving jet engines. John pointed out that a $.01 fuel increase, increases operating costs by $16 million. Continental is also working with Boeing to prepare for the delivery of the 787 Dreamliner, which is striving to get up 20 percent fuel efficiency as compared to today's aircraft.

An excellent question and answer session followed the presentation. A question was posed on flight software redundancy. Mr. Wiitala noted that software redundancy is triple deep in all critical systems and that the newer aircraft are much safer and more reliable than older aircraft. Another question focused on how much of the new Boeing 787 is based on old aircraft technology. According to Mr. Wiitala, everything is different in the aircraft because of new technology and new systems. For example, the fuselage is carbon fiber reinforced plastic. Someone asked about low-cost carriers and what threat they pose to Continental. Mr. Wiitala responded by saying that Continental has to drop their pricing to keep competitive. A fourth question on whether Continental has participated in biofuel testing was also asked. Mr. Wiitala responded by pointing out that this is exciting stuff and that it is the right thing to do. Continental has partnered with Boeing and General Electric and will conduct their first flight soon. A final question was asked regarding how an aircraft deals with space weather (solar activity) when it flies over the North Pole. This does cause some problems in communications according to Mr. Wiitala, but it is typically solved by changing the routing.

Ellen Gillespie presented Mr. Wiitala with a speaker gift and thanked him for sharing his presentation. She noted that this presentation allowed our JSC aerospace community to explore the aeronautical side of AIAA and to gain valuable insight into the workings of commercial aircraft operations.

Above: AIAA Houston Section Chair Elect Ellen Gillespie presents Mr. John Wiitala with a Space Shuttle crystal after his presentation

Event Report

Fifty Years of NASA Imagery

ALAN SIMON

Above: Shelly Kelly, Archivist for the university's Alfred R. Neumann Library JSC History Collection, Mike Coats, former astronaut and current NASA JSC Center Director, and University President, Dr. William A. Staples

The University of Houston at Clear Lake (UHCL) held a light reception on January 14 in the Bayou Building atrium to welcome NASA, the contractor community, and the general public to the opening of an exhibit that commemorates 50 Years of NASA Imagery. University President Dr. William A. Staples provided opening remarks and talked briefly about the 30-year relationship that UHCL and the NASA Johnson Space Center (JSC) have enjoyed. He said that the university continues to look at ways of expanding this relationship that would benefit the neighboring space-related industry. He is proud that the university is a part of the 50-year history, and looks forward to being part of its future.

Former astronaut and current NASA JSC Center Director Mike Coats shared the enthusiasm of Dr. Staples, and offered his perspective and insight on the two organizations. Shelly Kelly, the current Archivist for the university's Alfred R. Neumann Library JSC History Collection spoke specifically about the collection itself, which houses thousands of photos and other historic materials.

Dr. Staples provided closing remarks and thanked the attendees for their support. He invited the audience to view the sampling of photos that were displayed in the atrium. These were only a small portion of those available, which are available and can be used for research projects or other purposes.

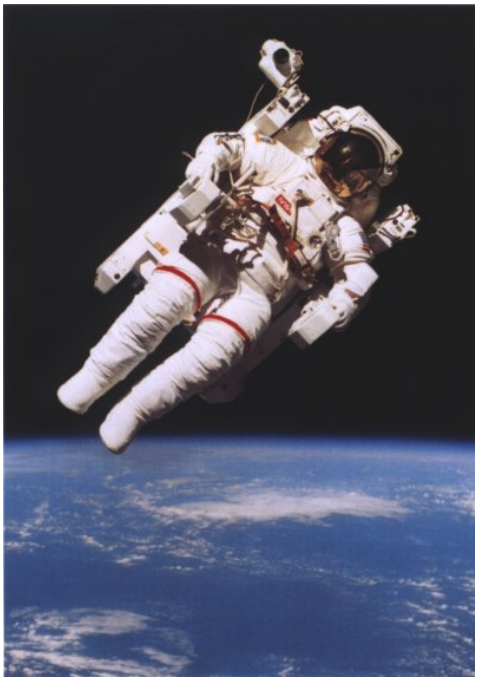
The JSC History Collection is located in the Neumann Library on the second level of the Bayou Building, Room 2402. It is open Monday – Friday, 8:30 a.m. - 5 p.m. Appointments are recommended. Anyone may use the materials held in the UHCL JSC History Collection. The university community and general public are welcome to do research in the archives.

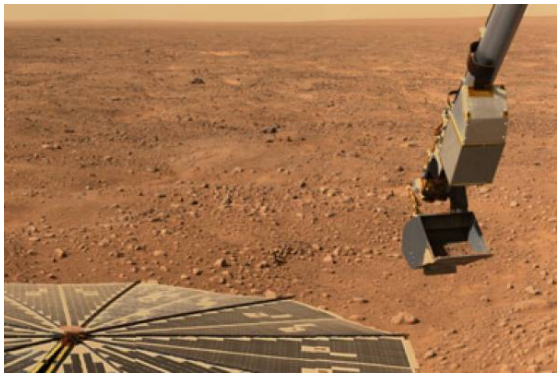
Eight years ago, UHCL signed a Memorandum of Understanding with NASA's Johnson Space Center and the National Archives and Records Administration to provide

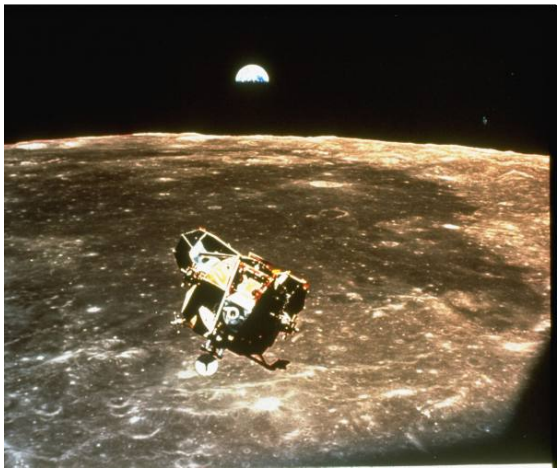
"temporary transfer of custody and loan of historically significant records accumulated by JSC relating to human spaceflight." This MOU allows the records to be housed in the University Archives where researchers can access them.

The History Collection is divided into program series including Mercury, Gemini, Apollo, Skylab, Apollo Soyuz Test Project (ASTP), Shuttle and Space Station. Aside from the program series, there is a series of non-program specific documents that relate to Center activities such as the development of space suits, management activities, test &

Right: Bayou Building reception at the University of Clear Lake, Hous-







Above: A selection of the iconic images represented at the exhibition

simulation facilities and activities, training information, mission control and much more. There is also an Oral History series containing interviews in various media (tape, CD, transcript, etc.) with a great number of people responsible for JSC's human space flight activities over the years. Descriptions of each series can be found on the JSC History web page,

http://www.jsc.nasa.gov/history/history_collection/descriptions.htm.

JSC patrons with an appropriate NASA badge may park without charge in Visitor's Lot R. However, you will need a token to exit the lot, available from the circulation desk in the Neumann Library after showing your NASA badge. Lot R is across the street from the front entrance to the Bayou Building.

International

Crewed Space Flights and Exploration: En Route to the Future

PHILIPPE MAIRET, LAURENT MANGANE, DELPHINE GOURDOU, AND DOUGLAS YAZELL

The Association Aeronautique et Astronautique de France, Toulouse-Midi-Pyrenees (AAAF TMP) is already working on this subject thanks to two working groups:

- Space Observation and Exploration, led by Pierre Conforti, with Secretary Laurent Mangane and with Philippe Mairet as a member, and
- Space Tourism, currently led by Delphine Gourdou

In discussing current events, we no longer argue about the worth of sending people into space. The International Space Station (ISS) is already in orbit and working as planned, and Columbus, the European Laboratory aboard ISS, has become an integral part of the station since its arrival in early February 2008. Europe has become a co-owner of the space station, with full rights.

Europe has mastered a good number of technologies necessary for access and exploration of space thanks to Ariane 5, the cargo vehicle called the Automated Transfer Vehicle (ATV), and the capsule called the Atmospheric Re-entry Demonstrator (ARD), whose 10th anniversary of launch we recently celebrated.

However, Europe does not yet possess a well-established road map for sending Europeans into space and returning them to Earth. This road map will be, perhaps, finalized in 2011.

As for the other nations who can send people into Earth orbit, the Chinese now have three very successful manned space launches to their credit, from 2003, 2005, and 2008, but their crewed access to space is not yet routine. The Russians continue to launch crewed Soyuz capsules on a regular basis. And finally, the Americans are in the unusual position of replacing their space shuttles with capsules, named Crew Exploration Vehicle (CEV) Orion, which are larger than the famous Apollo capsules, and with two new rockets. These rockets are Ares I, to be used to launch CEV Orion, and the larger rocket named Ares V, to launch mission-related cargo without people on board. The planned late 2010 retirement of the space shuttles is being re-examined by the administration of President Obama, since a painful gap of approximately five years will exist between the currently planned space shuttle retirement and the first crewed launch of Orion.

While waiting, the European astronauts will continue to use “strapontins” (foldaway seats, that is to say, temporary seats) to travel to ISS, thanks to Russian and American space vehicles.

But after ISS? Will they be invited to go walking on Lunar soil, as planned by the USA, who has decided to return to the Moon before undertaking, one day, a voyage to Mars? We hope so.

Certainly, the people who will take their places in future space vessels with various destinations in the night sky will be professionals. And it is possible we will one day see tourists paying for their tickets to be transported toward the Moon.

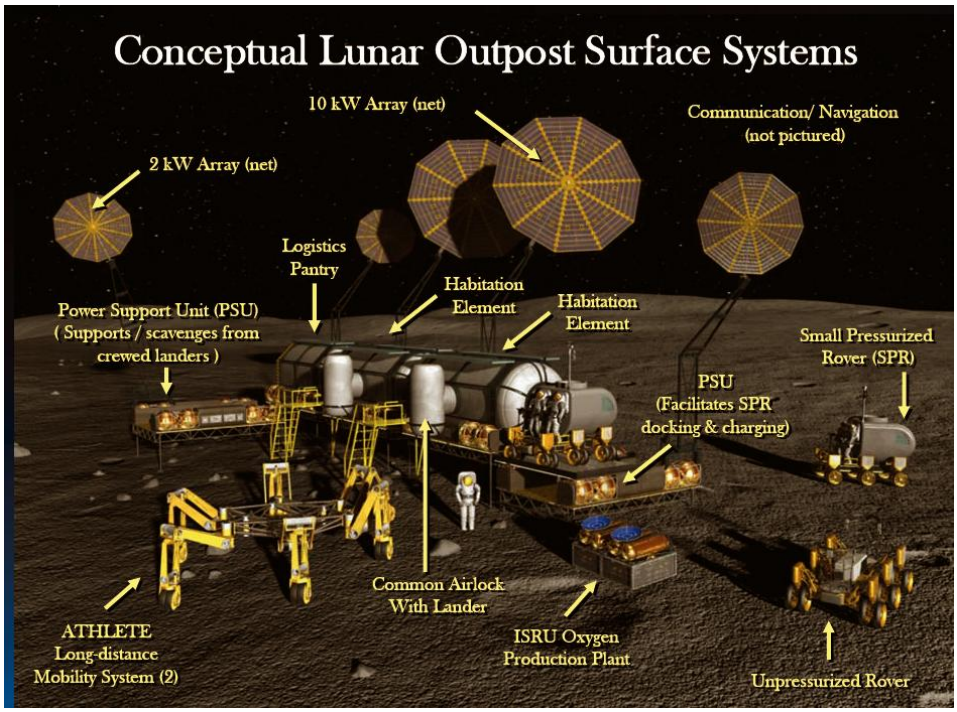


Image provided by Christopher Culbert, NASA/JSC
AIAA Houston Section Annual Technical Symposium 2008

Apollo 8 Panel Discussion

Lunch and Learn

STEVEN EVERETT, HORIZONS EDITOR

The December 19 Lunch and Learn, held by AIAA-Houston two days before the 40th anniversary of the launch of Apollo 8, commemorated what was considered to be one of the most important milestones in the history of space flight. It was formatted as a panel discussion focusing on the flight controllers and engineers behind this remarkable achievement and gave the listeners a glimpse into how this remarkable group of men were assembled and accomplished this crucial step toward the 1969 Moon landing.

The meeting was convened by event organizer Albert Jackson, who turned the podium over to writer Marianne Dyson, the panel moderator. Ms. Dyson began with detailed introductions of each member of the panel: Hal Beck, Rod Rose, Marty Jeness, Ken Young, John Llewellyn, Glynn Lunney, Chris Kraft, and Emil Schiesser. Much of their background and accomplishments, too lengthy to be recounted here, can be found in other sources such as Gene Kranz's book *Failure is Not an Option*, Chris Kraft's book *Flight*, as well as oral histories by Hal Beck and Ken Young available online at *http://www.jsc.nasa.gov/history/oral_histories*.

Ms. Dyson demonstrated models of the Command Module (CM) and Service Module (SM) for the benefit of some younger student members of the audience. She began the discussion by inviting each member of the panel to remark on their background and activities after the Apollo 1 fire and unmanned flights that led up to 1968. Each of these men expressed his own pride in being a part of the Apollo program and enthusiasm toward making this first Moon mission, although not without some shock at the suddenness of these plans.

Hal, who was working on the trans-Lunar injection (TLI) capability, mentioned the computing capability at the time. This resource initially consisted of a Friden calculator and eventually a borrowed IBM 704 from the University of Houston Medical Center. Glynn said that it was immediately after his duties for Apollo 7 had concluded that lead Apollo 8 flight director Cliff Charlesworth revealed his plans to go on to the Moon. After some initial disbelief, he was eventually convinced that this was the right step, because "to land on the Moon, we had to go to the Moon."

Chris Kraft reminisced of even earlier memories of learning that the U.S. would go to the Moon. He said that while working Mercury in 1961, he got call from Robert Gilruth that directed him to listen to the radio at 11:00 a.m. that day, during which Kennedy announced plans for the Moon landing to Congress. His first thoughts were "My G*, we have a crazy President. This guy is daft!"

He said that at the time, they didn't even know how to do orbit determination. In 1962, he had not yet moved to Houston and got a call from Gilruth that said Kennedy would be in Houston, and he was to tell the President how they would be going to Moon and back. He claimed to know nothing about going to Moon, so he learned with John Mayer's maps and charts so that he could brief the President, whom he had met once before when John Glenn flew.

Above: Lunch and Learn panel, from left to right: Marianne Dyson (moderator), Hal Beck, Rod Rose, Marty Jenness, Ken Young, John Llewellyn, Glynn Lunney, Chis Kraft, and Emil Schiesser. (photo by Douglas Yazell)

With Kennedy was one of the New Mexico senators, who was old and deaf and went to sleep during the meeting. As he finished, the Senator awoke and said "Son, do you really think you can do this G*d* thing?"

As late as the Summer of 1968, when there were still problems in all three stages of the Saturn V, Low called Kraft in and told him, "I'm thinking about going to Moon after the first manned flight. What do you think?" Kraft though he was crazy, since they were still having problems with MIT software, but he was told they were considering the plan because couldn't get Lunar Excursion Module (LEM) ready.

A series of meetings was held with the likes of Robert Gilruth and Wernher von Braun in an attempt to get their agreement, in which Kraft was asked to explain their plans, much to

Above: Lunch and Learn panel members, from left to right, top to bottom: Hal Beck, Rod Rose, Marty Jenness, Ken Young, John Llewellyn, Glynn Lunney, Chis Kraft, and Emil Schiesser. (photos by Douglas Yazell)

his chagrin. Kraft said he spent the next several months convincing contractors and everyone in Washington that this course of action was the right one.

Ms. Dyson continued the discussion by showing a series of photographs on which the panel members were asked to remark. The show included pictures of various groups who were assembled in Houston for mission planning, the Saturn V vehicle, groups on people on the beach awaiting the launch, rocket engines firing the TLI burn, and smoke filled rooms of flight controllers.

In regard to the nervous atmosphere portrayed in the latter picture, Kraft remarked that just before the Trans-Earth Injection (TEI) burn, the spacecraft disappeared around Moon, and controllers began to wander the room. Kraft has said on other occasions that this was the tensest moment of his career as a flight director. He said that he told the other flight directors, "Get back in your d* seats and pray with me! You're going to sit here for thirty minutes just like I am and sweat that blood that that engine is going to work when it comes back around."

One picture taken from the CM was shown of the Saturn IV-B third stage, which put the spacecraft in a trans-Lunar orbit, floating in space. It reminded the group that the original plans to open the panels like a flower were changed in favor of jettisoning them when simulations suggested there could be an inadvertent impact.

It was noted that Apollo 8 had no LEM, which would have been retrieved from the third stage segment, only a mass simulator and adapter. Originally the free return trajectory planned for the Apollo missions could have brought the Saturn IV-B around the Moon and back into the Earth's sphere of influence, posing a possible hazard to other orbiting vehicles. Not wanting to alter the free return trajectory, a method of venting the remaining propellant from the tanks to slow down the third stage slightly was devised to result in the segment returning to the Earth on a hyperbolic trajectory and escaping into solar orbit. (Ironically, while the Apollo 8 upper stage did achieve a stable solar orbit, an object sighted in 2003 was determined to be the Apollo 12 booster whose solar orbit is predicted to intersect our own every 25 or 30 years.)

Prompted by Ms. Dyson, Rod Rose then told of the events leading up to the famous Christmas Eve prayer from the Moon, in a voice stumbling from emotion and his developing Parkinson's disease. Rose had arranged for Frank Borman, who in an ironic coincidence had been assigned as lay reader for Christmas Eve at St. Christopher's Episcopal Church, to record the Prayer for Vision, Faith, and Work from Lunar orbit. They had called it experiment P1, the fist prayer from space.

It was later that evening when the crew of Apollo 8 broadcast the reading by Anders, Lovell, and Borman of the first ten verses of Genesis as the Lunar surface passed below. Both the prayer and the reading of the text were played for the congregation at St. Christopher's, which was also notified at the end of the service when the capsule was successfully on its way back to Earth after the burn to leave

Lunar orbit. In a very emotional description of the event, Rose said it was the best Christmas ever.

NASA was later sued over this prayer and reading of Genesis, claiming that government funds were sponsoring religion, but the suit was later dismissed. A note was later provided to the lawyers explaining why the vehicle had to be in orbit on Christmas Eve, citing reasons for launch window, lighting, etc., with no response. Lunney noted that when the subject came up about instructions for a potential Christmas Eve message, Borman was told to do "something appropriate", rather than being given detailed instructions assembled by a committee, for example, hinting at the trust team placed in each other.

Ken Young continued the program with his recitation of a poem he wrote for the crew upon the successful trans-Earth injection burn, reproduced in the sidebar.

After additional pictures of the splashdown and the Yorktown rescue ship were shown, final comments were solicited from the panel. Rod mentioned that while Apollo 11 gets the majority of the attention, Apollo 8 was really the epitome of the program. It was remarked that the Lunar landing was actually accomplished in about eight years, while it will take at least 16 years under the Constellation program.

Kraft described the trust the country placed in the team's decision making process and his faith in organizations all over NASA. He said problems never crossed his mind, but that launches would never be one hundred per cent safe; it is obviously safest not to launch at all. Glynn commented that Apollo 8 opened the door to the eventual manned landing. More incremental tests in orbit could have been done, but more testing would have exposed the program to more risk. In fact, if an Apollo 13 incident had happened before the first landing, events could have unfolded very differently. Kraft also wanted to remind the audience of the fantastic success of Apollo 7 given all the problems that had been faced previous to that mission. He closed by saying that given the mess the country was in during the year of 1968, he was

A Visit to the Moon
By Ken Young, with apologies to Clement Moore

'Twas the night before Christmas and way out in space,
the Apollo 8 crew had just won the Moon race.
The headsets were hung by the consoles with care,
in hopes that Chris Kraft soon would be there.

Frank Borman was nestled all snug in his bed,
while visions of REFSMMATs danced in his head;
and Jim Lovell, in his couch, and Anders, in the bay,
were racking their brains over a computer display.

When out of the DSKY, there arose such a clatter,
Frank sprang from his bed to see what was the matter.
Away to the sextant he flew like a flash,
to make darn sure they weren't going to crash.

The light on the breast of the Moon's jagged crust
gave a luster of green cheese to the gray Lunar dust.
When what to his wondering eyes should appear,
but a Burma Shave sign saying 'Kilroy was here.'

But Frank was no fool. He knew pretty quick
that they had been first; this must be a trick.
More rapid than rockets, his curses they came.
He turned to his crewmen and called them by name.

Now Lovell, now Anders, now don't think I'd fall
for an old joke you've written on the wall.
They spoke not a word, but grinning like elves,
and laughed at their joke in spite of themselves.

Frank sprang to his couch, to the ship gave a thrust,
and away they all flew over the gray Lunar dust.
But we heard them exclaim ere they flew around the Moon:
'Merry Christmas to earth; we will be back there real soon.'

Left: View of the Satrun V third stage after separation from the Apollo 8 spacecraft. (photo courtesy of NASA)

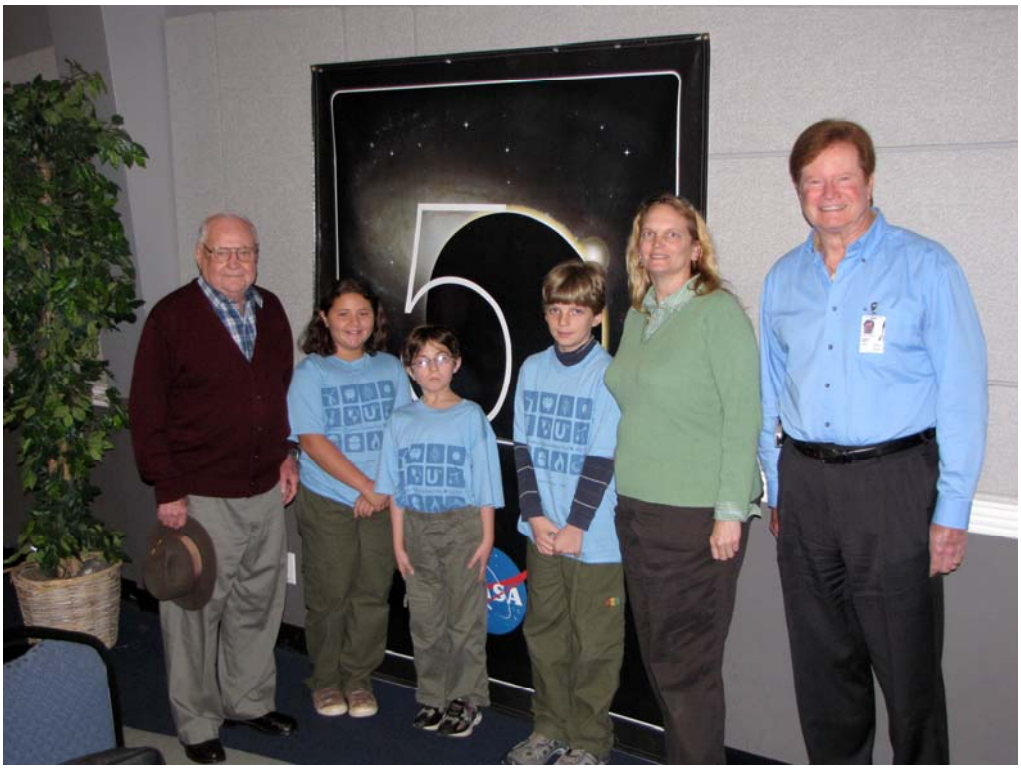
Above: Panelists with a few of the meeting attendees who were also involved with Apollo 8. Front row: Hal Beck, Rod Rose, Marianne Dyson. All of the others, left to right: Marty Jenness, Dr. Christopher Kraft, John Llewellyn, Dr. Glenn Lunney (Ken Young behind him), Emil Schiesser, Bob Wren, Bob Becker, John Jurgensen, next is …?, George Weiskopf, and then four more …? Please contact us at editor@aiaa-houston.org or past-chair@aiaa-houston.org to help us identify these Apollo veterans. We would like to print this photo again in our next issue with a complete caption. We apologize for the omissions.
(Photo by Douglas Yazell)

proud to be a part of what happened on Apollo 8.

While much of the audience was eager to hear more of the recollections of these men, the meeting finally ended well beyond its scheduled time. Ms. Dyson asked others who were involved with Apollo 8 to stand, and a recording of the Christmas message by Frank Borman was played.

The accomplishments of these men cannot be overstated, but theirs was merely one step in the journey of mankind into space. We in the aerospace community have been left the responsibility to build on what they have done. I hope we all can take to heart a remark made by John Llewellyn, "We left a legacy and I would appreciate it if you would do something with it."

Right: Oblique view of the Lunar surface taken from the Apollo 8 spacecraft (photo courtesy of NASA)



Among the participants at the Apollo 8 panel were Captain Andrew Hobokan (left); Satori School 4th and 5th graders Doris, Ben, and John with their teacher Nina Corley from Satori School in Galveston; and Bob Wren (right). The banner celebrates NASA's 50th anniversary.

Captain Hobokan became a member of the Space Task Group (STG) in 1961 at the Resident Office at McDonnell Douglas Aircraft Corporation in St. Louis, Missouri. Mercury production and checkout had been a problem for both STG and McDonnell and the Resident Manager, Mr. Bill Gray's group, including Hobokan, was charged with the task of working with McDonnell management to improve the process for the new Gemini program. Subsequently, Gemini went very well and flight ready spacecraft were delivered to KSC at regular intervals. Midway through the Gemini program, Mr. Gray was transferred to become the Resident Apollo Spacecraft Program Manager (RASPO) at Downy California. Shortly following the Apollo 1 disaster, Hobokan was called to JSC and was directed to report in three days to Grumman Aircraft Engineering Corporation, Bethpage, N.Y., to take the position of RASPO for the Lunar Module (LM). Here problems similar to those on the Mercury program caused the government Quality Assurance personnel to shut down the LM production and Hobokan requested McDonnell to train the Grumman LM team in the processes used for the Gemini production and test. Thus, LM production processes improved and the government QA personnel turned production back on and high quality LMs were produced leading to the successful Moon landings and safe returns to Earth in the decade of the 1960s. Following Apollo, her served as Manufacturing and Test Manager for the space shuttle orbiter project. He retired from NASA in 1978.

Bob Wren was part of a 200-person Apollo 8 team whose test program included a week-long vacuum chamber test with astronauts Kerwin, Brand, and Engle. Successful completion of that test was a direct constraint on the launch of Apollo 8.

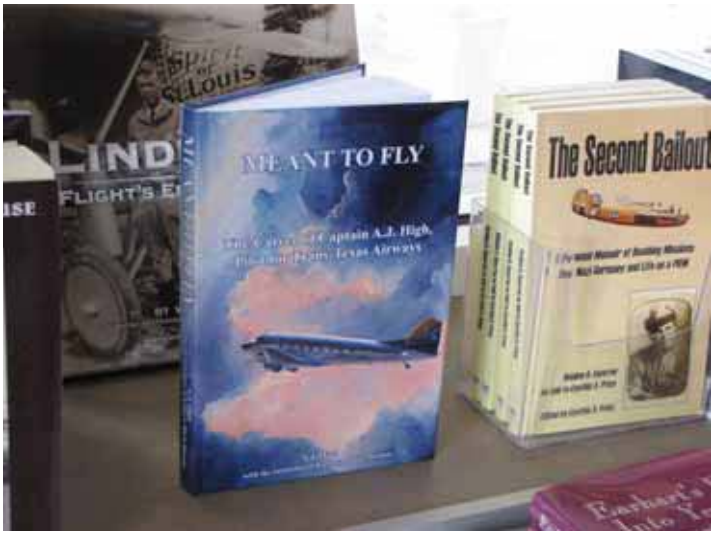
Book Review

Meant to Fly: The Career of Captain A.J. High, Pilot for Trans-Texas Airways

DOUGLAS YAZELL, PAST CHAIR

Right: The new book by Captain A.J. High

Photos: Yazell, unless otherwise noted



With ten chapters and almost 200 pages, this new book is a unique, important, and entertaining account of aviation history in the form of an autobiography. Chapter One begins, "I was born… [on] April 8, 1923." Before getting into more detail, let me note that the front cover artwork is a favorite of mine, a masterpiece based on one of the stories in this book. Although Captain High never lost a passenger and never scraped the paint on an airplane in his very long career, this event was his closest call. The artist is Jonathan D. Frank, a Houston resident, a Boeing 777 pilot for Continental Airlines, and owner of Ceilings Unlimited (http://www.ceilingsunlimitedaviationart.com), his art studio.

Captain High's book was written with the assistance of Kathryn Black Morrow. This is her third book, her second being *Defender of America's Gulf Coast: A History of Ellington Field, Texas 1917- 2007*, which was reviewed in a previous issue of Horizons.

Right: Part of the display about Captain High at the museum, including the photo with his daughter and his first wife.

The introduction points out that one can fly 801 miles in a straight line north to south in Texas, and 773 miles east to west, so the aviation business was a natural thing for this state.

Chapter Two is titled "World War II," so Chapter 1 gets us to that point. A.J.'s first solo flight was in December of 1941, at the age of 18, but it was not a certified and logged experience.

Among many experiences, A.J. piloted Lockheed P-38 twin-engine, twin fuselage airplanes for photo reconnaissance training in Colorado Springs in 1943. That year included piloting a B-25 under some famous bridges in the north of California from Sacramento to San Francisco, hijinks impossible to do these days. June of 1943 sent him overseas for the first time, but not far from Alaska, which was not yet a state: the Aleutian Islands, where the Japanese were the enemy. In late 1943, he was checked out in Ohio on the famous B-17 Flying Fortress bomber, a four-engine giant of an airplane. Chapter 2 ends in 1945 with A.J. having a wife, a daughter, and 45 days of leave to find a job.

In early 1946, his determination in the job search led him to Mr. Temple Bowen, president of the Continental Trailways bus line. Since war-era excess profits were taxed heavily, Mercury Airlines was being created as a tax shelter, and A.J. High took a job building that business.

Mercury Airlines came to an end in 1947, and Trans-Texas Airways starts its story in Chapter 4. Without a job for a short time, the situation was dire for a while for the High family. A.J.'s determination in the job search paid off when he was one of the group of sixteen pilots hired by Aviation Enterprises in Houston to start Trans-Texas Airways (TTA), a regional (inside that part of Texas) airline in the unusual

Left: AJ High in the airplane that made him a Captain. Photo by Richard Simental at the 1940 Air Terminal Museum at Hobby Airport, October 28, 2008.

situation of not relying on government air mail to survive. That began at what is now Hobby Airport and used what we now call the 1940 Air Terminal building, which still reads, "Houston Municipal Airport" above its main entrances. They worked long days and wore many hats to make that enterprise come to life. They obtained their clearance from the Civil Aeronautics Authority (CAA) on the first try. In fact, in the proving run on October 10, 1947, the CAA trusted them so much that they sent no one to be on board to check out the pilots' work.

A.J. became Captain A.J. High on his 25th birthday, April 8, 1948. That DC3 was the fifth airplane purchased by the company, and gave them enough planes to promote A.J. to Captain. More than 40 years later, in 1989, Continental bought that very same airplane to restore, and Captain High worked on that project in a terminal next to the 1940 Air Terminal Building at Hobby Airport.

The near-disaster that inspired the front cover art work occurred on December 18, 1952. In 1955 the new $5 million dollar terminal was completed: The Houston International Airport at what we now call Hobby Airport. Trans-Texas joined other airlines there, including American, Braniff, Continental, Delta, Eastern, KLM Royal Dutch, National, Pan-American, and Slick. A four-alarm fire at Trans-Texas Airways (TTA) did a lot of damage, but all 25 airplanes were saved, all of them DC3s. In 1962, the company built a large new office building nicknamed the Blue Barn. Texas Governor William P. Hobby died in 1964, and the Houston City Council named the airport in his honor that same year. In 1969, the Houston Intercontinental Airport opened north of Houston, and all of these airlines made the move across town, taking us to Chapter 5, which starts in 1966.

In September of 1967, Captain High left the flight line and took an office job for the first time: Vice President of Flight Operations. Continuing to wear many hats, he certainly was not tied to that desk for 40 hours a week, but it was a big change nonetheless. Still, the new job was not routine. It kept him on his toes in many ways. In April of 1968, TTA was sold to Minnesota Enterprises (MEJ). Late 1968 was the end of the piston DC3 era for the company.

Captain High did not think to take a snapshot after the 1971 emergency with a DC-9-30. It would have been a famous aviation photograph. Two inebriated pilots landed the airplane in one piece Houston after colliding with a telephone pole. They landed with the pole and the wires hanging out everywhere. No one was hurt among the passengers and crew, but Captain High had to explain the loss of the new airplane. There is more to the story in the book, but Captain High resigned as Vice President of Flight Operations, with that and a few other incidents on his mind.

As we start Chapter Six in late 1968, TTA becomes Texas International (TI) Airlines at Hobby Airport. A few regular flights to Mexico were included. Captain High was honored to be one of the pilots in the celebration of the opening of Houston Intercontinental Airport on June 7, 1969. He landed the airplane as planned just seconds after midnight, with a crowd of thousands watching. By the time TTA became TI, there were lots of

Left: A snapshot of the recently restored DC3 that made A.J. High a Captain in 1948. Part of the 1940 Air Terminal is in the background.

Vice Presidents, since promotions had been given out in place of pay raises for some time. Captain High was unique, being a pilot and having stipulated the salary details. For a few years, he earned more than the company president. They downsized, and his job title change to Senior Director of Flight, with no change in job duties. Targeted by a hostile executive officer, he had a miserable 18 months before returning to flying in September of 1971. He piloted several kinds of aircraft, mostly the DC-9, for 17 more years until his first retirement.

TI emerged from bankruptcy in 1972 with Frank Lorenzo at the helm. The 1978 Airline Deregulation Act had a strong effect on the industry. TI used "Peanuts Fares" to compete with Southwest Airlines. Starting in 1980, Lorenzo no longer offered contracts to TI employees. His Texas Air Company became a holding company for TI. "Texas Air seized the debt-ridded Continental Airlines in 1982, then merged TI with Continental, and renamed the combined organization Continental Airlines." Deregulation hurt unionized airlines over the next decade, and Texas Air grew and grew. In 1985, Lorenzo tried to gobble up Trans World Airlines (TWA), but failed, despite making a profit with the effort. "The following year, he acquired both Eastern Airlines and People's Express, with its Frontier Airlines included. By 1987, Continental Airlines had absorbed People's Express and New York Air, giving Texas Air Corporation control of 20 percent of the domestic airline market… At the same time, the mother corporation Texas Air officially employed only twenty workers."

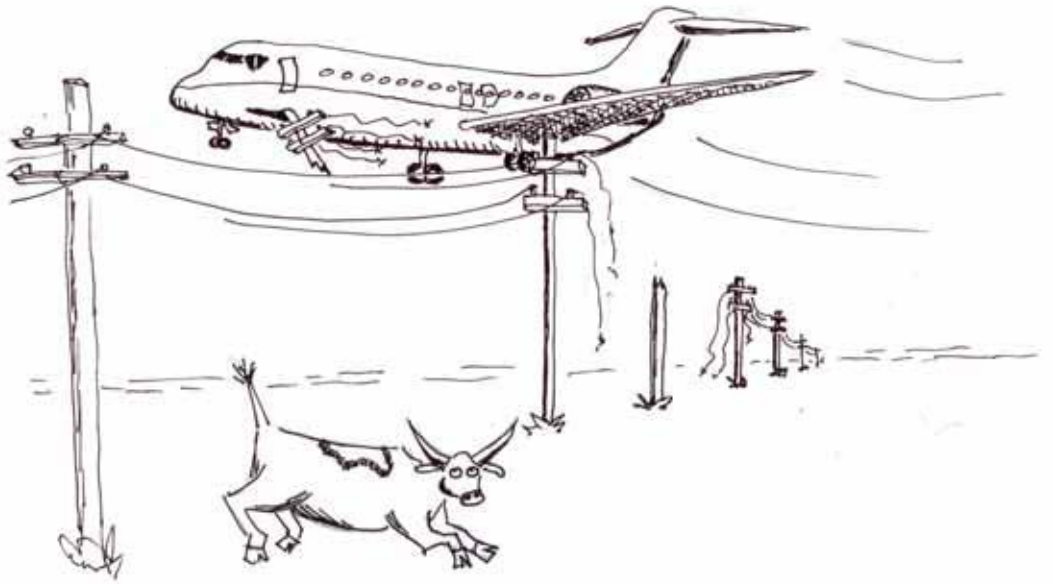
Captain High retained a high regard for Mr. Lorenzo. When TI and Continental merged, TI had a working class culture and the strongly unionized Continental pilots flew and did no other work, flying 42 hours a month and getting paid for 75, retaining an "us against them" attitude with respect to management. Quite a few Continental pilots went on strike and lost their jobs.

Chapter 7 describes a side business in cargo aviation, and Chapter 8 discusses the retirement from Continental and some later work. At the time, the FAA rule forbade pilots from flying after midnight on the day before the 60th birthday, so on April 7, 1983, Captain High made his last flight. Flying an airplane loaded with family and friends, an exception was made despite the culture to modern times to allow Captain High to "buzz" the runway, but not too low. He broke the rules one last time and ensured he obtained plenty of nice photographs of the stunt: a huge, modern jet buzzing over the runway with the landing gear up: 450 knots (about 500 miles and hour), 200 knots over the limit.

Chapter 9 discusses retirement projects at the Lone Star Flight Museum in Galveston, and Chapter 10 consists of personal notes.

Captain High is a well respected and popular aviation pioneer whose long career is amazing. Maybe that is typical of career aviation professionals of his era. If so, there are countless untold stories from other such pioneers yet to tell, maybe never to be told, from the 1940s to today's state of the art in aviation.

Right: Depiction of the scene described in Captain High's ook, art by Louis Abney



Odds and Ends

AIAA

The American Institute of Aeronautics and Astronautics

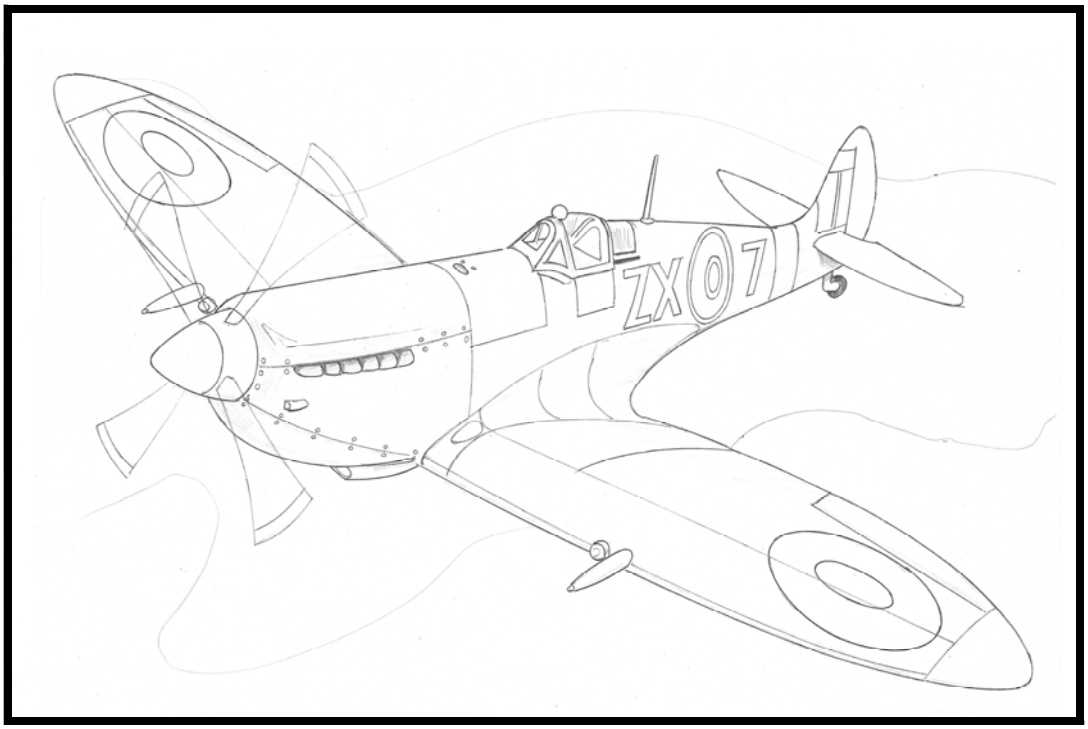
Historic Aerospace Site

Houston Air Terminal

The 1940 Air Terminal is a beautiful and rare example of classic art deco airport architecture from the golden age of flight. Designed by noted architect Joseph Finger, the Terminal was built to meet Houston's growing role as a major center for air commerce in the 1930s. Its grand opening by the City of Houston took place on September 28, 1940, at Houston Municipal Airport, now known as Hobby Airport. The 1940 Air Terminal was a destination for early airline service from points across Texas and the United States and international service, beginning in 1948. The 1940 Air Terminal also was at the center of early business aviation and general aviation. Within its walls, the 1940 Air Terminal housed rapidly advancing air traffic control and meteorological technology. It served as Houston's primary commercial air terminal until 1954.

2009

Left: Part of the forge's work order for the AIAA plaque. This will be presented to the 1940 Air Terminal Museum at Hobby Airport on Saturday, April 18, 2009, during Hobby Fest, the annual expanded version of their monthly Wings & Wheels program. On this day, admission will be reduced to $5 for adults and $2 for kids. That includes a light lunch of chips, water, soda, and something like hot dogs or hamburgers. As reported in recent issues of Horizons, this building is now an AIAA Historic Aerospace Site. The plaque will remain displayed at the museum.



Spitfire, drawn by Don Kulba, Horizons editor

Membership

LISA VOILES, MEMBERSHIP CHAIR

Congratulations to member Michael Kezirian (holding plaque), recently named as an AIAA Associate Fellow and awarded a Silver Snoopy on January 21 for exceptional efforts in leading the Composite Overwrap Pressure Vessel (COPV) analysis subteam, by providing System Safety products and tools that helped to understand hardware reliability allowing for Program acceptance of the risk.

Please welcome our newest AIAA Houston Members from December, January, & February!

MEMBERS:

Angel Alvarez-Hernandez
Christopher Brunner
William Chancery
Lewis Croog
Jerel Davis
Henry Dethloff
Marianne Dyson
Barry Finger
Bill Gottfried
David Held
Todd Hinkel
Glenn Jenkinson
Magda Lagoudas
Adele Luta
Michael Novick
Juan Popich
Steven Rickman
Dr. Shannon Ryan
Rodrigo Sanchez-Gonzalez
Gregory Slavin
Judy Tate-Brown
Lesley Weitz

STUDENT MEMBERS:

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Yogesh Babbar
Bryan Babbitt
Mark Baker
Sourav Banerjee
Austin Bond
Gianearlo Boswell
Brian Bourgeois
Zachary Carpenter
Kurt Cavalieri
Stephen Cornell
Nathan Cunningham
Shane Davis
Abir Djendou
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James Garton
Luis Gasca
Dick Gonzalez
James Halcombe
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Ladonna Handugan
Matthew Harris
Lap Hy
Nathan Jones
Gregory Kelderman
Ross Kotlar
Corey Larson
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Alexandra Long
Justin Mason
Benjamin Morales
Joshua Mott
Scott Palasota
Andrew Paton
Scott Peltier
Cameron Peters
Chad Phelps
Sumit Pokhrel
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Brandon Pruski
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Casey Rogers
Raphael Sanseyerino
Nirmal Sigamani
Krystal Stewart
Daniel Stovall
Zachary Sunberg
Micah Teel
Nathan Tichenor
Camilo Tobacia
Heather VanAntwerp
Mitchell Williams
MatthewWoodruff

EDUCATOR ASSOCIATES:

Peggy Eddy
Susan Foster (*St Clare of Assisi School*)
Ellen Hutto (*Ross Elem.)*
Denise Pool (*Lomax Elem.)*

Important notes:

- *Not a member? See the end*

Nominate a Colleague for One of AIAA's Top Awards

Do you know of a colleague who has made significant contributions to aeronautics or astronautics or to AIAA? Nominate them for one of AIAA's top awards.

Visit http://www.aiaa.org

Update Your Membership Records

Please verify your AIAA member record is up to date. Knowing where our members are working is vital to the Houston Section in obtaining corporate support for local AIAA activities (such as our monthly dinner meeting, workshops, etc.).

Please take a few minutes and visit the AIAA website at http://www.aiaa.org/ to update your member information or call customer service at 1-800-NEW-AIAA (639-2422).

You may always contact us at membership@aiaa-houston.org

The total number of AIAA Houston members as of February 1, 2009 is 1137. This includes 848 professional members, 260 student members, and 29 educator associates.

AIAA-Houston Calendar of Events

April 18 (Saturday)
AIAA Historic Aerospace Site ceremony for the 1940 Air Terminal Building at Hobby Airport
Time: 11 a.m. to 4 p.m. for Hobby Fest, 1:30 p.m. 1:45 p.m. for the AIAA ceremony
This is part of the monthly (every 3rd Saturday) Wings and Wheels program at the 1940 Air Terminal Museum
Wings and Wheels: see http://www.1940airterminal.org: Adults $10, kids $5, lunch included
Each year, one monthly Wings and Wheels program is bigger than the others, using most of the area next to one runway.
This annual event is called Hobby Fest. Prices are lowered to $5 for adults and $2 for kids.
For 2009, that especially big Wings & Wheels program is Saturday, April 18.
Worldwide, only about 33 such sites had been selected when this building was nominated.
In Houston, NASA JSC was selected as an AIAA Historic Aerospace Site in 2005.

April 23 (Thursday)
Free presentation at the Lunar and Planetary Institute (LPI), 281-486-2135
Cosmic Explorations: A Speaker Series
Title: A New Light on the Moon
Dr. Paul Spudis
probably starting at 7:30 pm, followed by a light reception
http://www.lpi.usra.edu/education/lectures
This is geared toward inquisitive adults
This is not an AIAA event

May 4 (Monday)
Council meeting

May 15 (Friday)
AIAA Houston Section Annual Technical Symposium 2009 (ATS 2009)
Location: Gilruth Center, Alamo Ballroom and a few smaller rooms
Time: 8:00 am to 5:00 pm
See http://www.aiaa-houston.org for publicity

June 1 (Monday)
Council meeting

June 5 (Friday)
Dinner meeting (AIAA Houston Section honors & awards)
The Future of U.S. Planetary Exploration
Speaker: Dr. Randii Wessen, NASA/JPL
Location: Gilruth Center, Alamo Ballroom is reserved, but event may be held at the 1940 Air Terminal Museum (http://www.1940airterminal.org). See publicity in upcoming weeks.

June TBD:
Free presentation at the Lunar and Planetary Institute (LPI), 281-486-2135
Cosmic Explorations: A Speaker Series
Title: TBD
Dr. Debra Fischer
probably starting at 7:30 pm, followed by a light reception
http://www.lpi.usra.edu/education/lectures
This is geared toward inquisitive adults
This is not an AIAA event

Horizons published quarterly, online late March, June, September and December.
See http://www.aiaa-houston.org/horizons

EAA Corner

Chapter Party – 18 April 2009, Williams Airport Just north and east of Houston Intercontinental Airport (IAH), Everyone has noted they want more parties like we had last year at Neil and Arne's where the spouses and families can come, ideas on dates, locations and activities are welcome – airports, pool parties, etc. Let one of the officers know your thoughts and offers! We are not yet sure as to our role after insurance etc, but please contact Phil at phil.perry@netapp.com for you want to help put together, exhibit, attend or comment!

9 May 2009, Ellington Wings and Wheels Charity Event and Fly-in, Ellington Field (KEFD), Houston TX: Charity event with a fly-in theme, details in the future plan on this one for fun and a good cause!

EAA Chapter 12 Notes:

For Sale: Frank Caldeiro is selling headsets in great condition: 1 Clark H10-49, 2 Softcoms (one is a child's size and used a couple of times). He also has an intercom available. Contact: rtsessions@earthlink.net.

For Sale: Jack Nelson, a former Chapter member, wishes to sell his Tri-Pacer. The Tri-Pacer has had some recovering done sometime in the past. The hours on it are estimated at about 1200 (Paul didn't know for sure), and the engine case has never been opened. Jack also has available an almost completed PA-15 that is ready to be covered and also almost ready for final inspection. Anyone interested should contact Jack at: 936-433-1001. He and the plane/project are located at Livingston airport

Labor Help: Rudy Ackerman is in the Clear Lake Area and is willing to help anytime and on any parts of the airplane. rudolph_ackerman@yahoo.com 281 460 7384

Recurring Events

Monthly Meeting: Chapter 302 Monthly Meeting, 2nd Saturday, 10 AM, Lone Star Builder's Center, Lone Star Executive, Conroe TX
1st Saturday of Each Month – La Grange TX BBQ Fly-In, Fayette Regional (3T5)
2nd Saturday of Each Month – Lufkin TX Fajita Fly-In (LFK)
2nd Saturday of Each Month – New Braunfels TX Pancake Fly-In
3rd Saturday of Each Month – Jasper TX BBQ Lunch Fly-In (JAS)
3rd Saturday of Each Month – Tyler TX Breakfast Fly-In, 8-11, Pounds Field (TYR)
4th Saturday of Each Month – Denton TX Tex-Mex Fly-In
4th Saturday of Each Month – Leesville LA Lunch Fly-In (L39)
4th Saturday of Each Month – Shreveport LA Lunch Fly-In (DTN)

EAA Chapter 12 Associates

American Institute of Aeronautics and Astronautics – Lots of activities in the local area and some announcements of our meetings! www.aiaa-houston.org
Houston Aviation Alliance, First Monday of each month at the Hobby Airport Hilton: www.houstonaviationalliance.com/
America's Flyways Magazine – Local Houston Editor - Jim Hartley, A great read: www.americasflyways.com/
Collings Aviation Foundation (some great war birds including jets and barnstormer vintage): www.collingsfoundation.org/menu.htm
EAA's B-17, Aluminum Overcast: http://www.b17.org – Scheduled to be in Houston 28-29 October 2008

Chapter Mission

The Experimental Aircraft Association's Chapter 12, located at Ellington Field in Houston, is an organization that promotes all forms of recreational aviation. The organization includes interest in homebuilt, experimental, antique and classic, warbirds, aerobatic aircraft, ultralights, helicopters and commercially manufactured aircraft and the associated technologies. This organization brings people together with an interest in recreational aviation, facilitating social interaction and info mation 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!

Contact Information

Please update e-mail information, host a meeting, present a topic or sponsor an event or make recommendations, please contact:
Richard Sessions at rtsessions@earthlink.net
EAA Chapter 12 Home Page: http://www.eaa12.org/
EAA National Home Page: http://www.eaa.org/

Aerospace Projects Review

APR Corner
Ancestor of the X-38: X-24

SCOTT LOWTHER

APR Corner is presented by Scott Lowther, whose unique electronic publication is described as a "journal devoted to the untold tales of aerospacecraft design." More information, including subscription prices, may be found at the following address:

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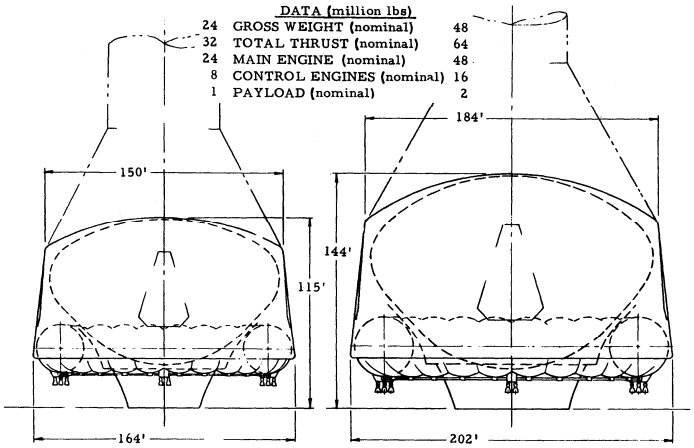
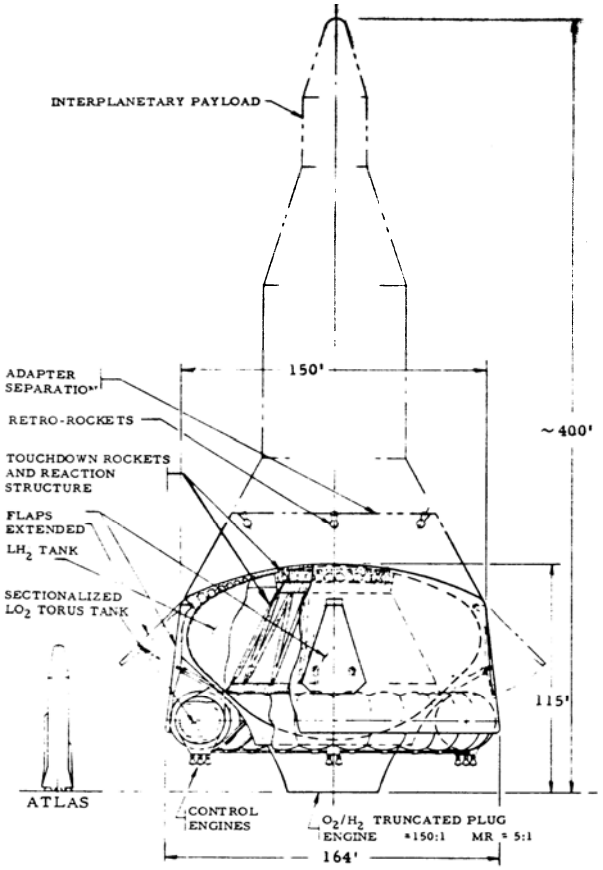
http://www.up-ship.com

In 1962, the Saturn V was still in early development, manned Lunar landings were another seven years away, and the future of manned space flight was going to be Bigger and Better for as far as the eye could see. Consequently, even though the Saturn V had not yet flown, plans were being drawn up for the post-Saturn era, when vastly larger launch vehicles would be needed to support such things as manned missions to Mars, giant space stations and Lunar bases. The Nova program had run concurrent with the Saturn development program; the early giant Nova vehicles turned out to be less capable than the Saturn V, but later Nova concepts grew immense in size and capability. By 1962, though, the Nova was moot as a launch vehicle for Apollo due to weight savings in the Lunar lander and the Lunar Orbit Rendezvous technique. Still, it seemed obvious at the time that the Saturn would need replacing sometime in the early to mid 1970's, and the Nova studies formed a basis for a Post-Saturn launch vehicle architecture.



Upper right: Two versions of NEXUS: the baseline 1,000,000 pound payload version at left, a larger 2,000,000 pound payload version at right.



Right: The baseline NEXUS booster with an interplanetary payload, showing an Atlas ICBM for scale.

Anybody who was anybody in American aerospace at the time wanted in on the Post-Saturn launch vehicle. A wide range of design possibilities were put forward, from all-solid to single-stage hydrogen/oxygen to nuclear powered. One of General Dynamics' designs was pushed by famed rocket engineer Krafft Ehricke, and was known as the "chemical NEXUS" booster, or NEXUS for short.

NEXUS, in its basic form, was a reusable single-stage hydrogen/oxygen vehicle. Incredibly stubby by normal launch vehicle design standards, the NEXUS used a plug cluster aerospike engine to generate maximum thrust and maximum specific impulse at all atmospheric conditions. Effective specific impulse throughout ascent was to be 431 seconds, while liftoff

thrust was in excess of thirty million pounds. Nominal payload was one million pounds… approximately four times what the Saturn V could orbit. However, it was extremely sensitive to specific impulse… a one second drop in Isp would lower effective payload to 843,000 pounds. Numerous options were studied for the individual engine elements, and details in available descriptions conflict somewhat. In order to increase payload performance – or offset payload losses due to Isp shortfalls – up to 12 large solid rocket motors (Titan boosters) could be added as "JATO" units.

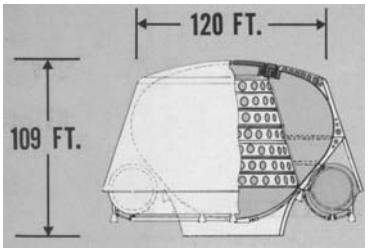
NEXUS had a single titanium liquid hydrogen tank of unusual semi-conical shape taking up most of the interior volume of the vehicle, with a toroidal liquid oxygen tank (built from intersecting stainless steel spherical subtanks) ringing it. The NEXUS had an extremely blunt forward surface; it would re-enter nose first, and the blunt face would help to dissipate aerothermal heating loads. The entire vehicle was clad in a titanium skin to provide heating protection on both ascent and descent.

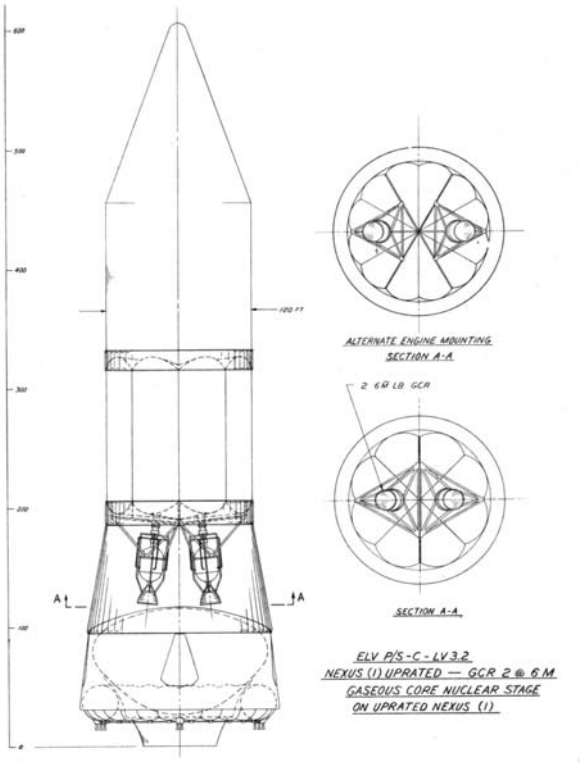
Landing would occur in the ocean. Control during descent would be provided by four body-mounted flaps; before splashdown the flaps would be extended as air brakes. Additionally, twenty-four to forty-eight solid rocket motors mounted on the forward face would fire just prior to splashdown… serving not only as retrothrust to slow the vehicle, but also to stir up the surface of the water and introduce a blanket of exhaust and steam, cushioning the impact. A foot of styrofoam would be provided behind the titanium skin as a crushable shock absorber.

Payloads envisioned for the NEXUS included not only space station elements and Lunar materials, but also giant deep-space vehicles. At this point in time, not only was the space program going to go nowhere but up, but nuclear power would soon take us to the stars. As a consequence, General Dynamics produced diagrams showing the NEXUS carrying conventional payload, Orion nuclear pulse payloads, even interplanetary stages using gas core nuclear rockets.

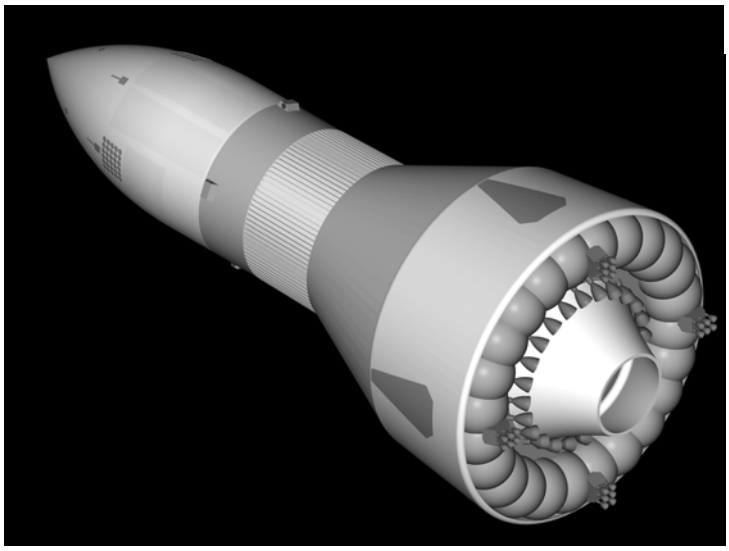
Sadly, the Post-Saturn programs fell victim to the rapid decline in future planning that came about in the late 1960's. In 1963, giant launch vehicles were an obvious forthcoming development, but the financial costs of the war in Vietnam, the loss (real and politically perceived) of public interest, and the end of the "race" part of the "space race" spelled doom for such grandiose hopes.

Below: Diagram of one version of the NEXUS, showing the inner structure and the retrorockets in the forward dome





Above: An uprated NEXUS booster with a gas-core nuclear thermal upper stage



Left: Computer rendering showing a 4,000 ton General Atomic "Orion" nuclear pulse vehicle atop a NEXUS lofter. (For more on the Orion vehicle, see the latest issue of Aerospace Projects Review magazine)

Scholarship winner

Scholarship Winner Becomes a Summer Intern here at NASA/JSC

EDWARD JABLONSKI

For more information on The "Spirit of Apollo" Scholarship, go to http://www.aiaa-houston.org/scholarship.

The AIAA-Houston Section gets its money's worth - University of Houston Student Ward Jablonski, recent recipient of a "Spirit of Apollo" Scholarship, was an intern this past summer for JSC Contractor Booz-Allen-Hamilton. Ward is an Electrical Engineering major at the Cullen College of Engineering at U. of H.'s Main Campus here in Houston, and was hired by BAH to work on International Space Station Payload Power Allocation Tables as part of the famous VIPER Team. He recently had the opportunity to attend the December 2008 AIAA dinner meeting, and was introduced to the audience there.

Ward said that he was "Proud to be able to contribute to the ISS, especially since he was getting scholarship money from the aerospace field." He also says that he is looking forward to continuing his technical studies and exploring a variety of fields during future internships. He has always liked to explore, and that in part explains why he has also become an Eagle Scout.

The "Spirit of Apollo" Scholarship is awarded annually by the AIAA-Houston Section's Scholarship committee, which has been chaired for several years by Dr. Doug Schwaab of the Boeing Company. Dr. Schwaab was quoted as saying that "it is Aerospace Engineering majors that usually win this scholarship. But Ward was so well qualified, he broke the mold."

Ward's younger brother Phillip Jablonski is also following in the same footprints. Phillip (also an Eagle Scout) was recently (Feb '09) accepted into the Honors College at the University of Houston as well; Phillip will be majoring in Mechanical Engineering there. Both boys, as it turns out, will have several of the very same professors that their father did three decades before. How about that!

Right: AIAA Scholarship Winner Ward Jablonski

Cranium Cruncher

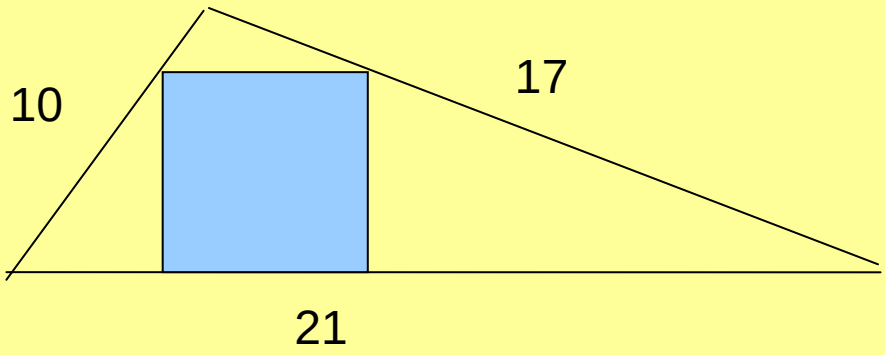
BILL MILLER, SENIOR MEMBER

The last issue's puzzle concerned a hapless operator of a test stand water tank and how long it took him to fill the tank. Steve Everett, Douglas Yazell, Ronny Newman, Bob Maraia, and Alan Simon all got the correct answer of approximately 10 hours and 48 minutes.

This month's puzzle:

A structural designer is working on a hypersonic wing of triangular cross section. Design requirements dictate that the sides of the triangle be in the ratio 10 / 17 / 21 as shown in the sketch below (not to scale). The designer wishes to include a box-beam of square cross section as the main structural member. The upper corners of the square touch the two upper sides of the wing and the base of the square lies along the bottom of the wing.

For the dimensions given, what is the length of a side of the square?



Send solutions to wbmilleriii@comcast.net. The answer, along with credits, references, and names of the solvers, will be provided next time.

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