Horizons

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Apollo 8
The 40th Anniversary

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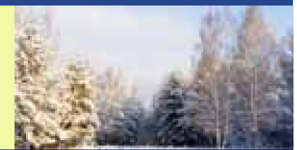

T A B L E   O F   C O N T E N T S

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2005 2006 2007

Honorable Mention 2008

Cover: Earthrise as viewed from the orbiting Apollo 8 on December 24, 1968 (credit: NASA)

40 Years Ago

From the Editor

STEVEN EVERETT, EDITOR

December 21, 2008, will begin a string of 40th anniversaries throughout the next few years marking the Apollo flights to the Moon. Following the Apollo 8 mission which was launched on that date in 1968 were Apollo 10 on May 18, Apollo 11 on July 16, and Apollo 12 on November 14 of the following year. (Apollo 9 was launched on March 3, 1969, but did not orbit the Moon.) Apollo 13 was the only mission launched in 1970, on April 11, and Apollo 14 and 15 followed on January 31 and July 26 of 1971. Apollo 16 and 17 were launched on April 16 and December 7 of 1972. A total of 10 missions, with only one major mishap, were accomplished over the course of 4 years, a remarkable flight rate for such new technology.

In this issue, our cover story features a submission about the first of these anniversaries by one who was there when the first and boldest step toward the Moon was made. However, another 40th anniversary of no less significance to me personally will also happen early next year: the 40th anniversary of my birth. While I have no recollection of the event, I watched man's first steps on the Moon as a five-month-old baby. In fact, my earliest memories of the space program were vague notions of the demise of Skylab, well past the prime of the Apollo era. That places me and those of my generation in the unique position of being too young to remember our country's first Moon landings and approaching the latter half of my aerospace career before potentially participating in the next missions to another world. It is difficult not to harbor feelings of disappointment or even resentment toward having nearly missed out on participating in our species' first faltering steps into interplanetary space.

Having no memory of such an extraordinary period of time and hearing the constant reminders from the media about the expense and effort of getting back to the Moon, it is somewhat more forgivable that there are those who do not believe it was possible for our country to achieve such a monumental goal 40 years ago, retro-reflectors and loads of Moon rocks notwithstanding. Thanks to one of the challenges proposed by the Google lunar X prize, however, we may soon have proof that only the most diehard conspiracy theorist could try to refute. In the vein of the multiple aviation prizes early last century, the Orteig prize being the best known, which spurred on engineers and inventors to push the envelope of aircraft design and performance, the Ansari X prizes are encouraging entrepreneurs to accomplish goals only attempted by national governments at much less time and expense. According to the Google lunar X prize rules, in addition to the $20 million first prize, a bonus prize of an additional $5 million will be available if one of the historic Moon landing sites can be imaged from the surface. It is unimaginable how the public's enthusiasm for space travel could be recharged with this visible reminder of where we have been. In many ways, this and some of the other commercial endeavors, such as those discussed in the article on Commercial Orbital Transportation Services (COTS) hold more promise for quickly advancing the state of space travel than the often glacial efforts of federally funded programs.

Continuing from the last issue of Horizons with the retrospective on NASA's first 50 years, an interview with another long-time NASA scientist, Dr. David Pitts, may also be found in this issue. As this milestone passes and NASA looks forward to its next 50 years, I'd like to close with the sentiment expressed by Frank Borman from lunar orbit 40 years ago: "...good night, good luck, a Merry Christmas, and God bless all of you." See you in 2009.

1940 Air Terminal

Wings & Wheels, Saturday, October 18, 2008

Douglas Yazell, Past Chair

Author Celeste Graves was a special guest once again at the 1940 Air Terminal Museum on Saturday, October 18, 2008. She sold and signed copies of her book, *A View from the Doghouse*, about the Women Airforce Service Pilots (WASP), who, as she explains in the book, got their start in Houston. She allowed visitors to look through two of her photo albums which include many, perhaps all, of the pictures used in this book.

Retired Captain A. J. High, a museum volunteer, was also at the museum. The book signing for his new book was postponed by Hurricane Ike, but he had a preliminary hardbound copy available for inspection by visitors. The front cover uses an original painting created years ago based on his description of one of the worst close calls he experienced as a commercial airline pilot. Both of two motors failed, but he and his crew succeeded in getting one restarted in time. One of the three airplanes on display was a McDonnell Douglas DC-3, the famous workhorse of commercial aviation. It was the last airplane flown out of the Lone Star Flight Museum in Galveston before Hurricane Ike arrived. If I recall the story correctly, this is the same airplane that was put into service at this Houston Municipal Airport in the 1940s, the fifth DC-3 to arrive there, allowing a young A. J. High to be promoted to Captain.

Top right: A DC-3 from TransTexas Airways, as I recall. Captain A. J. High is now an important volunteer at this museum, and this aircraft was his first when he was promoted to Captain.

Below: Damage to the control tower from Hurricane Ike

Every third Saturday the museum presents a special Wings & Wheels program with inspiring displays such as airplanes, cars, helicopters, or motorcycles. The price is $10 for adults and $5 for kids 12 and under, and includes soft drinks, water, chips, and a main course such as hot dogs, hamburgers, or chili. Hurricane Ike hit Houston Friday night, September 12, 2008. It left Houstonians exhausted from evacuations, days without electricity, broken traffic lights, and much worse for some. For once, the museum cancelled its monthly Wings & Wheels for September 2008, but Wings & Wheels was back in operation for October 2008, thanks to many museum volunteers. In the coming months, one part of a Wings & Wheels Saturday program (not scheduled yet by our national AIAA volunteers) will include the national AIAA ceremony honoring this museum as an AIAA Historic Aerospace Site.

Right: Spooky and the DC-3

(photos by Douglas Yazell)

Science on the International Space Station

SEAN KEEFE, ASSISTANT EDITOR, HORIZONS

Dinner Lecture Summary

On November 6, 2008, the NASA Alumni League JSC Chapter held a dinner and lecture in the Gilruth Alamo Ballroom for about 60 people.

Between dinner and the keynote speaker, Jean Engle introduced her new role as Chief Knowledge Officer (CKO) at NASA Johnson Space Center (JSC). At JSC, Engle's mission is to help capture and organize local spaceflight knowledge and help preserve and transfer it to current and future generations.

Engle explained that there is a new agency-wide initiative at NASA to preserve the last 50 years of human spaceflight experience and manage institutional knowledge in innovative ways. She quoted Mike Coats, who said, "If we're going to make a mistake, we ought to make a new one."

Engle invited members of the NASA Alumni League (NAL) to contribute to the agency's new knowledge capture effort. She announced an experimental program in knowledge sharing to be held every other month at JSC. The format would be an informal, one-hour interactive session for those with valuable lessons learned to share stories and take questions. Engle emphasized that real learning happens when people teach people in a contextual setting. Thus far, there are no limits on which subjects can be shared through the program. She pointed out that all disciplines are equally critical to NASA's success—administration, human resources, finance, engineering, science, etc. Interested NASA alumni should contact Jean Engle directly.

Dr. Julie Robinson, Program Scientist for the International Space Station (ISS), was keynote speaker for the evening. Her presentation was titled "Science on the International Space Station." Dr. Robinson holds a Ph.D. in Biology and has research experience in a wide variety of fields, including analytical chemistry, field biology, genetics, remote sensing, and statistics.

Dr. Robinson highlighted many scientific accomplishments achieved thus far aboard ISS during its prolonged assembly stage from 1998-2008. She summarized ISS science through Expedition 17.

To date, there have been 169 scientific investigations with 500 senior scientists as Principal Investigators (PIs) and a number of graduate students involved in these projects. Of those 169 investigations, 105 studies have been completed. During Expedition 18 (October-April 2008), there will be 72 investigations.

The Kibo (JAXA) and Columbus (ESA) science lab modules launched in 2008 have increased the space for more science aboard the station, but Dr. Robinson said that the station is only halfway to completion in terms of bringing up the racks used for science. These racks are hard-mounted into the Multi Purpose logistics Module (MPLM), which flies in the Shuttle's payload bay. Three MPLM flights—ULF-2, 17A, and19A—will finish outfitting science racks aboard the space station by 2010.

Going up in these MPLMs will be more materials science research racks, fluid integration racks, a combustion integration rack, two multi-purpose racks, a muscle atrophy system, and an optical-quality window instrument for remote sensing.

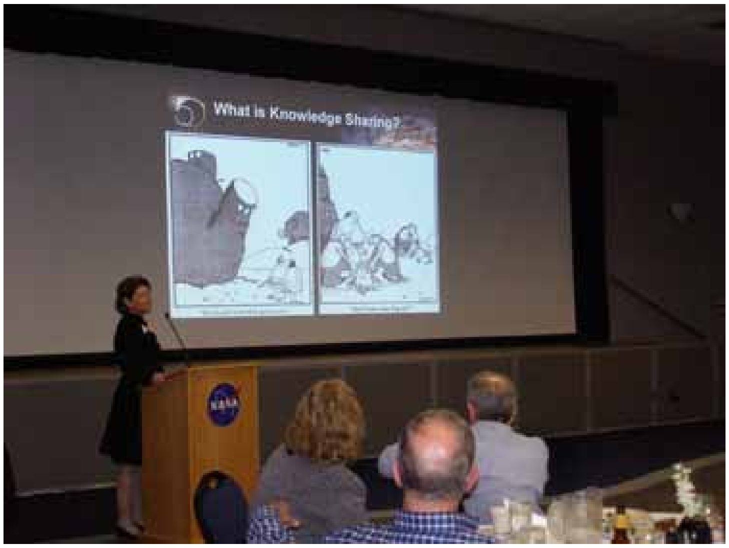
There have been external experiments aboard ISS in past years, including MISSE experiments— suitcase-sized suites of various materials (solar cells, paints, docking seals) exposed to ultraviolet and atomic oxygen fluxes in space.

For external science experiments, the first flight of the Japanese robotic resupply vehicle HTV-1 will bring a NASA payload to ISS with

Above: Jean Engle, Norm Chaffee, and Dr. Julie Robinson (photo by Sean Keefe)

Read NASA's Strategic Plan for Knowledge Management at http://km.nasa.gov/whatis/index.html.

Below: NAL alumni and guests catch up before dinner (photo by Sean Keefe)



Above: Jean Engle explains knowledge sharing (photo by Sean Keefe)

Below: Dr. Julie Robinson explains ISS science to an attentive audience (photo by Sean Keefe)

two instruments: HICO, the Hyperspectral Imager for the Coastal Ocean; and RAIDS, the Remote Atmospheric and Ionospheric Detection System. Two Japanese space science environment observing payloads, the SEDA experiment (Space Environment Data Acquisition equipment-Attached), and the MAXI experiment (Monitor of All-sky X-ray Image), will go up on Space Shuttle flight 2JA in 2009.

All four of these payloads—HICO, RAIDS, SEDA, and MAXI—will be attached to the Japanese Experiment Module Exposed Facility (JEM-EF), an external platform that can hold up to ten experiments outside Kibo. The new Columbus laboratory also has external research facilities where experiments will be attached.

Dr. Robinson described several medical experiments, including a human fluid-shift study; bone density and bone loss countermeasures; and the Nutrition Status Assessment, an integrative study concerned with bone metabolism, hormonal changes, nutrition, and oxidative damage over the course of a mission. The assessment is also concerned with the effectiveness of countermeasures such as exercise and vitamins in mitigating those risks.

Dr. Robinson shared early results from the first three crew members in one study: a significant Vitamin D deficiency was found. Physicians have subsequently doubled the amount of D supplements provide onboard ISS, and researchers will test those results.

Researchers follow astronauts for up to three years after ISS expeditions to learn exactly how their bones rebuild. They have discovered that exterior bone rebuilds more densely than interior bone, which results in an increased risk of bone fracture.

Dr. Robinson described a study of vitamin and drug stability on-orbit. After a two-week shuttle flight, some antibiotics in medical kits had already degraded. Such studies will help scientists understand how to preserve foods, drugs, and vitamins on other long-duration flights.

In the physical sciences, Dr. Robinson described the Microgravity Science Glove box, "the workhorse of early science utilization on ISS." The device can accommodate large experiments and has video and power feeds and a filtration system.

Glove box experiments include measuring the size of smoke aerosols to help design appropriate smoke detectors for Orion. Another study, In-SPACE, researches the particle dynamics of controllable fluids that quickly change viscosity in response to a magnetic field. Applications for these "smart fluids" include airplane landing gear, robotics, and vibration damping systems.

Other experiments Dr. Robinson described include the following: Cell Wall/Resist Wall experiments—how plants respond and build their cell walls in microgravity conditions; Elastic Memory Composite Hinge (EMCH), with applications for satellite and space station solar array deployments; Capillary Flow Experiment, with applications in fluid transfer on spacecraft; Lab-on-a-Chip, a hand-held device used to quickly detect biological and chemical substances.

Dr. Robinson said that research on ISS can lead to a better understanding of microbial adaptation and possibly result in new therapies, as well improve understanding of how to keep closed-loop life support systems like ISS clean and healthy for long-duration crews. She gave the example of a salmonella strain that had mutated into a "superbug" in space.

That superbug lost its virulence only four hours after returning to Earth. Scientists identified the controlling protein that made the bug more virulent. Results of this study were published in the proceedings from the prestigious National Academy of Science. Every shuttle flight is launched with different species of salmonella. This commercially-funded study has the potential to result in a salmonella vaccine.

Dr. Robinson revealed even more promising research from ISS: the micro-encapsulation of drugs used to treat prostate cancer in rodents. This therapy was found to be twice as effective as another treatment. It was patented last year and is now in clinical trials.

Dr. Robinson described the challenge of trying to work within the US government's shifting definitions of the space station's scientific research priorities. The President's Vision for Space Exploration, announced by President Bush in January 2004, limited science performed aboard ISS to three objectives from NASA's new core mission: developing health risk countermeasures; testing and researching technology needs for future exploration missions; and gaining operational knowledge for long-duration space missions.

Congress's response to the President's Vision for Space Exploration, the NASA Authorization Act of 2005, opened up more research opportunities aboard the space station by allowing other government agencies and the private sector to meet their own research objectives using their own budgets for ISS science.

Dr. Robinson said that ISS will become a National Laboratory in 2010, which increases funding and collaboration opportunities. NASA now has Space Act agreements with three private companies and two memoranda of understanding with the National Institute of Health (NIH) and the US Department of Agriculture (USDA) for ISS science. When ISS becomes a National Lab, it will open up the space station potentially to all investigators.

Dr. Robinson noted that ISS is a critical long-duration test facility. She compared six-month expeditions on ISS to six-month trips to Mars. An astronaut's physical condition after returning to Earth from the station is comparable to the physical condition of an astronaut after traveling to Mars: there is significant bone and muscle mass loss. What countermeasures can be used to minimize that problem? That basic question need to be addressed, and ISS provides the best test laboratory for such long-duration studies.

Dr. Robinson observed that the International Space Station provides a truly unique facility for pure research that can apply to several disciplines. That pure research on ISS is another challenge: it is difficult to track the benefit of innovations that affect such a diverse number of scientific fields. However, Dr. Robinson says she tracks publications from all experiments on ISS and operational and technological development from non-specific studies.

With three US crew members aboard ISS and assembly almost complete, Dr. Robinson said that astronauts now have 35 hours per week dedicated to science and more time to collaborate and conference with PIs on the ground.

The International Space Station also provides opportunities for students to be involved in science. There are student experiments aboard ISS, student science information downlinks, and other educational outreach opportunities for students that come from the Space Station Program.

With the International Space Station nearing completion in 2010, Dr. Robinson warned that there will be only four years to demonstrate the benefits of ISS to science at the "assembly complete" stage before a decision is made whether or not to extend the life of ISS to 2015. That extension is critical to ISS achieving its full scientific promise. "Otherwise," Robinson said, "the International Space Station will not have enough time between 2010 and 2014 to develop all of the experiments that achieve the potential that we sought from its inception."

The benefits to science and humanity from research on the International Space Station are difficult to calculate, although breakthroughs in scientific and medical research on ISS are easily imagined. So much has already been accomplished during the distracting assembly stage, and much more is to come when assembly is complete and the station finally becomes the dedicated laboratory in space that it was designed to be. It is hoped that the public and Congress will give the International Space Station the support it deserves to achieve its original purpose.

Above: Dr. Lisa Monaco examines Lab-On-A-Chip. (source: NASA)

For more on ISS science experiments, see http://www.nasa.gov/mission_pages/station/science/experiments/List.html

Event Summary

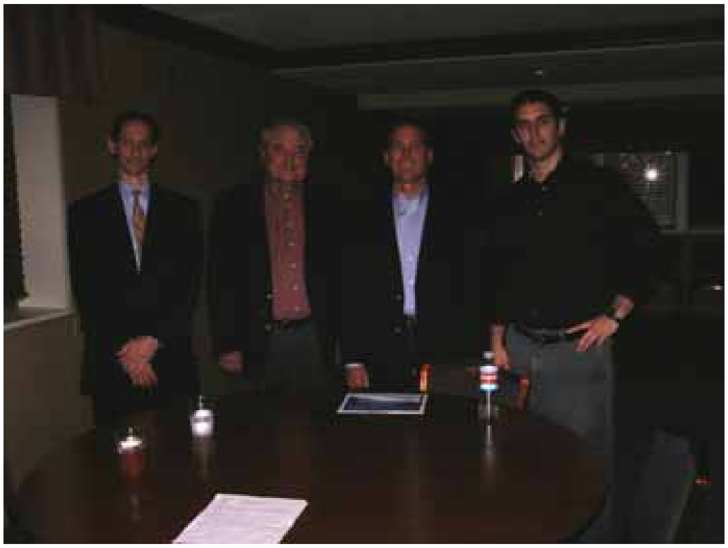
AIAA YP Seminar: Aerospace Business Paths

SEAN KEEFE, ASSISTANT EDITOR, HORIZONS

On November 3, 2008, the AIAA Young Professionals (YP) Committee hosted a career panel in the Gilruth Lone Star Room. Approximately 30 people attended the seminar.

There were three distinguished panelists introduced by AIAA YP Chair Jim Palmer. Nick Pantazis is founder and Vice President of Integrated Strategic Solutions, Inc. (ISSI), a small business serving government and commercial customers in Aerospace since 1999.

Kyle Rone is President of Kyle Rone Enterprises, which specializes in delivering education and services to government, industry, and educational institutions. Mr. Rone has worked on NASA's human spaceflight programs since 1965. He has been a consultant for 14 years and also teaches at the University of Houston Clear Lake. Pat Schondel is Vice President of Business Development for the Boeing Corporation. He is responsible for developing, planning, implementing, and directing business development strategic marketing activities for Boeing Space Exploration.



The three panelists spent about twenty minutes summarizing their careers and sharing lessons learned about working for a company, consulting, and starting their businesses.

Next, the panelists spent well over an hour answering questions from the audience. The panelists provided real-life experiences and wisdom gained from many years of trial and error in their respective careers.

There was a discussion about whether or not to pursue the Master's in Business Administration or to stay with a firm and get direct management experience. The three panelists described their own decision-making process about the MBA and whether to stay in the technical side or go into management and the trade-offs of each decision.

General advice for young aerospace professionals was to manage their own careers; set flexible career goals for 5, 10, and 20 years out; keep up with new training; network in various organization such as AIAA; find and become mentors; stay active in the local community; and try to advance their careers in a stepwise fashion by becoming technical leaders, projects leaders, project managers, and managers.

The turnout was high despite the short notice, and attendees stayed around to ask questions even after the official Q&A period. This may indicate a strong interest and/or need for more of this type of interactive career panel. Perhaps we will see another such seminar from the AIAA YP program in the near future.

Top right: Nick Patanzis, Kyle Rone, Pat Schondel, and Jim Palmer
Bottom right: AIAA young professionals listen intently to experienced aerospace professionals
(photos by Sean Keefe)

Global Warming: Ready or Not!

Event Summary

ALAN SIMON

Political change was not the only topic offered for public consumption and participation when Kevin Trenberth lectured the general public this past November Election Day. Dr. Kevin Trenberth, head of the Climate Analysis Section (CAS) at the National Center for Atmospheric Research (NCAR), is one of this country's most influential climate scientists. He was a guest at the University of Houston's Science and Engineering Center (SEC). Trenberth is originally from New Zealand, but calls Boulder, Colorado home these days.

To put things of seemingly grand scale in perspective, Trenberth sized up our Earth as a trek that air pollution makes during a 10-day trip; though air pollution has a life span of only about 5 days. In comparison, carbon dioxide (CO_2) can last in the atmosphere for more than 100 years. Photosynthesis, as most know, draws down CO_2 levels such that CO_2 concentrations tend to rise in the winter and decrease in the summer. But over the past 50 years, concentrations have tended to rise, from an average of 320 ppm to about 380 ppm.

A handful of countries have contributed significantly to the rise in CO_2 over the last half-century, and some of the statistics Trenberth presented are quite revealing. Although the US still holds the record for being the highest contributor per capita of CO_2 emissions—19.4 tons—countries like China and India have doubled their output over the past 8 years. In fact, China showed an 8% increase from 2006 to 2007. Russia contributed almost 12 tons per capita, the European Union, 8.6 tons per capita, and China and India, 5.1 tons and 1.8 tons, respectively. And if these numbers were not frightful enough, California by itself contributes 11 tons per capita, and Texas a whopping 32 tons!

So, while CO_2 is a natural greenhouse gas, and greenhouse gasses are necessary to maintain our Earth as habitable, too much of this commodity could prevent the Earth from radiating absorbed heat, leading to a rise in temperature—or so is one school of thought. Dr. Trenberth informed the audience that, today, CO_2 levels are responsible for an imbalance between energy radiated from the sun, and energy that the Earth radiates back to space. That imbalance has been determined to be approximately 1 Watt/m^2. To scrutinize this energy imbalance, Trenberth first eliminated man-made power generation. Sun energy is about 120 million times larger than the largest power plant that has ever been constructed. Therefore, human influences of this type are inconsequential and cannot be attributed to the trend of rising temperatures.

According to Trenberth, global mean temperatures have been on the rise, particularly since the 1970's, about 1 degree F every 30 years. As evidence, the warmest 13 years on record occurred during the previous 20. In 2008, a record number of tornados were recorded. The Gulf of Mexico was also warmer, helping to fuel more storms with the additional moisture.

Trenberth also spoke about the 2003 European heat wave, an event during which an estimated 35,000 people died. He said there was no way, based on temperature data from the last century, natural variability could solely account for this event. In fact, statistically, a less than 1-in-10 million probability of such an event exists, he said.

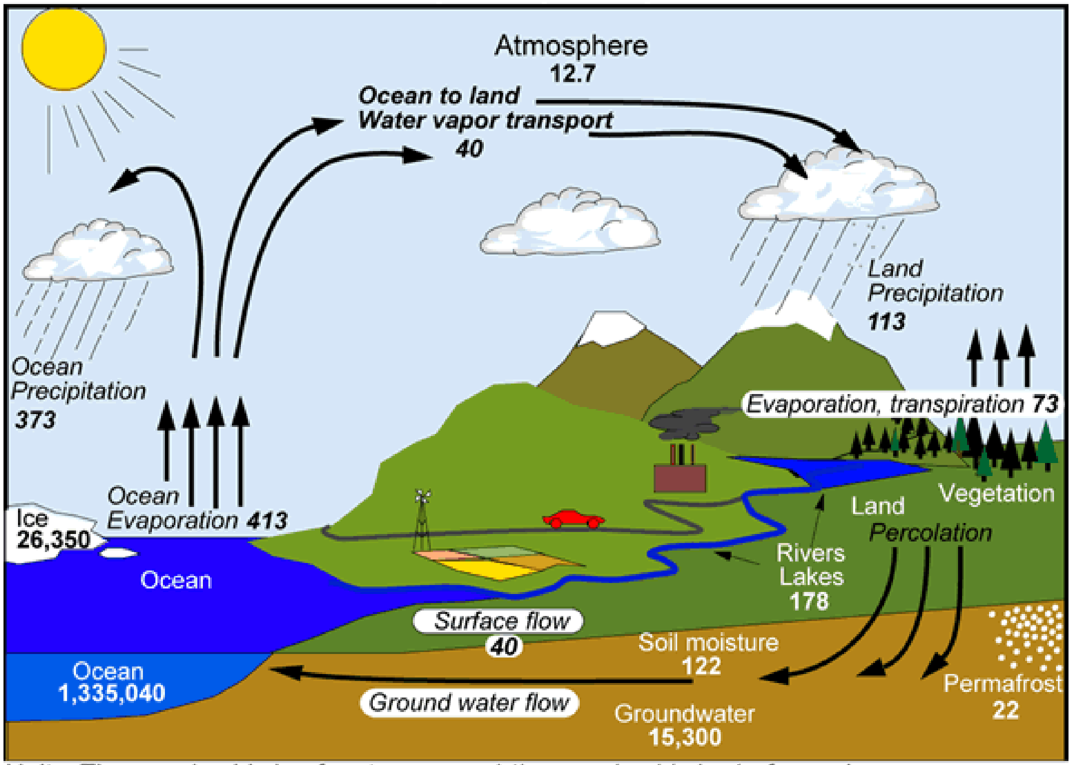
"It's not one or the other. It has to be global warming, plus natural variability," Trenberth said.

Oceans cover about 70% of the Earth. Water evaporation from the oceans provides an effective means of cooling the Earth. For every degree F increase in the Earth's temperature, the holding capacity of the atmosphere increases by another 4%. And, in fact, the atmosphere is holding more water vapor today.

Trenberth also talked about change in precipitation patterns. At any given time, precipitation is occurring over about 6% of the Earth's surface. Rainfall over the US as a whole has increased by about 7% since 1970. But the rain fall is not more frequent. Rather, it is less frequent, but more intense, leading to erosion. And precipitation as rainfall has increased, while snowfall amounts have decreased.

These changes have resulted in multiple issues. First, with less snow, stored water has been reduced. And without water reserves, wild fires have become more prevalent, which then put additional CO_2 into the atmosphere. Also, reduced snow and ice coverage diminishes the Earth's ability to

Above: Kevin Trenberth, head of the Climate Analysis Section at the National Center for Atmospheric Research



Right: Hydrological cycle (from Trenberth, K. E., L. Smith, T. Qian, A. Dai and J. Fasullo, 2006: Estimates of the global water budget and its annual cycle using observational and model data. J. Hydrometeor.)

reflect the sun's heat, and instead, absorbs that energy.

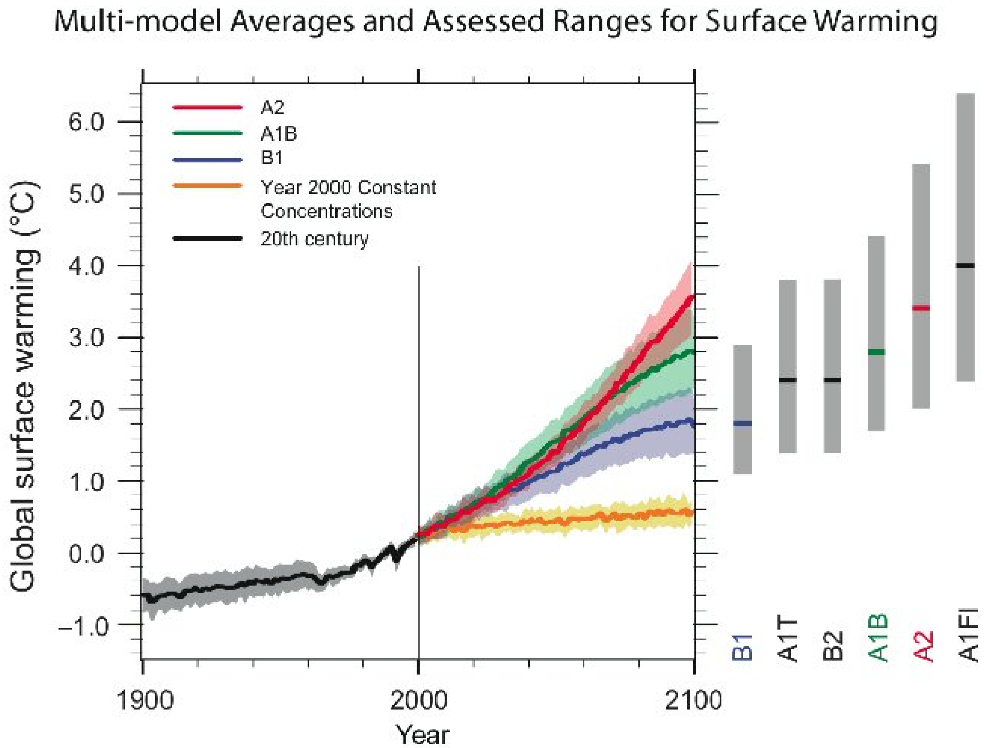
Sea levels are also on the rise. Accurate measurements taken by satellites show an average rise of about 3.2 mm per year, and a total of about 48 mm since 1992. The rise is attributed to expansion, due to warmer temperatures, and from rapidly melting glaciers.

Snow cover and arctic sea ice has also been declining on the order of about 3% per decade since 1980. In fact, 2007 amounts were 22% lower than that of 2005. Additionally, surface melt in Greenland has lead to faster moving ice sheets. In 2001, the consensus among climate scientists was that Greenland's ice sheet would melt completely within about 5,000 years due to the effects of global warming. Now, their best guess is only 850 years, Trenberth said.

Modeling the Earth climate system, including land masses, water, and air, has improved significantly in recent years. In fact, much of the data extracted from arctic core samples provides insight into conditions many thousands of years ago. Climate models that are forced with observed changes in atmospheric composition show that, since about 1970, the human influence on world climate has exceeded the effects of natural variability, and the ability to simulate the changes provides confidence in future predictions. These math models agree with the core sample data, but cannot account for warming trends observed since 1970. Trenberth argued that natural forcing functions cannot be attributed to this recent warming. And most alarming are the warming trends expected for the Polar Regions over the next hundred years, even if CO_2 levels did not increase over this same period.

Arctic samples also confirm that methane and CO_2 levels today are the highest in over 400,000 years of Antarctic ice records.

Several industrialized nations have tried to bring about changes that would slow these warming trends and help preserve the Earth. The Kyoto Protocol, for example, attempted to freeze greenhouse gas emissions to 1990 levels. However, even though 189 countries initially ratified this protocol, many countries refused at that time, or, like the US, withdrew from their initial agreements. Emission taxes have been proposed that would attempt to assign values to emissions. But, how would such taxes be imposed fairly? Cap and trade solutions have also been proposed whereby emissions would be limited, and emission credits would be traded. These potential solutions also pose their share of equitability issues.



Left: Multi-model averages and assessed ranges for surface warming. Solid lines are multi-model global averages of surface warming (relative to 1980-1999) for the A2, A1B, and B1 Special Report on Emissions Scenarios (SRES) scenario families, shown as continuations of the 20th century simulations. Shading denotes the ±1 standard deviation range of individual model annual averages. The orange line is for the experiment where concentrations were held constant at year 2000 values. The gray bars at right indicate the best estimate (solid line within each bar) and the likely (>66% chance) range assessed for the six SRES marker scenarios. (from IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.)

But as responsible as the US may be for contributing to these adverse CO_2 emissions, China is currently ramping up their contributions at alarming rates. While the power production in the US has been fairly constant for many years, China is going online with 3 new coal powered electric stations everyday!

While Dr, Trenberth by no means came across as an alarmist, he is truly convinced that the Earth is headed for disaster, and climate changes may have proceeded too far to ever completely recover—or at least recovery would not be possible anytime soon. Instead, our Earth is potentially changing into a planet that will not be recognizable within 50 years and beyond.

However, he did suggest that every person could individually make a difference to slow the current trends. There are many ways of going “green” that are easy. Driving personal vehicles less, planning errands more efficiently, carpooling with co-workers, walking or bicycling for short trips, line drying laundry, and adjusting home and business thermostats more sensibly all add up to favorable results. Even eating less meat would help reduce the demand for cattle production. Assigning social stigmas to encourage a change in thoughts and behavior, or even more judicious use of tax revenues (e.g., free/subsidized public transportation) could bring about meaningful change. Whatever is done, ultimately, sustainable management methods for our ever changing planet can no longer be put on hold, Trenberth said.

In the remaining few minutes after his lecture, Dr. Trenberth entertained several questions on the next ice age (more than 40,000 years from now). He also responded to questions regarding increased atmospheric CO_2 levels, whereby the CO_2 has registered in increased acidity of the oceans and sea life. This increase in acidity is particularly harmful to coral and shell fish which have an alkaline base.

Dr. Trenberth is a fellow of the American Meteorological Society (AMS), the American Association for Advancement of Science, the American Geophysical Union, and an honorary fellow of the Royal Society of New Zealand. Trenberth is also a lead author of global warming reports issued by the United Nations Intergovernmental Panel on Climate Change (IPCC).

Lunch and Learn Summary

Above: Dennis Stone, the Assistant Manager for Commercial Space Development, Commercial Crew & Cargo Program Office (C3PO).

Commercial Orbital Transfer Services

STEVEN EVERETT, HORIZONS EDITOR

Speaking to a crowd of over 60 people at November's AIAA Houston lunch-and-learn was Dennis Stone, the Assistant Manager for Commercial Space Development, Commercial Crew & Cargo Program Office (C3PO). As lead for the business evaluation of proposals for Commercial Orbital Transportation Services (COTS) funding from NASA, he spoke about the beginnings and the status this program.

This effort stemmed from the Presidential Vision for Space Exploration and the subsequent Aldridge Commission, in which it was stated that commercialization of space should become a primary focus in the implementation of this vision. NASA Administrator Michael Griffin has also stated his preference for purchasing cargo and crew transportation services to the International Space Station (ISS), if possible. The objective of the C3PO, established in 2005, is to implement, facilitate and help create the market environment for commercial endeavors in space, which led to the creation of the COTS program. Mr. Stone described the "ecosystem" of destinations, markets, insurance, FAA regulations, and government support being encouraged by their office to continue to support this commercialization.

In a unique approach, NASA has established goals, rather than requirements, for COTS and is funding selected companies as financial and technical milestones are met. An advisory team of technical experts was established in which NASA assesses these milestones but provides other support only when requested; the partners are solely responsible for their progress. The four possible objectives for this work are launch of unpressurized cargo, launch of pressurized cargo, launch and retrieval of pressurized cargo, and launch and retrieval of a crewed vehicle. In phase 1, a \$500M Space Act Agreement plus private investment is being used to fund selected companies as they meet agreed-upon milestones. SpaceX and Rocketplane Kistler were granted awards in 2006, but after not meeting its required milestones, Rocketplane was replaced by Orbital Sciences in 2008. In phase 2, Commercial Resupply Contracts (CRS) of potentially greater than \$1B in value, will be awarded in late December this year.

Mr. Stone went on to describe the progress each of these companies has made. SpaceX, established in 2002 by Internet millionaire Elon Musk, has recently made a fourth and successful flight of its Falcon 1 rocket, with the third almost meeting its objectives. A successful full mission length firing of the Falcon 9 was also conducted in late November 2008. Their Dragon spacecraft is made up of a pressurized capsule and unpressurized trunk used for Earth-to-LEO transport of pressurized cargo, unpressurized cargo, and/or crew members. Orbital Sciences, who began late due to the recompetition but has made considerable progress, is developing the Taurus II rocket and Cygnus spacecraft. Their first COTS demonstration mission to the ISS is

Lower left: Liftoff of the Falcon 1 flight vehicle from the Kwajalein Atoll on September 28, 2008.
Lower right: Artist's conception of the Dragon spacecraft. (Photos from SpaceX)

Upper left: Taurus II, a new medium-class launch vehicle being developed by Orbital Sciences
Upper right: Artist's concept of the Cygnus spacecraft.
(Photos from Orbital Sciences)

scheduled to take place in the fourth quarter of 2010.

Several other commercial partners have also been working under unfunded Space Act Agreements in preparation for CRS contract bids. PlanetSpace, partnered with Lockheed Martin, Alliant Techsystems, and the Space Exploration division of Boeing, is developing the Athena III and associated Orbital Transfer Vehicle. A lifting body called DreamChaser, which would carry passengers, pressurized or unpressurized cargo, or various combinations of crew and pressurized cargo, is also under development by SpaceDev under such an agreement.

Many of the questions which followed the presentation concerned the future of the COTS effort and commercialization of space. Mr. Stone noted that the $500M in funding for COTS is fairly well protected, and that Lori Garver, who represents NASA on the transition team for the new administration, is committed to this effort. He also said that while the C3PO must consider the limited market for space transportation systems, competition is good for business and the success of one company would not eliminate others from consideration for future contracts. In response to other questions about commercial involvement in exploration, he said some partnerships have been suggested, and the presence of commercial transportation to the ISS would naturally free up NASA funding to support the Constellation program.

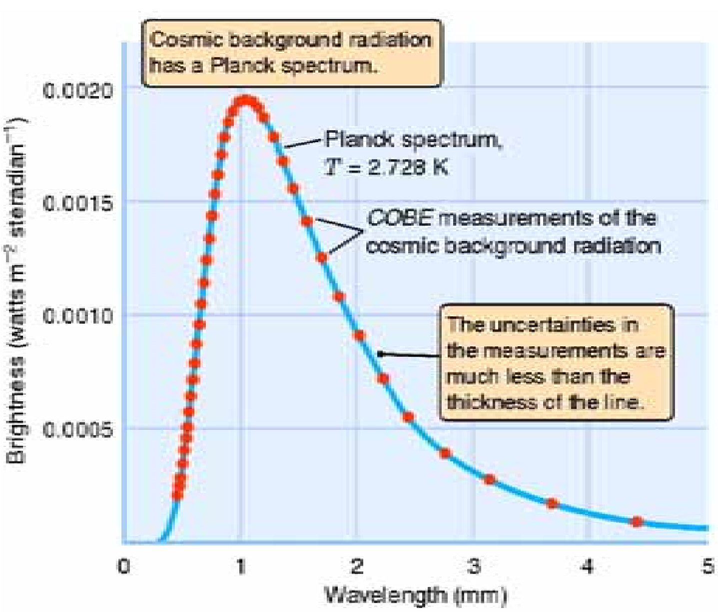
Above: SpaceDev's Dreamchaser lifting body.
(Photo from SpaceDev)

Mr. Stone closed his presentation by noting how in the 1920s, a new technology called airplanes was becoming more prevalent. However, it was the Post Office and airmail delivery that gave the commercial airlines their true start. The Kelly Act, in which the government transferred airmail service to private companies, was the first major step toward the creation of a private and profitable US airline industry. The implication was that encouragement of private industry through COTS and other government programs could do the same for the commercialization of space.

Lower left: Athena III launch vehicle
Lower right: PlanetSpace team's Orbital Transfer Vehicle
(Photos from PlanetSpace)

Event Summary

Above: Dr. Jeff Hester, Professor at the School of Earth and Space Exploration, Arizona State University
Below: Cosmic background radiation brightness as a function of wavelength. Note that the blue line is theoretical while the red points are measured values. There error is only about 1% of the thickness of the line.



From the Big Bang to Big Brains: The Origins of Structure in an Evolving Universe

ALAN SIMON

Fourteen billion years of history in just about an hour! Dr. Jeff Hester of the School of Earth and Space Exploration at Arizona State University, opened the second season of Cosmic Exploration lectures at the Lunar and Planetary Institute (LPI). That evening, November 13, 2009, the LPI staff introduced 2009 as the International Year of Astronomy.

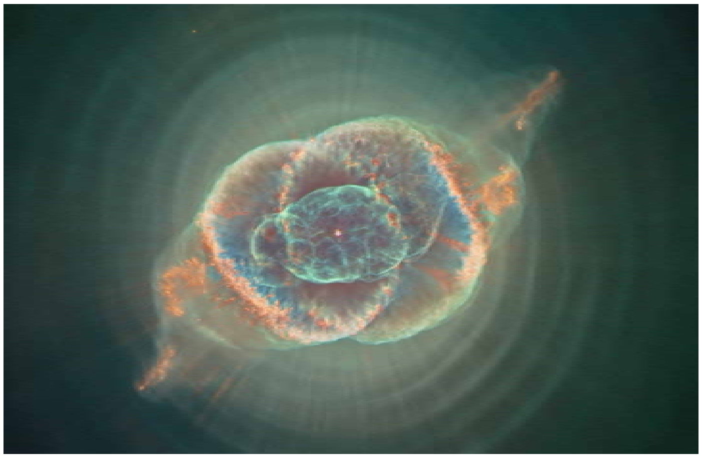
Once the lights were brought down, Dr. Hester's energy level came to life. He began his lecture telling the completely full auditorium that, "We can actually watch as the universe evolves!" from our vantage on Earth. Light can travel around the Earth at the speed of a finger snap. So a glance up at a full moon provides an observer a view of what happened there just 1.25 seconds earlier. A careful sighting of the sun on a warm spring day takes the viewer back almost eight and a half minutes. A momentary look at the closest and brightest star system, Alpha Centauri, takes Dr. Hester back to when his daughter, who recently graduated, had just begun her secondary schooling a little more than four years ago. For the nostalgic, Sagittarius, in the center of the Milky Way, brings back visions of more than 28,000 years ago. The Andromeda Galaxy is 2.5 million light years away, while the Virgo Super Cluster goes back to the extinction of dinosaurs, 65 million years.

Captured by the Hubble Space Telescope, Dr. Hester presented one of the most fascinating photos to behold: galactic clusters and nebulae, but with countless tiny specs of light in between. The density of worlds in that one scene was completely and absolutely amazing; the view was truly a religious experience for this author! And these tiny worlds—millions and billions of them—are a window into the past by almost 14 billion years.

For years, astronomers have professed that the universe is expanding. But how can they make those claims? What evidence do they have? By observing the spectra emitted from far away worlds, astronomers are able to measure red-shifted wavelengths, much the same way sound waves shift as a train leaves the station. And the farther away galaxies are from Earth, the faster they appear to be moving away. A galaxy twice as far away moves twice as fast. Running the clock forward, Hubble's Law implies that the universe is expanding from a big bang that occurred almost 14 billion years ago. Likewise, running the clock backwards would imply that everything in the universe was at the same place 14 million years ago.

But Dr. Hester clarified that galaxies are not actually moving apart through space. Rather, the space between galaxies is expanding, and galaxies are simply, "…going along for the ride!" Hester drew an analogy of coins affixed to a rubber sheet. As the rubber sheet is pulled and stretched from the edges, the sheet becomes bigger and bigger. But even as the coins (or galaxies) move farther apart, they do not actually move across the sheet. The coins that start off close to each other near the center of the sheet move apart; but not very rapidly. Those that start off farther apart, and towards the edges grow apart rapidly.

If a big bang did occur, what is the evidence for that event? Hester answered this question by providing some simple basics. When a gas is compressed, it gets hot. And where there is heat, there is usually a glow. The universe is no exception. Robert Wilson and Arno Penzies took these basic concepts and applied them on a grand scale to win the Nobel Prize in Physics in 1978 for discovering cosmic microwave background radiation—the glow that has been left behind from the very early time of the universe when it was still very hot. And just 2 years ago, John Mather and George Smoot won the Nobel Prize for demonstrating the glow left from the big bang, which shows up as a very uniform curve when wavelength is plotted against brightness. The precise matching of data these scientists were able to measure to values that would be anticipated if a big bang had actually occurred, implies that the



‘theoretical’ big bang and the universe are understood as one and the same.

So, given the premise that the universe was extremely uniform back in the beginning—more uniform than the blue of the bluest sky—how did the universe evolve into the wealth of structure it has today? According to Dr. Hester, this query is the central unifying question of science, and people are continually perplexed by it anytime individuals stare in awe at the Crab Nebula, Spiral Galaxy, Cone Nebula, Sombrero Galaxy, or Swan Nebula, to name just a few. Even the ability to pose this question, however, is a fairly new capacity.

The answer to this central question is not exactly child’s play. But Dr. Hester’s use of simple metaphors, such as “pizza dough physics” and “ice skater physics,” made these concepts much more palatable. Ripples formed in the early bath of uniform light and elementary particles. Then, gravity caused those ripples to collapse to form galaxies and clusters of galaxies. And within those galaxies, gravity again acted to cause clouds of gas and dust to collapse to form stars.

When these large clusters collapsed, just as an ice skater speeds up as she brings her arms in (because of conservation of angular momentum), so did these large clusters. Additionally, just as a pizza dough ball is thrown in the air and spun to become flat, so did the early galaxies spin to become flat. (The Milky Way is flat as well.) Conservation of angular momentum requires that, when a star collapses, it will be surrounded by a flat, rotating disk, just as young stars are that can be observed today.

Within the first several minutes following the Big Bang, the temperature of the universe was about a billion degrees; and the extreme heat and density of matter sustained nuclear reactions. But the reactions taking place could only support formation of a handful of elements, including hydrogen, helium, lithium, beryllium, and boron.

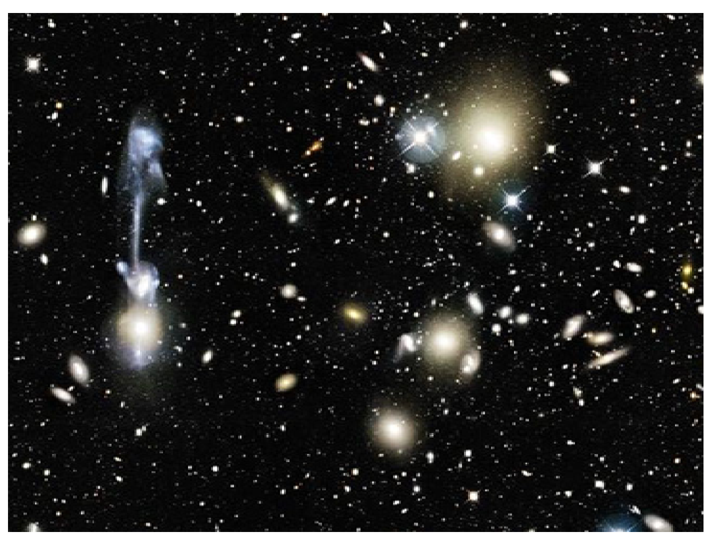
Within those stars, however, new elements were formed—helium burning to carbon, carbon burning to sodium, neon, and magnesium, neon burning to oxygen and magnesium, oxygen burning to silicon and sulfur, silicon and sulfur burning to iron, and so on. And these new elements were then blasted back into the interstellar medium as dying stars erupted into supernovae such that the next generation of stars had not only Hydrogen, Helium, and Beryllium, but also all of the new elemental material formed by previous generation of stars. This cycle continued to form stars and planets. There are many examples that can be observed today whereby chemical elements can be seen blasting into space from supernovae.

So life on Earth is literally made of atoms, formed in the interior of stars that lived and died over the past many billions of years, between the birth of the universe and the formation of our solar system. Dr. Hester said, “Life is the inexorable algorithm of evolution.” So, the generation of people today, for the first time in history, knows of the origins of the universe and of the processes that transformed life into species. “It is a remarkable moment.”

Poets have said that we are stardust, and that claim is, “Absolute, literal truth,” according to Dr. Hester.

All of these processes happen because physics works! No matter the specific location, the universe is governed by physical laws.

Left: Cat’s eye nebula, Hubble remix
Below: Crab nebula
Bottom: Galactic collision in cluster Abell 1195



Airshow Report

Wings Over Houston

DOUGLAS YAZELL, PAST CHAIR

(Right: Wings Over Houston airshow banner, used with permission)

The weather was great on Saturday, October 25, 2008, at Ellington Field as we celebrated the 24th annual Wings Over Houston airshow. Our booth was made possible by the Houston chapter (*www.eaa12.org*) of the Experimental Aircraft Association (EAA), which is the 12th chapter created among the more than 1500 chapters. EAA Houston chapter President Richard Sessions worked tirelessly to make this possible.

Right: (Pictured L to R) AIAA Houston Section volunteers Ellen Gillespie, Natasha Rowell, Jim Palmer & Douglas Yazell. (Photo by David Gillespie)

Right: Natasha (at left) and Ellen with our section's banner

The space for our booth was made possible by Chapter 12 and the Commemorative Air Force's Wings Over Houston organization. We send our sincere thanks to those two groups. We were joined by EAA Chapter 712, The Fun Chapter (*http://groups.yahoo.com/group/EAAchapter712/*), which is located in LaPorte, Texas. The Chapter 712 President Valerie Vaughn flew her plane to the airshow from Pearland for display at our booths that morning, a 5-minute flight.

Many thanks go to our AIAA Houston Section organizing committee members, namely me and the following:

BeBe Kelly-Serrato
Natasha Rowell
Jim Palmer
Ellen Gillespie
Ben Longmier

About 50 people signed our EAA/AIAA sign-in list. Our AIAA Houston Section secretary from 1987-1988 (when Carl Huss was Chair), Karen Johnson, recently moved back to Houston after living near LSU, and she just missed us at the airshow that day. She is looking forward to joining our volunteers at the airshow next year, when we plan to ask some local aerospace companies to lend us some small hardware samples to be conversation starters at our table.

It's inspiring to see that airshow leader Bill Roach and the many other volunteers joined sponsor Ron Carter to create this fantastic show despite the recent devastation from Hurricane Ike.

Until next year's airshow, we wish you clear skies and happy landings!

Above: One of the EAA banners at our shared booth near the nose of the B-52.

Above: Smoke rises during Pearl Harbor re-enactment. (photo by Natasha Rowell)

Above: The NASA 747 that carries the space shuttle orbiters (photo by Natasha Rowell)

Left: Valerie's airplane, a Whitman Tailwind, parked at our booths near the nose of the B-52.

Membership

LISA VOILES, MEMBERSHIP CHAIR

Please welcome our newest AIAA Houston Members from September, October, & November!

MEMBERS:
Nataliya Allard
Juergen Bahr
Thomas Bailey
Travis Baldwin
Reginald Bednar
Erica Berry
Sara Blatz
Robert Carroll
David Coan
Kreta Desai
David Fanelli
Christopher Gilmore
John Gouveia
John Gowan
Kevin Hames
Marissa Herron
Robert Hirsh
Shian Hwu
Anup Katake
Robert Karl
Timothy Kennedy
Thanh Le
Mike Martin
Joseph Mayer
Luke McNamara
Ryan Odegard
Christopher Palmer
Kenneth Peek
Alan Simon
Dr. John Turner
Pamela Workings
Renato Zanetti

STUDENT MEMBERS:
Steven Bowles
Michael Boyd
Andrew Carlberg
Peter Chapman
Cameron Davis
Anthony De Castro
Thomas Elder
Tarek Elgohary
Gregory Gaenzle
Megan Heard
Kyle Lake
Mark Landreneau
Austin Mcconnell
Kristin Nichols
Matthew Novia
Colin Phillips
Michael Pierce
Caleb Quinones
Caitlin Riegler
Raul Rios Violante
Jonathon Rosenkranz
Luis Ruiz Brito
Steven Sandlin
Eric Schettek
Maxwell Steadman
Jennifer Turner
Bryan Tuthill
Bryant Vichainarong

EDUCATOR ASSOCIATES:
Kirk Moore (*Anahuac HS*)
Kathy Bailey (*Falcon Pass Elementary*)
Lisa Brown
LTC Arthur Levesque (*Sheldon Cadet Squadron*)

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 membership total from September 1, 2008, was 1219, which included 879 professional members, 249 student members, and 91 educator associates. By October 1, 2008 there were 1177 total members which included 882 professional members, 270 student members, and 25 educator associates. As of November 1, 2008, there are 1148 members which includes 869 professional members, 252 student members, and 27 educator associates.

Important notes:

- *Not a member? See the end page.*

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

NASA's Earth Observations from Space

SEAN KEEFE, ASSISTANT EDITOR, HORIZONS

As part of our exploration of NASA's first 50 years, AIAA takes a look at NASA's aerospace remote sensing and Earth Observations programs. First, we look back at NASA's early remote sensing programs. Next, we report on the future of NASA's global observing programs.

Looking back: We interviewed Dr. David E. Pitts about his career at NASA Johnson Space Center and his work with historic Earth Observations and other aerospace remote sensing projects. Dr. Pitts is a retired NASA branch chief and expert in remote sensing and image analysis. He has been involved in remote sensing since its inception in the US at NASA Johnson Space Center in the 1960s. His research includes the Skylab Program; the Large Area Crop Inventory Experiment (LACIE), the Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing project (AgRISTARS), and the Landsat Program. More recently, Dr. Pitts was involved in the Space Shuttle and International Space Station programs and served on the Space Shuttle Challenger Accident Investigation Team.

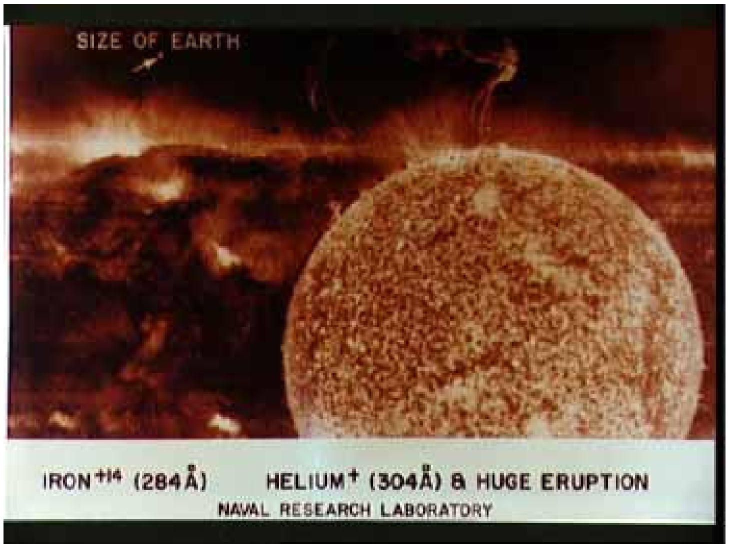
Dr. Pitts was involved with the first US space station program, Skylab, part of the Earth Resources Experiment Package (EREP). He was the principal investigator on the Skylab Severe Storms Experiment. He also used remote sensing techniques to research crop production in the LACIE and AgRISTARS projects: these interagency collaborations demonstrated how remote sensing data could be used to comprehend and more efficiently manage Earth's natural resources and agricultural crops.

Dr. Pitts used LANDSAT and aircraft remote sensing data for several applications: He researched the biological productivity of forests using microwave remote sensing techniques and helped develop advanced image analysis techniques for the optical detection of orbital debris.

Dr. Pitts served as Chief of the Flight Science Branch in the Solar System Exploration Division at JSC. He developed and implemented programs to support the Space Shuttle astronauts in the acquisition of scientifically useful photographs of the Earth from orbit. He and his team provided robust photographic and television flight safety analysis of the launch, landing, and on-orbit phases of Space Shuttle missions STS-26 through STS-61.

Dr. Pitts received several NASA awards, including a

Above: Dr. David Pitts
Left: 1973 EREP infrared photograph of Colorado's Uncompahgre Plateau taken by the Earth Terrain Camera during the Skylab-2 mission. Skylab stereoscopic data provided the best identification of vegetation complexes and delineation of their boundaries, particularly in areas where changes in relief were related to changes in vegetation type (caption and photo source: NASA)



Above: 1974 image of a huge solar eruption taken during the Extreme Ultraviolet Spectroheliograph experiment (S082A) aboard Skylab 3. Over 1000 such spectroheliograms provided an enormous amount of solar data in the 171 to 630 wavelength range (source: NASA)

commendation for scientific leadership in optical remote sensing. He retired from NASA Johnson Space Center in 1994 after 31 years of space research. Since leaving NASA, he has consulted in remote sensing and teaches courses in the Computer Science Department and Geology Department at the University of Houston-Clear Lake.

How did you get involved with NASA early on? Did you come to NASA straight from college, or work elsewhere? How was the NASA culture different from what you had previously experienced?

I was hired in 1963, when I had almost completed my masters degree in meteorology and geophysics. I was actually hired to do lunar geophysics, but when I arrived at the Manned Spacecraft Center, Division Chief Jack Eggleston told me to talk to each of the branches and determine where I wanted to work. I was excited when I learned that I could do Mars and Venus atmospheric research, in addition to supporting Apollo from a meteorological standpoint. In 1965, Bob Piland asked several of us to start working part-time with aircraft remote sensor systems. 1n 1968, the Apollo Applications Program was initiated and NASA sent me back to school for my doctorate. I returned in January of 1969 and worked on the Apollo 9 experiment, SO-65, which showed the feasibility of taking multispectral images from space—that served as a prototype for the ERTS [Earth Resources Technology Satellite] Landsat spacecraft launched a few years later.

What NASA remote sensing/Earth Observation projects did you work on?

The first Earth Observations project I worked on was the NASA Earth Observations Aircraft program, which was based at JSC and physically located at Ellington Field. This was 1965, and NASA only had one aircraft—a Convair 240—that Leo Childs found and modified in order for it to carry cameras. Then JSC got the P-3. That aircraft is used extensively as a hurricane hunter now, but in those days it was used by the Navy for anti-submarine warfare. Later, JSC got a C-130 aircraft. Then we got a RB-57F: that was the high-altitude predecessor of the U-2 aircraft. When the program was transferred to the Ames Research Center, NASA got a U-2 plane.

I worked on the remote sensing experiment SO-65 on Apollo 9 and on Apollo Applications A & B, which later evolved into Skylab EREP. I studied the infrared properties of the tops of severe storms using aircraft sensors, ERTS, and Landsat satellites. Shortly after Landsat 1 [ERTS-1] was launched in 1972, I worked on the LACIE project, which lasted until 1978. The purpose was to estimate the wheat production in all of the major wheat-producing countries of the world. In 1978, AgRISTARS was started, which attempted to do the same thing on a purely research basis for corn and soybeans. After the demise of the Earth Observations Division at JSC in the early 1980s, I worked on hypervelocity impact studies and image processing until the 1986 Challenger accident occurred. After that, I worked on analyzing imagery for flight safety for the Space Shuttle and then later became the manager of the Space Shuttle Earth Observations Project.

Tell us about Skylab. Was it a successful project? What were the benefits/implication for Earth Observations science and other research that grew from Skylab?

Skylab flew at the same time as the first ERTS/Landsat 1 spacecraft, in 1973. My section had two Earth Observations instruments on Skylab: the S-191 spectrometer; and the S-192, a 13-band scanner. Other departments had the S-190 multispectral Cameras, the S-193 K Band Scatterometer/altimeters, and the S-194 L-Band radiometer. There is an entire book on the Skylab EREP SP-390, which gives a detailed summary.

Skylab showed the feasibility of using mid-infrared and thermal infrared scanners for a variety of Earth Observations applications. It also showed that scatterometers/altimeters are useful for sea state and topographic investigations and that passive microwave radiometers are useful for soil moisture. The aircraft program at JSC was doing EO from aircraft altitudes, but Skylab was the first time that had been done from space. The S-191 spectrometer paved the way for pointable sensor systems in space like SPOT. The blue channel on S-192 shows the feasibility of doing Ocean Color, which resulted in the CZCS and SeaWiFS sensors being flown in space.

[The objective of the Skylab project was to demonstrate that astronauts could work and live in space for long periods and to perform solar astronomical observations. As part of the Earth Resources Experiment Program (EREP), NASA deployed a variety of instruments in Skylab's docking adapter to record EO data. Those instruments recorded data in the visible, infrared, and microwave regions of the electromagnetic spectrum. The Coastal Zone Color Scanner (CZCS) was a multi-channel scanning radiometer aboard the Nimbus 7 satellite launched in 1978. The Sea-viewing Wide Field-of-view Sensor (SeaWiFS) is an optical sensor aboard the GeoEye SeaStar satellite launched in 1997.]

What lessons did you and your colleagues learn from Earth Observation & Skylab that inform where NASA's efforts should be today in terms of studying Earth?

Skylab's success in the using the visible, mid-infrared, and thermal infrared channels paved the way for Landsat 4 and later Landsat spacecraft for a variety of Earth Observation applications. The S-193 scatterometer/altimeter on Skylab paved the way for SEASAT, with its L-band radar, and for TOPEX/Poseidon, which is used to detect El Nino conditions, among other things.

[SEASAT, launched in 1978, was NASA's first Earth-orbiting satellite designed for remote sensing of the Earth's oceans. TOPEX/Poseidon, launched in 1992, was a collaboration between NASA and CNES, the French space agency, to map ocean surface topography.]

Do you feel that global climate change demands more emphasis on studying Earth than, for example, lunar or planetary studies?

Planetary atmospheric studies aid global change research because they push the envelope of research and understanding of conditions which we don't yet experience on Earth. Lunar studies may provide needed resources at some point in addition to understanding how the solar system and universe have evolved.

In the context of NASA 50th Anniversary in October, how important do you think NASA's Earth Observations (EO) programs (satellites, lasers, radar, astronaut photography) have been, and how important are they today?

We in NASA were starting to determine the state of the Earth before the famous photograph taken by the Apollo astronauts caused the entire world to take note that our planet Earth is an island in space with limited resources. Now, with global warming and the energy crisis, with limited arable land for agriculture and the tiny amount of potable water available on the Earth, it is apparent that we must become better stewards of the resources of our planet. Without a census of what is available and accurate predictions of what is feasible for the future, we will not be able to survive as our human population continues to grow.

Are NASA's current EO projects adequate to study global climate change and other dynamic Earth processes? If not, what projects do you think NASA should put into place/are needed for scientific research of Earth and its climate?

The sensor systems in use today will continue to evolve with better signal-to-noise ratios, higher resolution, and more spectral bands. However, we need continuity in order to compare previous conditions to current conditions. That is why the Landsat series and SPOT series of spacecraft as well as the spacecraft imaging radars need to have follow-on spacecraft that can be used for comparison. Geosynchronous platforms should also be used for Earth Observations.

Below: This concept illustrates Skylab Earth Observation studies, an EREP package. EREP used the widest possible portion of the E-M spectrum for Earth resource investigations with sensors that recorded data in the visible, infrared, and microwave spectral regions (source: NASA)

Below: *"Blue Marble" photo taken by Apollo 17 astronauts in 1972 as they looked back home on their way to the Moon (source: NASA)*

[SPOT (*Satellite Pour l'Observation de la Terre*) is satellite system which uses high-resolution optical instruments to image Earth operated by a spinoff of CNES, the French space agency. Since 1986, Spot satellites have taken over 10 million images of Earth.]

If you were personally in charge of NASA expenditures for the next 20 years, and your budget proposals were approved by Congress, what projects would you propose for the next 50 years of studying Earth?

I think the most important thing right now for our country is to become energy independent. It is possible that space-based systems could contribute substantially to this need through the use of solar energy converters. Certainly the research skills of NASA could be used to substantially contribute to the harnessing of wind power. However, if we harness a substantial amount of the wind energy, it will also result in climate change, so this needs to be studied. With energy independence will come the capability to drastically increase our research infrastructure and eventually send man to Mars and to the stars. As the Shah of Iran once said, petroleum is too valuable of a resource to be used for conversion to energy (for transportation.) It must be used to create petrochemical products.

Do you have any final observations to make about NASA's 50th anniversary?

NASA is a wonderful organization with a can-do attitude. It hasn't changed in that regard since I joined NASA on June 3, 1963. Whatever the problem, NASA believes it can contribute to the solution. Therefore I believe that more should be asked of NASA.

Looking forward: In 2007, the National Academy of Science (NAS) Space Studies Board published a new assessment of our nation's Earth Science programs, titled *Earth Science and Applications From Space: National Imperatives for the Next Decade and Beyond*. That report evaluates past and present Earth Observations (EO) systems and programs, outlines strategies for restoring and improving critical EO capabilities and platforms, and recommends prioritized applications from such observations in the coming decade. The report will be used by NASA, NOAA, and the USGS to help determine coordinated efforts in global observations of Earth.

According to the study, "understanding the complex, changing planet on which we live, how it supports life, and how *human activities affect its ability to do so in the future is one of the greatest intellectual challenges facing humanity."* At the same time, the NAS also warns that the future of our nation's EO systems are in jeopardy. Those factors include the loss of global measurements in the near future as aging sensors and instruments fail; decreased capability by planned technology replacements; and reduced funding for new Earth Observations programs. The NAS estimates a 40% loss of instruments and sensors on NASA spacecraft in the next decade alone.

One of the benefits of continued Earth Observations platforms is the ability to track change over time using measurements of critical Sun-Earth interactions and atmospheric and geophysical data. Without improvements in the number and capability of instruments to make these observations, the loss of timely and accurate data could be significant to our safety and security.

A key recommendation of the NAS Space Studies Board is that the US government work closely with the public and private sector and the international community to "renew its investment in Earth-observing systems and restore its leadership in Earth science and applications." The Academy of Science report lists pressing questions that must be addressed by a revitalized national Earth Observations program, including these:

· Will tropical cyclones and heat waves become more frequent and more intense? Will droughts become more widespread in the western United States, Australia, and sub-Saharan Africa? How will this affect the patterns of wildfires? How will reduced amounts of snowfall change the needs for water storage?

· Will there be catastrophic collapse of the major ice sheets, including those of Greenland and West Antarctic and, if so, how rapidly will this occur? What will be the time patterns of sea-level rise as a result? What are the health impacts of an expanded ozone hole that could result from a cooling of the stratosphere, which would be associated with climate change?

· How will coastal and ocean ecosystems respond to changes in physical forcing, particularly those subject to intense human harvesting? How will the boreal forest shift as temperature and precipitation change at high latitudes? How will mosquito-borne viruses spread with changes in rainfall and drought?

Reacting to the report published by the NAS Space Studies Board, US House Science and Technology Committee Chairman Bart Gordon issued this statement:

> At a time when accurate weather forecasting and climate research is becoming increasingly important to the well-being of our citizens, this distinguished panel of experts is warning in no uncertain terms that the United States' extraordinary foundation of global observations is at great risk. That finding is no surprise to those of us who have watched the cuts made to NASA's Earth science program over the last six years, and the disruption to NOAA's observations programs caused by the significant cost growth and schedule slips in the NPOESS [National Polar-orbiting Operational Environmental Satellite System] program. A significant unresolved issue that emerged from the restructured NPOESS program is how to provide for continued climate observations. The [House Science & Technology] Committee will persist in its vigorous oversight of these important satellite acquisition programs in the 110th Congress and explore options for maintaining continuity of our climate and weather observing systems.

There is no doubt that NASA's investment in remote sensing instruments and platforms during its first 50 years has advanced the state of the art in Earth Observations systems and greatly accelerated the scientific understanding of our dynamic and complex planet. It remains to be seen whether our nation revitalizes its space-based Earth Observations instruments to address those global imperatives—studying and managing Earth's rapidly changing and vulnerable systems—or not.

Click on the links below for online copies of the NAS report and for example images, animations, and scientific visualization of data based on Landsat, GOES, and other Earth Observations instruments' data:

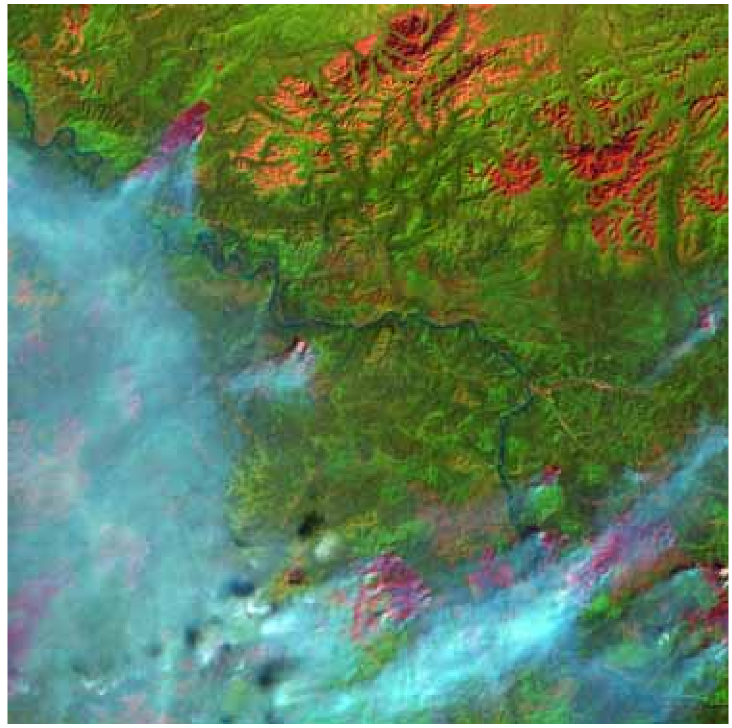
Online Books:

Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond

Earth Observations from Space: The First 50 Years of Scientific Achievements

Example imagery from Earth Observations:

- Animation: creating Landsat images from raw data
- Changes in the ozone hole over Antarctica, 1979-1999
- Panda Habitat Deforestation, 1965-1997
- Iceland Glacier Recession, 1973 to 2000
- Mt. St. Helens eruption and ecological recovery, 1973-2000
- Hurricane Katrina rain accumulation, August 23-30, 2005
- Zoom out from the Big Blue Marble to the center of Reliant Stadium
- The Hologlobe Project animation (be sure to view the entire animation)



Above: This false-color composite image of fires in Alaska and Canadian Yukon Territory from 2004 uses shortwave infrared, infrared, and green wavelength data from Landsat's Enhanced Thematic Mapper Plus and other instruments. Bare ground/low vegetation appear orange, vegetation appears in shades of green, infrared energy (heat) in bright pink around the perimeters of actively burning fires, burned areas in a deeper pink. (Image by Jesse Allen, based on data from the United States Geological Survey EROS Data Center. Source: NASA)

Apollo 8 40th Anniversary

Above: Apollo 8 crew patch

The Essence of the Human Spirit: Apollo 8

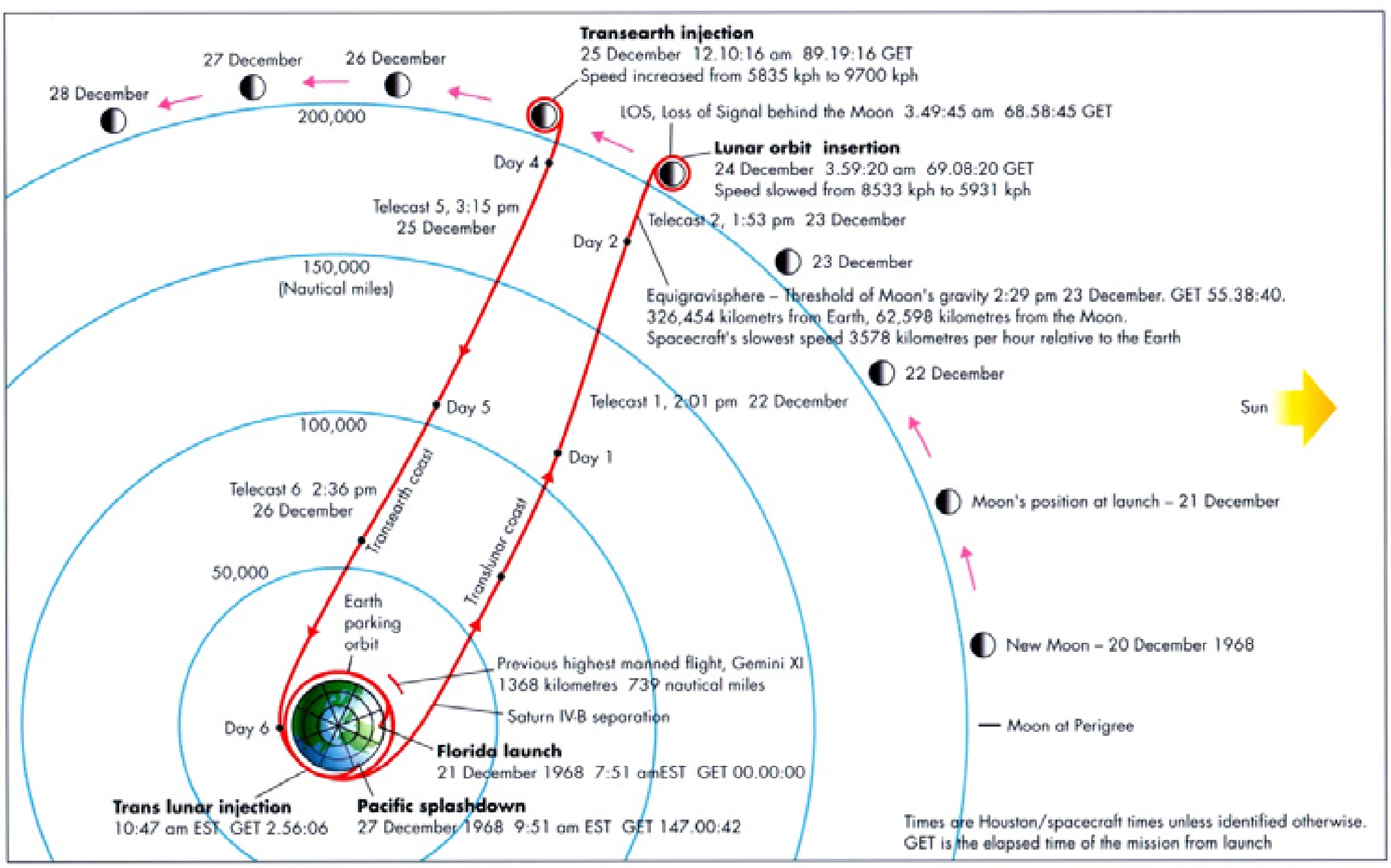
DR. ALBERT A. JACKSON

"Please be informed there is a Santa Claus."-- Jim Lovell (Post TEI December 25, 1968)

"Sir, it wasn't how you looked, it was how you smelled." -- Navy Seal frogman to astronaut William Anders, explaining his reaction to opening the Apollo 8 capsule.

Imagine that you have been mandated with going to the Moon before 1970 and you are faced with the following: a launch vehicle that had seventy anomalies on its last unmanned flight, three engines that had failed, and severe pogo problems, and yet it is required to fly with a human crew. You have a spacecraft that has not made a manned flight yet and has been re-engineered after a terrible disaster. You have a whole suite of on-board and ground software that has never been tested in a full non-simulation mission. You have a large ground tracking network not yet used to work a manned mission at the lunar distance. You have only four months to plan and train for a manned flight no one has ever done before. Four months out, the Pacific fleet was expecting a Christmas break, and no recovery ship might be available. The crew would have no Lunar Module 'life boat.' No human had ever escaped the gravity of the Earth. Facing a terrible array of unknowns, your decision? 'You' are George Low, Manager of the Apollo Spacecraft Program Office, no hesitation… an orbital flight to the Moon! [1, 2, 5]

Problems with achieving a landing mission in 1969 to the Moon made themselves manifest in the spring of 1968 when the delivery of the Lunar Module slipped. However troubles with the Saturn V during the Apollo V launch test seemed on the way to being solved by late spring. The concept of circum-lunar flight goes back to Jules Verne with the technical aspects laid out by Herman Oberth in 1923. In the 1960's all the flight planning documents for the Apollo program had laid out all the astrodynamics of the trajectory [7].



Below: Apollo 8 trajectory (Figure used with permission of Hamish Lindsay)

Problems with the Lunar Module looked as if the first Moon landing might be pushed off into 1970. Placed against this situation, the Soviet Union was still actively pursuing a lunar landing, particularly the possibility of a circumlunar flight in 1968. In April 1968 both George Low of the Manned Space Craft Center (later JSC) and Director of Flight Operations Christ Kraft started thinking about a lunar flight in April 1968, and by August of 1968 George Low decided the only solution to a lunar landing in 1969 was to fly to the Moon before the end of 1968. [1, 2, 5]

The 9th of August 1968 was a very eventful day; between 8:45 a.m. an 10 a.m., Low, Gilruth (MSC director), Kraft, and director of Flight Crew Operations Donald K. Slayton, after a breathless morning meeting at MSC, set up a meeting at Marshall Space Flight Center with its director Wernher von Braun, Apollo Program Director Samuel C. Phillips and Kennedy Space Flight Center director Kurt Debus at 2:30 p.m. that same day. At this meeting they finalized a plan to present to senior NASA management that if Apollo 7 were successful Apollo 8 not just go circumlunar but into lunar orbit in December of 1968. [1, 2, 5]

On that same August 9, Deke Slayton called Frank Borman and had him come to Houston from California to ask him if he wanted to go to the Moon. He said yes, went back to California and told James Lovell and William Anders; they were enthusiastic. They all came back to Houston to start training. [1, 2, 5]

On August 15 Deputy Administrator Thomas Paine and Director of the Apollo Program finally got approval from the Administrator for Manned Space Flight George Mueller and NASA Administrator James Webb to go ahead, contingent on the success of the upcoming Apollo 7 mission. Therefore, before a manned version of the Command and Service Module had flown, a decision to go to the Moon had been made. Planning and preparations for the Apollo 8 mission proceeded toward launch readiness on December 6, 1968. [1, 2, 5]

On September 9, the crew entered the Command Module Simulator to begin their preparation for the flight. By the time the mission flew, the crew would have spent seven hours training for every actual hour of flight. Although all crew members were trained in all aspects of the mission, it was necessary to specialize. Borman, as commander, was given training on controlling the spacecraft during the reentry. Lovell was trained on navigating the spacecraft in case communication was lost with the Earth. Anders was placed in charge of checking that the spacecraft was in working order. [1, 2, 5]

September, October and November of 1968 were three months of intense planning, training and work by Mission Planning & Analysis Division (MPAD), Flight Crew Operations Directorate (FCOD) and Flight Operations Directorate (FOD). The Manned Spacecraft Center, Marshall Spaceflight Center and the Kennedy Space Center had a lot on their plates! [1, 2, 5]

Marshall had to certify the Saturn V for its first manned spaceflight.

MPAD had to plan for the first manned vehicle to leave the Earth's gravitational field.

MOD and FCOD had to plan and train for the first Lunar flight.

MIT had to prepare for the first manned mission using computer to perform guidance, navigation and control from the Earth to another celestial body.

Tracking Stations

Apollo 8 was a milestone flight for the MSFN, since it was the first test of the network during a mission to the Moon. Prior to the mission, concerns were raised regarding small terrestrial errors found in tracking tests that could be magnified to become much larger navigation errors at lunar distances. For assistance in the matter, MSC turned to JPL to look into their navigation system and techniques. JPL personnel, experienced in lunar navigation, proved very helpful as they assisted in locating tracking station location inaccuracies within Houston MCC software. These erroneous values would have manifested themselves as large tracking measurement errors at lunar distances. The tracking station location fixes were implemented less than two days prior to the launch of Apollo 8.

Of special note was the Honeysuckle Creek near Canberra in *Australia*. It had a prime role for many of the first time critical operations, acquisition of signal after Lunar Orbit Insertion, prime for post Trans Earth Injection and prime for reentry. [3]

Honeysuckle Creek Tracking Station near Canberra, Australia

Above: Apollo 8 spacecraft

The various Apollo contractors had to prepare every hardware aspect of a Command Module for both transfer in Earth-Moon space and orbit operations around the Moon.

The MSC Lunar scientists had to formulate a plan for photographic exploration of the Moon from Lunar orbit. The science community had to examine and plan for the radiation environment in trans Earth-Lunar space.

KSC had to plan and train for the first manned Saturn V launch.

MSC and Apollo contractors had to plan for the first ever hyperbolic reentry into the Earth's atmosphere of a manned spacecraft.

Those were just some of the problems to be solved!

The success of Apollo 7, flown October 11-22, 1968, paved the way. On November 10 and 11 NASA studied the Apollo 8 mission, approved it and made the public announcement on the November 12.

Apollo 8 was launched from KSC Launch Complex 39, Pad A, at 7:51 a.m. EST, December 21, on a Saturn V booster. The S-IC first stage's engines underperformed by 0.75%, causing the engines to burn for 2.45 seconds longer than planned. Towards the end of the second stage burn, the rocket underwent pogo oscillations that Frank Borman estimated were of the order of 12 Hz. The S-IVB stage was inserted into an Earth-parking orbit of 190.6 by 183.2 kilometers above the Earth.

Below: Apollo 8 crew, Frank Borman, William Anders and James Lovell
Photo credit: NASA

As Bill Anders later recalled: [4]

> Then the giant first stage ran out of fuel, as it was supposed to. The engines cut off. Small retro rockets fired on that stage just prior to the separation of the stage from the first stage from the second stage. So we went from plus six to minus a tenth G, suddenly, which had the feeling, because of the fluids sloshing in your ears, of being catapulted by -- like an old Roman catapult, being catapulted through the instrument panel.
>
> So, instinctively, I threw my hand up in front of my face, with just a third level brain reaction. Well, about the time I got my hand up here, the second stage cut in at about, you know, a couple of Gs and snapped my hand back into my helmet. And the wrist string around my glove made a gash across the helmet face plate. And then on we went. Well, I looked at that gash and I thought, 'Oh, my gosh, I'm going to get kidded for being the rookie on the flight,' because you know, I threw my hand up. Then I forgot about it.
>
> Well, after we were in orbit and the rest of the crew took their space suits off and cleaned their helmets, and I had gotten out of my seat and was stowing them, I noticed that both Jim and Frank had a gash across the front of their helmet. So, we were all rookies on that one.

After post-insertion checkout of spacecraft systems, the S-IVB stage was reignited and burned 5 minutes 9 seconds to place the spacecraft and stage in a trajectory toward the Moon, and the Apollo 8 crew became the first men to leave the Earth's gravitational field. [5]

The spacecraft separated from the S-IVB 3 hours 20 minutes after launch and made two separation maneuvers using the SM's reaction control system. Eleven hours after liftoff, the first midcourse correction increased velocity by 26.4 kilometers per hour. The coast phase was devoted to navigation sightings, two television transmissions, and system checks. The second midcourse correction, about 61 hours into the flight, changed velocity by 1.5 kilometers per hour. [5]

In the words of Jim Lovell [4] :

> Well, my first sensation, of course, was "It's not too far from the Earth." Because when we turned around, we could actually see the Earth start to shrink. Now the highest anybody had ever been, I think, had been either—I think it was Apollo or Gemini XI, up about 800 mi. or something like that and back down again. And all of a sudden, you know, we're just going down. And it was—it reminds me of looking—driving—in a car looking out the back window, going inside a tunnel, and seeing the tunnel entrance shrink as it gets— as you go farther into the tunnel. And it was quite a—quite a sensation to—to think about.
>
> You know, and you had to pinch yourself. "Hey, we're really going to the Moon!" I mean, "You know, this is it!" I was the navigator and it turned out that the navigation equipment was perfect. I

mean, it was just—you couldn't ask for a better piece of navigation equipment.

The 4-minute 15-second lunar-orbit-insertion maneuver was made 69 hours after launch, placing the spacecraft in an initial lunar orbit of 310.6 by 111.2 kilometers from the Moon's surface - later circularized to 112.4 by 110.6 kilometers. During the lunar coast phase the crew made numerous landing-site and landmark sightings, took lunar photos, and prepared for the later maneuver to enter the trajectory back to the Earth. [5]William Anders had this to say[4] :

…[T]hat one [view] is sunk in my head. Then there's another one I like maybe [and this is] of the first full Earth picture which made it again look very colorful. … [T]o me the significance of this [is that the Moon is] about the size of your fist held at arm's length … you can imagine … [that at a hundred arms' lengths the Earth is] down to [the size of] a dust mode. [A]nd, a hundred lunar distances in space are really nothing. You haven't gone anywhere not even to the next planet. So here was this orb looking like a Christmas tree ornament, very fragile, not [an infinite] expanse [of] granite … [and seemingly of] a physical insignificance and yet it was our home…

According to Frank Borman [4]:

Looking back at the Earth on Christmas Eve had a great effect, I think, on all three of us. I can only speak for myself. But it had for me. Because of the wonderment of it and the fact that the Earth looked so lonely in the universe. It's the only thing with color. All of our emotions were focused back there with our families as well. So that was the most emotional part of the flight for me.

During the flight William Anders said, "Earthshine is about as expected, Houston." Kraft said he shook his head and wondered if he'd heard right. Earthshine! [1]

On the fourth day, Christmas Eve, communications were interrupted as Apollo 8 passed behind the Moon, and the astronauts became the first men to see the Moon's far side. Later that day , during the evening hours in the United States, the crew read the first 10 verses of Genesis on television to Earth and wished viewers "goodnight, good luck, a Merry Christmas and God bless all of you - all of you on the good Earth." [5]

On Christmas Day, while the spacecraft was completing its 10th revolution of the Moon, the service propulsion system engine was fired for three minutes 24 seconds, increasing the velocity by 3,875 km per hr and propelling Apollo 8 back toward the Earth, after 20 hours 11 minutes in lunar orbit. More television was sent to Earth on the way back and, on the sixth day, the crew prepared for reentry, and the SM separated from the CM on schedule. [5]

The Apollo 8 CM made the first manned 'hot' reentry at nearly 40,000 km/hr into a corridor only 42 km wide. Parachute deployment and other reentry events were normal. The Apollo 8 CM splashed down in the Pacific, apex down, at 10:51 a.m. EST, December 27, 147 hours and 42 seconds after liftoff. As planned, helicopters and aircraft hovered over the spacecraft and para-rescue personnel were not deployed until local sunrise, 50 minutes after splashdown. The crew was picked up and reached the recovery ship U.S.S. *Yorktown* at 12:20 p.m. EST. All mission objectives and detailed test objectives were achieved. [5]

Frank Borman said [4]:

We hit the water with a real bang! I mean it was a big, big bang! And when we hit, we all got inundated with water. I don't know whether it came in one of the vents or whether it was just moisture that had collected on the environmental control system. ... Here were the three of us, having just come back from the Moon, we're floating upside down in very rough seas -- to me, rough seas."

Of course, in consternation to Bill and Jim, I got good and seasick and threw up all over everything at that point.

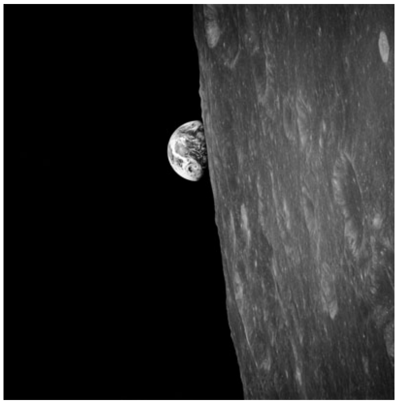
To which William Anders responded [4] :

Jim and I didn't give him an inch, you know, we [Naval Academy graduates] pointed out to him and the world, that he was from West Point, what did you expect? But nonetheless, he did his job admirably. But by now the spacecraft was a real mess you know, not just from him but from all of us. You can't imagine living in something that close; it's like being in an outhouse and after a while you just don't care, you know, and without getting into detail... messy. But we didn't smell anything…

Christopher Kraft recalled in the Apollo oral history:[4]

The firsts involved in Apollo 8 almost were unlimited, if you stop to think about it, from an educational point of view, from a theo-

Below: The first photograph taken of Earthrise over the Moon. Note that this photograph is in black and white. Photo credit: NASA



logical point of view, from an esthetic point of view, from an art point of view, from culture, I don't know, you name it, that event was a milestone in history, which in my mind unless we land someplace else where there are human beings, I don't think you can match it, from its effect on philosophy if you will, the philosophical aspects of that.

Be sure to check out the Apollo 8 flight journal at http://history.nasa.gov/ap08fj/

References

[1] Kraft, Chris . *Flight: My Life in Mission Control*. New York: Dutton, 2001

[2] Gene Kranz, Failure Is Not an Option, Simon and Schuster, 2001

[3] Hamish Lindsay, Tracking Apollo to the Moon, Springer, 2001

[4] Oral History Project , Johnson Space Center, 1997 – 2008 (Ongoing)

[5] Apollo 8 Mission Report, MSC-PA-R_69-1, February, 1969.

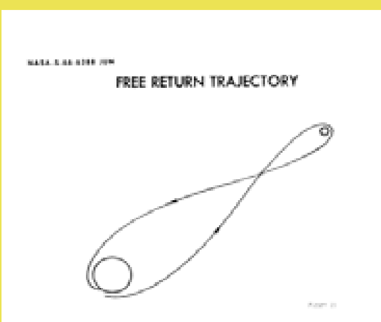
[6] Robert Zimmerman, Genesis: The Story Of Apollo 8, 1998.

[7] APOLLO LUNAR LANDING MISSION SYMPOSIUM, June, 25-27, 1966 Manned Spacecraft Center Houston, Texas

Personal note from Dr. Jackson:

I was 28 years old in December 1968 and had a space program career in mind from when I first read the Collier's magazine spaceflight series. The first issue was dated March 22, 1952, when I was 11 years old. The series came to an end with the April 30, 1954 issue, Can We Get to Mars? I was 13 then and remember Werner Von Braun writing that it would take 25 years to get to Mars, I was downcast! That was too long. I came to the Manned Spacecraft Center in Jan 1966 and in time became an instructor for the Lunar Module training simulator. I did not train the Apollo 8 crew but I was in Building 4 Christmas Eve at a second floor small remote control room listening to the flight controller's loop. It was very exciting, after Lunar Orbit Insertion, to hear acquisition of signal and confirmed orbit at approximately 4 am Houston time. I walked over to building 2 (building 1 these days) and got a cup of coffee. On the way back I looked into a cold (about 35 deg F) clear Houston night sky at a waxing crescent winter-cold Moon for about 15 minutes and thought, "Wow! There are humans in orbit up there."

Free Return and the S-IVB



After the S-IVB executed the TLI maneuver, the CSM separates from the third stage of the Saturn V rocket, then performs the transposition and docking maneuver to extract the LM. An evasive maneuver was then performed to provide a safe separation between the CSM and the S-IVB. Then Trans Lunar Injection is performed, the Command Module is on a free return trajectory, meaning that if the Service Module engine fails a safe return to the Earth is possible (if the Service Module power system does not fail as happened with Apollo 13!) A free-return trajectory is a path that uses the Earth's and the Moon's gravitational forces to propel a spacecraft around the Moon and back to Earth again. It's called a "free-return" because it is, in essence, automatic. With some minor course corrections, a space craft will automatically be whipped around the Moon, and pulled back into the Earth's orbit, simply because the Earth's gravitational pull is so strong. The Earth's gravitational pull is so strong; in fact, that a spacecraft traveling at 20,000 mph when leaving Earth's atmosphere will have been slowed to less than 5,000 mph by the time it reaches the Moon. The Moon's gravity will temporarily grab hold of the spacecraft, but as soon as the craft rounds the Moon, the Earth's gravity begins to pull it back again.

But where does the S-IVB go? It also comes back to the Earth! For a while no one had thought about this. Luckily, the danger to our planet is small, since it would most likely go into an ocean. To obviate any risk the S-IVB makes a tweak maneuver that places it on a slingshot trajectory into Solar orbit. (After Apollo 11 the S-IVB impacted the Moon for seismic measurements.)

AIAA-Houston Section Calendar of Events

December 19 (Friday)
Apollo 8: The 40th Anniversary
Lunch and Learn: A panel discussion with Apollo 8 flight planning and operations engineers
Moderator: Marianne Dyson, former NASA flight controller and award-winning author (www.mdyson.com)
Time: 11:30 a.m. to 1:00 p.m.
Cost: None
Advance sign-up recommended at *www.aiaa-houston.org:* Appetizers, iced tea & water compliments of AIAA Houston Section

January 5 (Monday)
Council meeting (unless holiday plans force it to the 12th)

January 9 (Friday)
The Space Center Lecture Series, co-sponsored by AIAA Houston Section
Planetology: Unlocking the Secrets of the Solar System, by astronaut Tom Jones, Ph.D.
Time: 6:15 p.m. (meet the author), 7:00 p.m. (lecture), 8:30 p.m. (book signing)
Place: Bayou Theater in the Bayou Building at The University of Houston at Clear Lake, 2700 Bay Area Blvd., capacity: 500
Cost: free (limited seating, reservations recommended): Reservations: *www.aiaa-houston.org*

January 20 (Monday)
Dinner meeting with AIAA Houston Section and United Space Alliance Leadership Association (USALA)
Speaker: Astronaut Mike Fossum (EVA Specialist on space shuttle missions STS-121 and STS-124).
Place: NASA/JSC Gilruth Center Alamo ballroom

February 2 (Monday): Council meeting

March 2 (Monday): Council meeting

March 4 (Wednesday): Dinner meeting with Dr. Jeff Jones, Long Duration Mission Medicine, in the Gilruth Center Lonestar room

April 4 (Saturday)
Yuri's Night Houston (an AIAA Houston Section event)
Celebrating the April 12, 1961 launch of Yuri Gagarin and the April 12, 1981 launch of STS-1
Note: April 12 is Easter Sunday, and April 11 is the MS 150 bike ride (Houston to Austin), so our planning targets Saturday, April 4

April 6 (Monday): Council meeting

May 4 (Monday): Council meeting

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

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

With the International Year of Astronomy in mind, this event is added to our calendar, though it is not an AIAA event.
January 23, 2009 (Friday)
Black Holes: Powerhouse of the Universe
Presented by John F. Hawley, Professor of Astronomy and Chair of the Astronomy Department at the University of Virginia
Time: 6:00 - 8:00 p.m.
Place: University of Houston at Clear Lake (UHCL), Bayou Theater in the Bayou building
Cost: free admission
Open reception following the presentation
Free parking in student lot D.
Maps and directions: *www.uhcl.edu/maps*
Presented by the UHCL School of Science and Computer Engineering's Physics Program

Calendar updates: www.aiaa-houston.org. Horizons is published online quarterly. This issue: online in mid-December 2008.

EAA Corner

Preliminary Meeting Schedule 2009

7 Jan 09 –	Annual Planning Meeting – You want it in the group, now is the chance to put it forth! I will be bringing some historical documents and other bits of history that are destined for disposal if you are interested!
4 Feb 09 –	Builder Websites – Basic Nuts and Bolts of the How To's – Phil Perry
4 March 09 –	Composite Basics – Presentation
March 09 –	The 1940 Air Terminal Museum – EAA Day
1 April 09 –	Composites Work Shop – Basic Layup Workshop – Small materials fee for non members
6 May 09 –	Composites Workshop – Finishing – Small materials fee for non members
9 May 09 –	Houston Airport System Ellington Field Charity Fly-in, KEFD
3 Jun 09 –	Aircraft Propeller Speed Reduction Units (PSRUs), Bud Warren, Geared Drives, Conroe TX, RV10 Chevrolet LS1 firewall forward kit, http://www.geareddrives.com
1 July 09 -	Builder's Visit - Recently completed RV or canard?
5 Aug 09 -	LaBiche Flying Car - tentative - www.labicheaerospace.com/

Right: Aircraft seen at the 6th Annual Great Southern Sonex Gathering, Lone Star Executive Airport, Conroe TX , November 1, 2008.



Right: Photos from the Reklaw fly-in, 2008





Recurring Events

Monthly Meeting: Chapter 302 Monthly Meeting, 2nd Saturday, 10 a.m., 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 information sharing between aviation enthusiasts. Many of the services that EAA offers provide valuable support resources for those that wish develop and improve various skills related to aircraft construction and restoration, piloting, aviation safety, and aviation education. Every individual and organization with an interest in aviation and aviation technology is encouraged to participate (EAA membership is not required, but encouraged). Meetings are generally from 6:30 p.m. to 9 p.m. 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 aero-spacecraft design". More information, including subscription prices, may be found at the following address:

Scott Lowther
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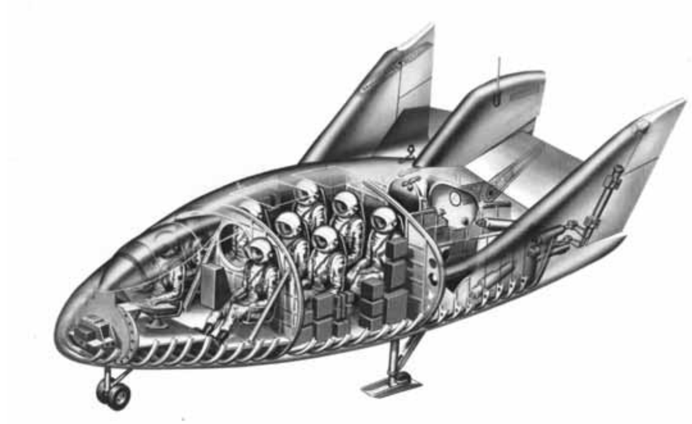
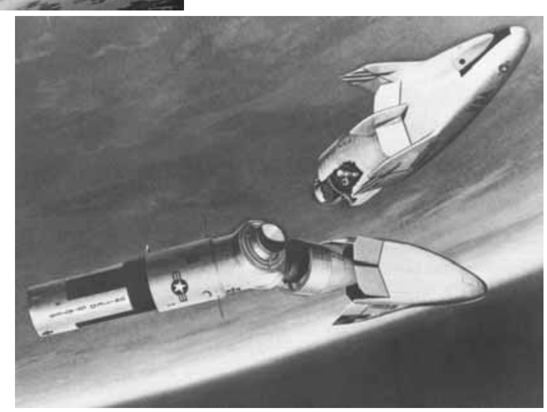
Illustrations courtesy of Glenn L. Martin Aviation Museum

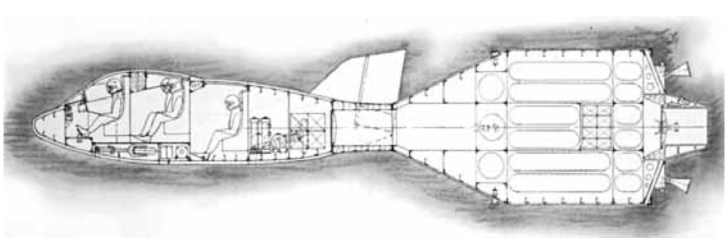


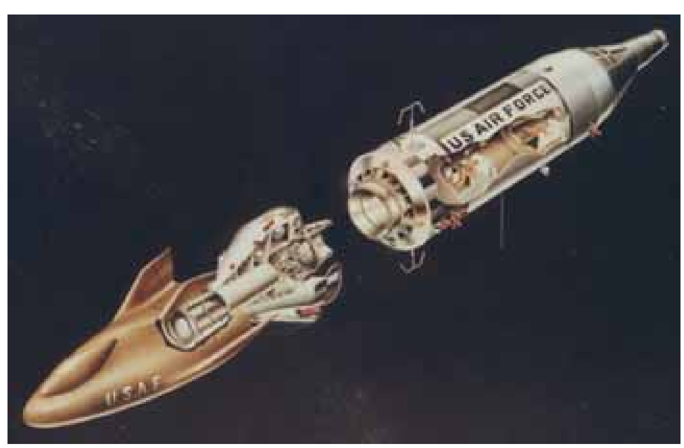
More than three decades before NASA tried to build the X-38 Crew Return Vehicle, Martin Marietta Corporation proposed effectively the same concept using their X-24 lifting body. The X-38, as is well known, was derived from the X-24 configuration, which was derived from the Martin SV-5 lifting body design. Martin Marietta spent several years attempting to sell the SV-5 configuration to both NASA and the USAF as a crew transport and space station logistics vehicle. Launch into orbit was typically proposed to be performed via a Martin Marietta Titan III launch vehicle, though larger variants would use the Saturn Ib.

Space stations to be serviced by the SV-5 included the USAF's Manned Orbital Laboratory (MOL). MOL, interestingly, was announced by the USAF as they cancelled the X-20 Dyna Soar, a Boeing spaceplane to be launched by the Titan III. The Dyna Soar could also be used as a logistics spacecraft for space stations, capable of transporting up to six astronauts, with major modifications to the interior arrangement. SV-5 derivatives, on the other hand, could comfortably transport eight or more. With substantially increased capability be made available with larger sizes. However, 8 seems to have been about the maximum for launch on the Titan III. Being a fairly rotund lifting body opened up a great deal of internal volume for the seating of passengers and storage of payload.

As the 1960's love affair with space stations died with the realities of the 1970's, the need for an SV-5-derived logistics craft also died. The USAF never did generate their own manned space capability, and NASA's needs were met by the Space Shuttle. In the mid-90's the SV-5 geometry was revived for the X-38 Crew Return Vehicle (which itself passed through several nomenclature changes, including brief stints as the X-35, and one unfortunate period of time as the CRV-X… sound it out). The X-38, as with the SV-5/X-24 before it, also failed to send a single astronaut into space, and was cancelled in 2002.







Cranium Cruncher

BILL MILLER, SENIOR MEMBER

Last issue's puzzle required the deciphering of some torturous syntax in order to figure out how old an Orbiter and its robotic arm was. This puzzle came from an old and unattributed collection of puzzles I ran across on the Internet (the original problem, which was solved incorrectly, dealt with a steamship and its boiler).

Douglas Yazell, Alan Simon, Gary Turner, Steven Everett, Blake Schwellenback, and Norm Chaffee all managed to convert the words into equations and calculate the correct age of the Orbiter: 17 1/7 years.

Thanks to all who participated.

This issue's problem:

The water deluge tank for a propulsion test stand has two fill lines and one drain line. Fill line A flows at a rate that can fill the tank from empty in ten hours (if only line A is active). Fill line B flows at a rate that can fill the tank from empty in eight hours (if only line B is active). The drain line can empty a full tank in six hours (if neither fill line is activated).

On a particular occasion test engineer Eddie Viscosity begins to fill the empty deluge tank by simultaneously turning on both inlets. When the tank level reaches 50% he realizes that it is filling much slower than expected and notices that he has inadvertently left the drain line open. Groaning at the thought of the paperwork that will be required due to this error, he closes the drain line.

How long did it take Eddie to fill the tank to 100% on this occasion?

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