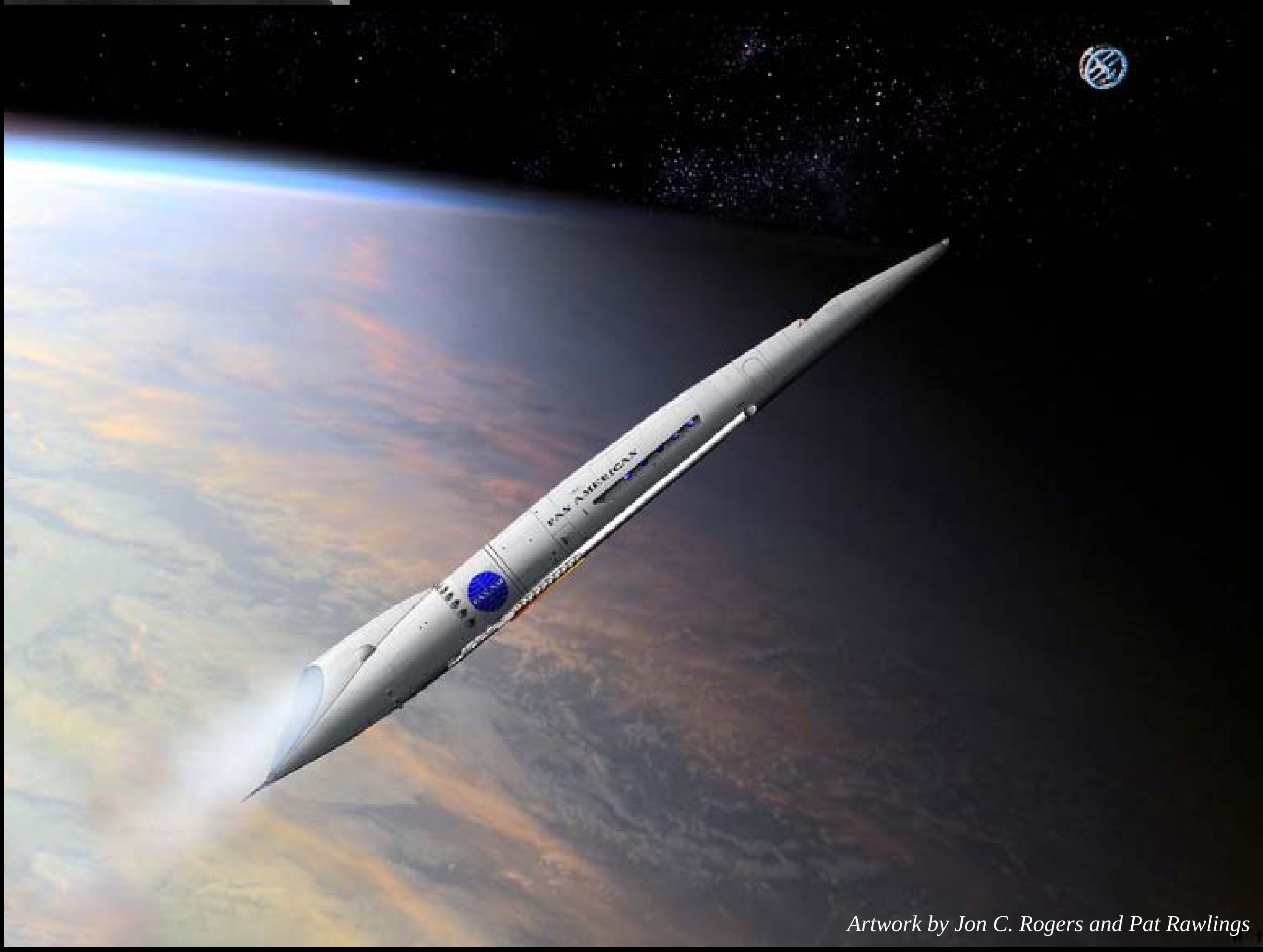
Horizons

Volume 33, Issue 2 AIAA Houston Section www.aiaa-houston.org April 2008

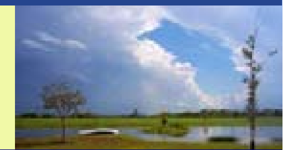
Arthur C. Clarke
1917 - 2008

2001: A Space Odyssey - 40 Years Later
Yesterday's Tomorrow



Artwork by Jon C. Rogers and Pat Rawlings

April 2008



AIAA HOUSTON
American Institute of Aeronautics and Astronautics

Horizons is a quarterly publication of the Houston section of the American Institute of Aeronautics and Astronautics.

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

Horizons and AIAA Houston Web Site
AIAA National Communications Award Winner

2005 2006 2007

Cover: Artwork by Jon Rogers and Pat Rawlings.
Arthur C. Clarke: born December 16, 1917, died March 19, 2008.
Photo: a snapshot of Mr. Clarke taken by Dr. Albert A. Jackson's friend in 1969 at a dinner hosted by the science fiction club The Cepheid Variables at Texas A&M University.

From the Acting Editor

Douglas Yazell

The authors of our feature story have been working on that for a few months. As they planned, this issue of Horizons will go online in April of 2008 in order to celebrate the anniversary of opening night for the movie 2001: A Space Odyssey. Opening night was April 6, 1968. Al Jackson was in touch with Mr. Clarke by e-mail to work on nominating someone as an AIAA Fellow. Mr. Clarke was an AIAA Honorary Fellow. Mr. Clarke agreed to help as a reference for that nomination. After Mr. Clarke died on March 19, 2008, at age 90, our editors decided to devote this issue of Horizons to him as much as possible.

Our French sister section in Toulouse (AAAF TMP) produced an article about light pollution for their newsletter, la Gazette. This article was created with our newsletter in mind, too, so it is included here now that I worked on its translation. That translation work was a good education for me. We thank its author, Michel Bonavitacola, and Mr. Philippe Mairet, who brought us together.

Our next editor has probably been identified already, and we thank him in advance. During this transition period, I enjoy being acting editor, but I need less computer work in my life, not more.

This issue will be online by April 25, 2008, followed by our last issue of our AIAA year on June 25, 2008. We will then return to a quarterly schedule.

We will look into printing a shorter version of this issue on 2-sided, glossy, color pages so that we can hand it out at our events prior to the end of our AIAA year on June 30, but that might not be in our budget.

Thanks to our assistant editors Don Kulba, Jon Berndt, Robert Beremand, and Dr. Rattaya "Chow" Yalamanchili. Our section's council of 45 people helps with our newsletter, too, but special thanks go to these assistant editors. If you like to write, edit, or publish, please come and join us in this volunteer work to be of service to our profession. AIAA Houston Section membership consists of about 1,150 people. Horizons is online at www.aiaa-houston.org/horizons. You can always contact us at editor@aiaa-houston.org.

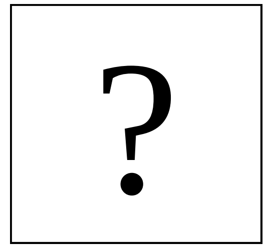
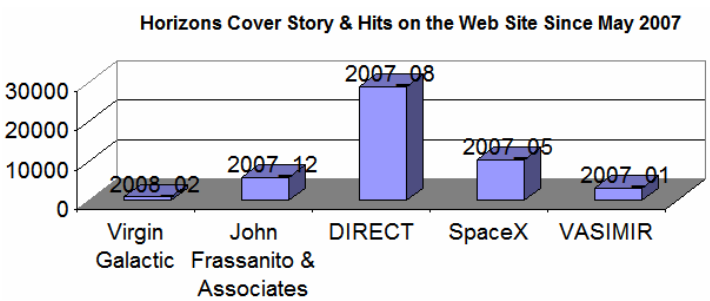


Photo of our next editor



Below: this plaque is on display at NASA/JSC's Rocket Park, outdoors near the nose of the Saturn V rocket.

Houston's second AIAA Historic Aerospace Site is the 1940 Air Terminal Building at Hobby Airport. A ceremony to unveil its plaque will take place late this 2008 calendar year or early next year at the museum at Hobby Airport (www.1940airterminal.org).

Chair’s Corner

Douglas Yazell, AIAA Houston Section chair

Our AIAA year is winding down, and it will end on June 30, 2008, preceded by a few busy weeks. We will end the year by ensuring our section’s annual report is submitted at www.aiaa.org by June 30. On June 25, 2008, our year’s last issue of Horizons will go online at www.aiaa-houston.org/horizons, then we will return to a quarterly schedule. AIAA Distinguished Lecturer Roger Launius of the Smithsonian Institute will be our dinner meeting speaker on Tuesday, June 10, 2008, probably speaking about, “Key Turning Points in the History of the Space Age”. That’s our annual honors & awards dinner meeting.

Our section’s Annual Technical Symposium will be Friday, May 9, 2008, at the NASA/JSC Gilruth Center (no badges required). The morning keynote speaker will be Wayne Hale/ NASA-JSC, who recently directed space shuttle launches. The luncheon keynote speaker will be someone from the NASA/JSC lunar lander program office. Professor Daniele Mortari of Texas A&M University plans to give a presentation about the flower constellations, one of those rare science and engineering subjects that almost everyone finds to be inspiring.

Students from Satori School wrote letters to AIAA and Dr. Adler after his lunch-and-learn about the Mars rovers. They had a 90-day expected mission due to Martian dust on their solar panels. Surprise! Martian dust devils clean them, so they are still going after 4 years! (Art: Ben from Satori School and NASA)

The Student Paper Conference (SPC 2008) for our 4-state region IV (South Central) is being run by our AIAA Houston Section this year. Its leader is our section’s secretary Sarah Shull, who recently returned to our section after taking an educational leave of absence from her job to earn her masters degree from MIT. We have 30 papers in the competition and about 85 students attending. Volunteers include about 30 online judges and 12 oral judges, as well as Linda Phonharath, our college and co-op chair. SPC 2008 takes place April 18 and 19, 2008, at the Gilruth Center and Space Center Houston. Corporate sponsors are helping greatly to make this event a big success.

In our next issue of Horizons we will report on Yuri’s Night Houston (www.yurisnighthouston.net), led in Houston by the American Astronautical Society and co-sponsored by AIAA Houston Section. Local communities such as Nassau Bay invited Bay Area Rally, a big motorcycle rally, into Space Center Houston for a few days in order to stimulate local businesses during a slow season. While the rally was there for a few days, our event of Saturday, April 12, 2008, was a very nice fit to add on to their event.

The week of Monday, March 10, 2008, saw us with four events in four days, two of which took place that week because the speakers were in town for the Lunar and Planetary Science Conference. AIAA Houston Section co-sponsored the last of those 4 events, a lecture by Apollo 17 astronaut Harrison Schmitt, the last person to step onto the Moon. That attracted a crowd of 450 to Space Center Houston’s Northrup Grumman IMAX theater, so our volunteers were happy and exhausted at the end of that night. Dr. Larry Friesen pointed out to me that we would be wise to interact with the organizers of that annual conference. AIAA Houston Section space operations technical committee chair BeBe Kelly-Serrato attended that conference and asked one of their most popular speakers to speak at a lunch-and-learn at NASA/Johnson Space Center during the conference next year, and he agreed, so we are working to build on that beginning.

Our events during that busy week were:

Monday, March 10, 2008: lunch-and-learn by Dr. Mark Adler/JPL, Mars rovers Spirit & Opportunity

Tuesday, March 11, 2008: dinner meeting with John Frassanito & Associates

Wednesday, March 12, 2008: lunch-and-learn by Nazareth Bedrossian/Draper, Sailing the Space Station with Zero-Propulsive Maneuver (ZPM) Guidance

Thursday, March 13, 2008: co-sponsoring the first of the Space Center Lecture Series: see SpaceCenterLectureSeries.com

The children from Satori School who attended our March 10 lunch-and-learn about the Mars rovers participated in the January 2008 Mars rover competition, a University of Houston event that our section supports.

On April 11, 2008, our section co-sponsored Engineer for a Day at the Boeing building on Bay Area Boulevard. About 70 high school students spent the day with us, organized by the Boeing Black Employees Association.

2001: A Space Odyssey - 40 Years Later
Yesterday's Tomorrow

Feature Article

AL JACKSON, BOB MAHONEY, AND JON ROGERS

This year marks the fortieth anniversary of the release of Stanley Kubrick and Arthur C. Clarke's science fiction film *2001:A Space Odyssey* and the novel of the same name. The narrative structure of the film is a transcendent philosophical meditation on extraterrestrial civilizations and biological evolution, a theme known in science fiction since H. G. Wells as one of the 'BIG THINKS'. Books, articles, and even doctoral dissertations have been written about the film. Framing these deeper speculations was a 'future history' constructed on a foundation of rigorously researched then-current scientific and engineering knowledge. Today, nine years after (as portrayed in the film) the discovery of the extraterrestrial artifact on the Moon, we address this technology backdrop and assess its accuracy. We'll leave any commentary on the film's philosophy to film critics and buffs.

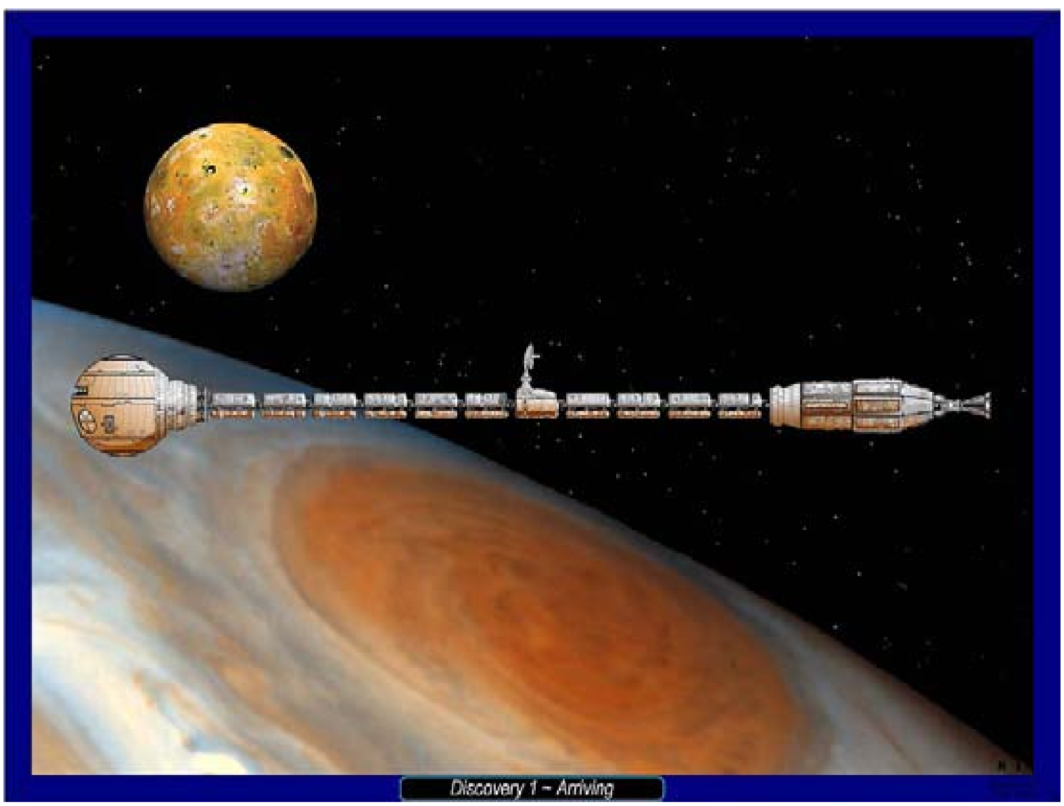
Hailed at the time as a bold vision of our future in space, it presented both Kubrick's and Clarke's predictions of spaceflight three decades beyond the then-current events of the Gemini and early Apollo programs. One's first impression, even in 1968, is that Kubrick and Clarke were overly optimistic. We certainly don't have 1000-foot diameter space stations spinning in Earth orbit and multiple large bases on the lunar surface supporting hundreds many more of people. There are no large nuclear-powered manned space missions to the outer planets.

But these "projection errors" are programmatic in nature, not technology-related. One must recall that the film was conceived in the mid-1960s when the space programs of both the U.S. and U.S.S.R. were racing ahead at full speed. Checking any pertinent literature of the late 1930's through 1965 reveals that *many* writers assumed such extensive infrastructure was perfectly feasible (even inevitable) by the turn of the last century. (It should be noted that many prose science fiction writers including Robert Heinlein and Isaac Asimov hedged their bets and put such technological developments depicted in the film 50 to 100 years beyond 2001.) The many social and economic circumstances that would place pressures on space program funding had not developed until the film's production was nearly complete. This was also at a time when individual countries unilaterally pursued their own space programs.

Yet when one looks beyond the obvious programmatic "overshoot" of the film to the *technical* and *operational* details of their portrayal of spaceflight, Kubrick and Clarke's cinematic glance into the crystal ball seems much more remarkable. There are few sources of technical material about the spacecraft in the film although we know that Marshall engineers Fredrick Ordway and Harry Lange (7,8), spent nearly three years designing the technical details

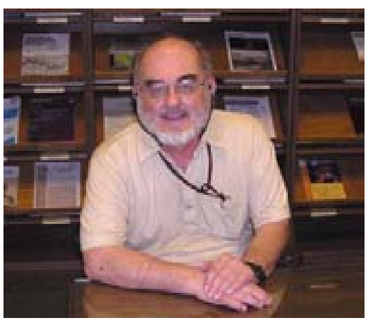
(Continued on page 6)

Art: Jon Rogers



Feature Article

Dr. Al Jackson came to JSC (MSC then) in 1966 and has been involved with crew training during Apollo, flight planning software, planetary science, orbit debris and engineering simulation software for NASA and several contractors. He is currently with Jacobs Engineering on the ESCG contract. He is Chair of the AIAA Houston Section Astrodynamics technical committee, with many publications in the area of astrodynamics, celestial mechanics, and astronautics. Dr. Jackson received his PhD in physics at the University of Texas in 1975.



Dr. Albert A. Jackson at the Lunar and Planetary Institute in the Houston Clear Lake area, where he is a visiting scientist. Dr. Jackson is also a Fellow of the British Interplanetary Society and a member of AIAA Houston Section's International Space Activities Committee (ISAC), whose web page is www.aiaa-houston.org/tc/isac.

(Coninued from prior page)

for the film with the help of both the American and British aerospace industries. Their considerable efforts are evident even down to the details.

Commercial Space Transport Inevitability?

Take the *Orion III* space plane. Excluding the Pan Am logo (no one would have expected Pan Am to go bankrupt only 15 years later!), the space plane ferrying Dr. Floyd into Earth orbit shares an amazing number of features with today's one active space plane, the shuttle. Not only does it have a double-delta wing, but the three sweep angles (both leading and trailing edges) are within 10 degrees of those on NASA's shuttle. One also finds it intriguing (as superficial a matter as this might be) that the back ends of both vehicles have *double* bulges to accommodate their propulsion systems.

Watching the docking sequence cockpit view in the film is like sitting in the flight engineer's seat on the shuttle flight deck. Three primary computer screens, data meters spanning the panel over the windshield, a computer system by IBM, and dynamic graphics of the docking profile can be found in today's Orbiter. While the real shuttle approaches not nose-first but top-first, and the dynamic images of space station approaches are displayed on laptop computers, not the primary computer screens, these are minor discrepancies driven by particular engineering and aesthetic choices of both the filmmakers and the real shuttle's engineers.

Another implied technical feature of the *Orion III* docking operation is that the space plane's crew is not doing the flying; the space plane's computers are. While this isn't quite the way the shuttle docks to the space station today (the crews fly most of the approach and docking manually but their stick and engine-firing commands pass through the computers), fully automatic dockings have been the norm for Russian *Soyuz* and *Progress* for many years and the recently launched ESA Automated Transfer Vehicle has done the same. But the premise of the space plane flying itself as the crew monitors its progress is standard operating procedure for shuttle ascent and entry.

Speaking of ascent, the film leaves us to speculate on how the *Orion III* achieved orbit, but Clarke's novel fills this in, and here we find a serious divergence from the currently flying stage-and-a-half vertically launched shuttle. (It has been suggested that the *Orion III* was a 'III' because the first stage, *Orion I*, was the booster, while *Orion II* was a cargo carrier: see note 1.) In the novel, Clarke clearly describes the *Orion* space liner configuration as a piggy-back Two-Stage-to-Orbit (TSTO), Horizontal Take Off and Horizontal Landing (HTOHL) tandem vehicle launched on some form of railed accelerator sled, such as a maglev (magnetic levitation, which is now used with maglev trains).

This mid-60's speculation for an ascent/entry transportation system is remarkably in line with (minus the rail sled) many of the European Space Agency's extensive '80s/'90s design studies of their *Sänger II*/*Horus-3b* shuttle (9), note 2. (A multitude of TSTO studies in the Future European Space Transportation Investigations Programme (9) echoed the space transportation system suggested in the film *2001*.) But perhaps Clarke's prescience (and ESA's design inspiration) stemmed not from looking forward but from looking back. Amazingly, basic physics had guided Eugen Sänger and Irene Brent—in 1938!—to define this fundamental configuration (*including* the rail sled) for their proposed 'orbital space plane' the *Silbervogel*.

Zero G

One of the best aspects of *2001*, and certainly a significant reason most knowledgeable space enthusiasts admire it, is its absolute respect for true physics. Nearly every spaceflight scene shown in *2001* conforms to the way the real universe works. Only one other film since *2001* has even come close to portraying spaceflight so realistically: *Apollo 13*. And talk about a compliment to the special effects crew of the 1968 film—the *Apollo 13* team achieved most of their zero-g effects *with* zero g, by filming inside the NASA KC-135 training aircraft as it flew parabolic arcs.

If you are in an orbiting spacecraft that's not undergoing continuous acceleration due to its own propulsion, you can't just walk around like you're heading into the kitchen from the living room. Those bastions of "science" fiction pop culture, *Star Trek* and *Star Wars*, conveniently used an

(Coninued on next page)

Feature Article

(Coninued from prior page)

old prose science fiction ploy, ‘super-science’ ‘field-effect’ gravity, to permit walking (and thereby limit their F/X budgets). However, careful comparison of the 1968 film scenes to those of crew members operating in spacecraft today quickly reveals that Kubrick dealt with the technical (and potentially F/X-budget-busting) challenge of faking zero gravity by blending scientifically legitimate speculation, real physics on the soundstage, and a touch of artistic license that collectively helped to produce visually compelling aesthetics.

In *2001*, when the crew move about in non-rotating parts of their spacecraft, they walk (and even climb up and down ladders) on Velcro (or some similar material) with special footwear. In fact, one of the more visually interesting sequences (the stewardess heading up to the cockpit in the *Aries IB* moon shuttle) gains its impact with the idea—the stewardess calmly (if awkwardly) walks her way up a curving wall until she's upside down. Shuttle and Station astronauts must fidget anxiously when they watch this scene since they would accomplish a similar trip today in seconds with just a few pushes. In to-

(Coninued on next page)

Society Imperfect?

While the individual spaceflight technology predictions in *2001* remain hit or miss, Kubrick’s most precise piece of prognostication might have been his comment on how technology would affect our society. He predicted with an uncannily keen eye that advancing technologies of personal communication and entertainment would fracture our communities and isolate individuals even as the greater world grew into one vast conglomeration of cultures.

On board *Discovery*, as we see Bowman and Poole performing their individual tasks, we catch a scene wherein the two crewmembers join up for a meal at the ship’s dining table (certainly a symbol of community) as they watch a previously recorded BBC interview with themselves. Yet even though they sit less than five feet apart, they’re not eating together. Trading caretaker shifts, one appears to be eating breakfast, the other lunch or dinner, both meals individually specified. They exchange no words. Most telling of all, they’re watching the *same* television broadcast on their own separate video devices! Recall that this scene was filmed in the mid-1960s when the notion of the nuclear family sitting together in front of the living room television was still very much a societal norm. Personal DVD players and Watchmans were far in the future.

The *Orion III* space plane so majestically ferrying Heywood Floyd into orbit carries another clue to this technology-driven isolation. In a cabin designed to carry forty or more people, each and every seat has its *own* TV screen and controls. No in-flight movies for everyone to watch together—just individual in-flight satellite TV streams or, more likely, some sort of Internet access. In fact, this aspect of the space plane design has done away with the need for the passengers to carry along their own isolation-enabling ‘personal electronic devices’ - they’ve already been built into the spacecraft!

Finally, the *Aries IB* moon shuttle cabin also supports this capacity for personalized entertainment; one of the flight attendants is seen watching, of all things, a judo or wrestling match. Linked with the aforementioned British television interview, Floyd’s daughter’s request for an African bushbaby as a birthday present, and the close familial relationship (shared vacations) between Floyd and the Russian scientist (not Soviet…now *that’s* impressive!) he greets on the space station, there can be no mistaking that Kubrick was suggesting that globalization would march forward hand in hand with personal isolationism. *How did he know?*

Kubrick's most subtle technological prediction regarding our time may have been his most accurate, and it wasn’t restricted to the realm of spaceflight. He foresaw that as our technology advanced it would contribute to the loss of our sense of community by permitting us to retreat into our personal, individual worlds, even as that same technology enabled the global village. In this sense, the date in the film's title was a bit *too* far into the future. Thanks to the ever-advancing invasion of personal technologies, many of us have spent the last two decades or more alone.

Image: Wenhua www.google.com

Feature Article

Passion for spaceflight propelled Bob Mahoney through bachelor's and master's degree programs in aerospace engineering at the University of Notre Dame and the University of Texas at Austin, respectively. Love of writing carried him into lead editorships of his high school's literary magazine and Notre Dame Engineering's Technical Review.

Bob discovered an outlet for both of these passions while serving nearly ten years as a spaceflight instructor in the Mission Operations Directorate at Johnson Space Center. While working at JSC, he taught astronauts, flight controllers, and fellow instructors in the disciplines of orbital mechanics, computers, navigation, rendezvous, and proximity operations. His duties included development of simulation scripts for both crew-specific and mission control team training.

Bob supported many missions, including STS 35, the first

(Coninued on next page)

(Continued from page 7)

day's spacecraft, you don't walk anywhere; you *float*. Kubrick adopted the concept (not necessarily an unreasonable one for the mid-60s) that routine space flyers would insist on retaining the norms of earth operations, including walking, while in zero gravity. (In fact, most crewmembers do prefer at least a visual sense of a consistent up-and-down in spacecraft cabins.) While this helped him out of a major cinematic challenge, it predated the early 70's Skylab program when astronauts finally had enough room to *really* move around and learn the true freedom of zero gravity. (You'll note too that the flight attendant's cushioned headgear also helped avoid the likely impossible task of cinematically creating freely floating long hair, a common sight in today's downlink video.)

2001 was probably the first space flight film to actually use zero g to depict zero g. In the scene where astronaut Dave Bowman re-enters the *Discovery* through the emergency hatch, the movie set was built vertically. This allowed actor Keir Dullea to be dropped, and thus undergo a second or two of freefall, before the wire harness arrested his plunge. (Note 5)

Of course, today's space flyers use Velcro to secure just about everything else. Cameras, checklists, pens, food containers—you can tell the space items apart from their earth-bound cousins by their extensive strips of fuzzy tape. Unfortunately, this convenient fastener's days in the space program may be numbered for long-duration flight. Velcro, composed of tiny plastic hooks, eventually wears out and small pieces break off and can become airborne hazards to equipment and crew. Consequently, long-stay crews keep equipment and themselves in place with other fastening techniques: magnets, bungee cords, plastic clips, or even just simple foot straps.

Artificial Gravity

Kubrick and Clarke's other means of fighting zero g was well-established in the literature of the time: centrifugal force. (The physiological effects of zero g on humans had been a worry from the early days of theoretical thinking about spaceflight. Some thought it might be beneficial, but many worried that since the human body evolved in one g long exposure to no or reduced gravity might be detrimental.) In the film, both the large space station orbiting Earth and the habitation deck of the Jupiter mission's *Discovery* spacecraft rotate to create artificial gravity for the inhabitants. While Gemini 11 achieved this during an experiment, the general trend in space operations has been to live with zero gravity (properly termed *microgravity*) while combating its effects on the human body through exercise. This path was chosen for two reasons: a rotating spacecraft's structure must be significantly sturdier (and thus more massive, and thus more expensive to launch) to handle the stresses of spinning, and the utility of zero g has far outweighed (*sic*?) its negative aspects. Yet one must note that research on the ISS has indicated there are limits to how much exercise and other similar countermeasures can counteract physical deterioration. This is one of the aspects of space medicine research that makes the ISS such an important laboratory.

Ordway and Lange designed the *Discovery's* crew quarters centrifuge realistically to simulate/generate 0.3 g while counteracting Coriolis forces, but a 300-foot diameter wheel was just not feasible as a set. Nevertheless, Vicker's aircraft built the fully working prop with remarkable accuracy. (6) The space station interior set did not rotate, but consisted of a fixed curved structure nearly 300 feet long and nearly 40 feet high. (2) The curve was gentle enough to permit the actors to walk smoothly down the sloping floor and maintain the desired illusion.

Propulsion

While the *Orion III* spaceplane's external propulsion elements hint at systems a few years beyond even today's state-of-the-art (possible air intakes for a scramjet and a sloping aerospike-like exhaust nozzle), the spherical *Aries 1B* moon shuttle has rocket nozzles which would look perfectly at home on the old lunar module. Kubrick was smart to not show exhaust as they fired, only lunar dust being blown off the lunar surface landing pad. Ordway has indicated that the propellants were LOX/ LH2 and thus would be extremely difficult to see in a vacuum in sunlight. Even the MMH/N2O4 shuttle jet firings wash out during orbital day.

One particular propulsion depiction potentially unique to *2001*, which Kubrick likely used more for cinematic aesthetics as well for the sake of realism, is the roar, whine, or boom of engines in the space

(Continued on page 9)

(Continued from page 8)

vacuum. Kubrick correctly shows these propulsion-related events in silence when the camera uses external views. Even *Apollo 13* fell down here, going for the rock 'n' roll excitement of the service module's jets pounding away with bangs and rumbles in external views.

Something that almost all fictional space TV and movies miss is the *cabin* noise of those jets firing, however. Unlike the vacuum outside, a spacecraft's structure can carry sound and the shuttle crews *do* hear their jet firings; at least the ones up front near the cabin. They are quite loud; crewmembers have compared them to howitzers going off. The Moon Bus was small enough that the film probably should have depicted this.

2001's one big cinematic overshoot propulsion-wise is the nuclear rockets of the interplanetary *Discovery*. While deep-space probes such as *Voyager*, *Galileo*, and *Cassini* employ RTG units to generate electricity with the radioactive heat of their plutonium, no nuclear *propulsion* has ever flown in space to date, primarily because (and this gets back to the movie's optimism) no manned mission thus far has required such high specific impulse and sizable thrust. Note, though, that the U.S. NERVA nuclear thermal rocket program was not canceled until 1972, a full four years after the movie's release.

Discovery was actually missing a major component: massive thermal radiators. As any nuclear engineer could point out (and described properly in the novel), these huge panels would have dominated the otherwise vertebrae-like *Discovery's* structure like giant butterfly's wings. (Even the decidedly non-nuclear fuel-cell-powered shuttle and solar-cell-powered ISS sport sizable radiators to dump the heat of their electricity-powered hardware.) Ordway and Lange were quite aware of the need for such radiators and appropriate models were built, but in the end aesthetics carried the day so the cinematic *Discovery* coasted along (silently) somewhat sleeker than known physics demanded. (One interesting tidbit here: some Glenn Research Center engineers redesigned the *Discovery* recently as an engineering exercise. (10))

Cabin Interior

Speaking of sound, *2001* may be the only fictional film to convey the significant background noise in a spacecraft cabin. Every interior scene in *Discovery* is flooded with a background hum, most certainly meant to be the many spacecraft systems running continuously, including air circulation fans. Crews have reported that the shuttle cabin is a very noisy workplace, and some portions of ISS were once rumored to merit earplugs.

As already noted, the *Orion III* cockpit is remarkably similar to the shuttle cockpit. One notes that all of the cockpits in the film are "glass" cockpits, where all information is displayed on computer screens (versus the dials and meters typical of 1960s technology). But this time it was the real-world shuttles that caught up with the film (and a significant portion of the world's airliners). During the 1990s the orbiter's cockpit displays (including many 1972-era di-

(Continued on page 10)

Feature Article

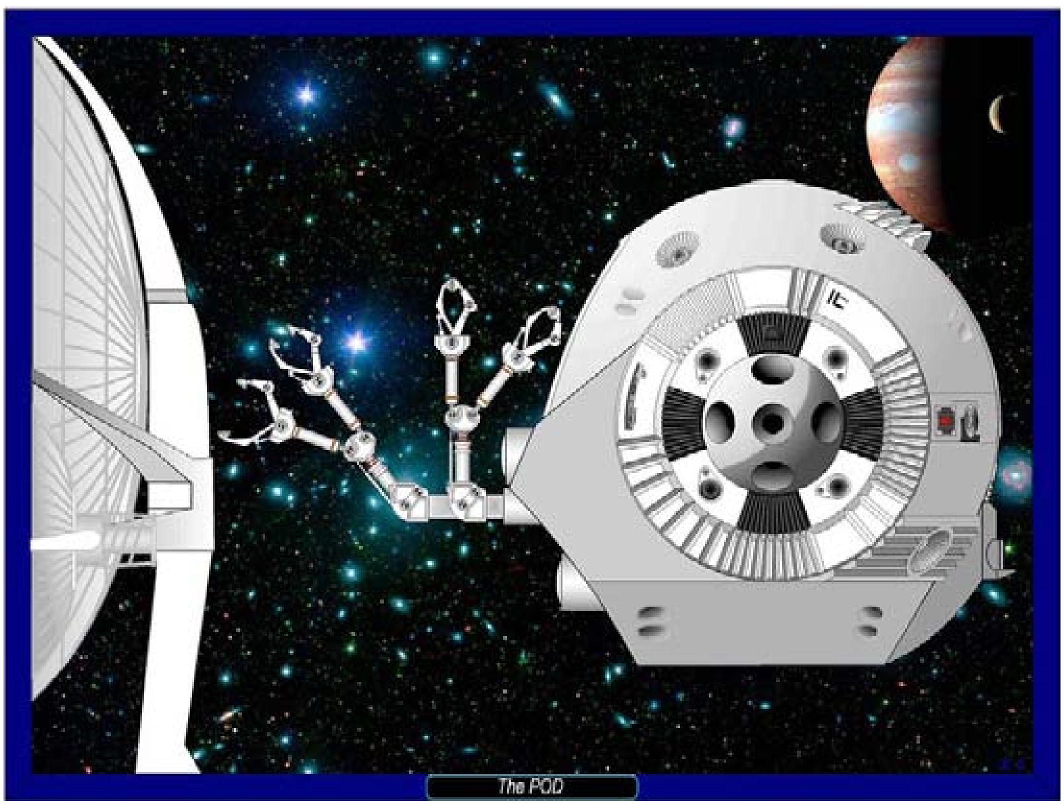
Continued from prior page

flight of Spacelab post-Challenger, and STS 71, the first shuttle docking to Mir. As Lead Rendezvous Instructor for STS 63, the first shuttle-Mir. rendezvous, and STS 80, the first dual free-flyer deploy-and-retrieve, he ensured both crew and flight control team preparedness in rendezvous and proximity operations.

The highlight of Bob's time at JSC was serving as Support-

(Coninued on next page)

Art: Jon Rogers



Feature Article

Continued from prior page

ing, and then Lead, Tether Dynamics Instructor for STS 46 and 75, respectively, the first missions to operate deployable/retrievable space tethers. He found developing and then executing the unique training flow for this entirely new realm of space operations especially rewarding. In July 1996 Air & Space/Smithsonian published his essay describing the disappointment and wonder of watching the broken STS 75 tether fly overhead in the early

(Coninued on next page)

Art: Jon Rogers

(Continued from page 9)

als and meters) were entirely replaced with glass-cockpit technology. Try to tell them apart now!

Communications

This is a technology that really tends to hide behind the flashier and more obvious equipment but is so critical that it should never be taken for granted. Unfortunately, by using it as a device serving the subplot involving HAL and the *Discovery* crew, Kubrick and Clarke committed a serious misstep in predicting the technology of today—er, yesterday. If you recall, the first sign of HAL's neurosis is his false report that the AE-35 unit (the electronic black box responsible for keeping *Discovery's* antennae suite pointed at Earth) is going to fail. Mission Commander Dave Bowman must take a spacewalk to haul it inside after replacing it with a substitute. After finding nothing wrong with it, the crew (acting on the ominous suggestion of the erroneous HAL computer) decides to put the original unit back.

Here's the problem: a system as critical as the communications pointing system would not have a single-point failure, especially in a manned spacecraft flying all the way to Jupiter! In fact, a shuttle launch was scrubbed because one of *two* communications black boxes was not working properly. The shuttle was designed with fail-operational fail-safe redundancy. In other words, if a critical unit fails, the shuttle can still support mission operations. If a second, similar unit fails, the shuttle can get home safely. Realistically, such a failure in a sophisticated Jupiter-bound manned spacecraft would call for simple rerouting of the commands through a backup unit, with at least one more unit waiting in reserve beyond that. This wouldn't be a very dramatic turn, but such a sequence would better parallel the occasional shuttle and ISS systems failures that have thus far been irritating but not showstoppers. (*Of course, not too long ago* Mir *lost all attitude control when its* one *computer failed, so perhaps the premise isn't* too *farfetched...*) Once again, though, this technical ‘gaffe’ was dictated by the cinematic narrative. Is it not interesting, however, that our premier unmanned *Jupiter* probe, *Galileo*, suffered a crippling failure of its primary communications antenna?

On the spinning space station, Dr. Floyd makes an AT&T videophone call to his daughter. Today's space station inhabitants do, in fact, converse with their families over a video link, but we are reasonably certain that their calls don't cost $1.70 and get charged to their calling cards.

Spacesuits & EVA

2001 presented spacesuits (especially those on the Jupiter mission) that were sophisticated, logical in design, quite impressive in capability, and perfectly believable for an advanced space program.

The single component of the *2001* suits worn by Dave Bowman and Frank Poole most analogous to the EMUs today is the built-in jet maneuvering pack. Small, unobtrusive, minimal—that pretty much sums up the SAFER unit developed for station EVA. The *2001* suit does reflect the modularity concept of the shuttle-era suit as well: helmet

(Continued on page 11)

(Continued from page 10)

and gloves attach to the main suit with ring seals, but Ordway and Lange did not anticipate the move towards "hard shell" design (the American suit's rigid torso, the Russian back-door-entry *Orlan*) . The cinematic suits appear much more akin to the old Mercury and Gemini configurations, or even the recent advanced design of Dr. Dava Newman at MIT. (3)

While not a matter of technical prognostication, we can't help but mention that the EVAs shown in *2001* remain the most realistic fictional depiction of spacewalking ever put on film. The fluidity of motion and the free-floating grace of the crewmembers as they move completely in line with real physical laws is nearly identical to what you see downlinked on NASA TV. Not impressed? Compare Bowman's approach and arrival at the *Discovery's* antenna in *2001* to the *2010* depiction of Max and Curnow's reality-defying kinematics during their transit from the *Leonov* to the *Discovery*. How'd Kubrick pull it off? Skilled stuntmen suspended from cables *filmed from below*—that was the key. Filming at high speed and then slowing the footage for incorporation in the film also helped.

One EVA item in *2001* that today's engineers and astronauts would love to have but don't is the space pod: that ball of a spacecraft with the pair of multi-jointed arms out front. Such a vehicle would eliminate the need for some suited EVAs (the crewmember could just stay inside the pod) and would make others much easier (since the pod, under the control of the ship's highly intelligent computer, could help out). But if you think about it, we're really not too far off with the shuttle and ISS remote manipulator systems (the Canadarms). These now (especially with the recent addition of DEXTRE with its two multi-jointed arms) permit the accomplishment of some tasks outside the spacecraft without EVA, and they have proven themselves capable EVA assistants under the control of a highly intelligent computer—namely, a crew member back inside the spacecraft cabin!

The most glaring difference in EVA, however, lies in protocol. During the EVAs in *2001*, a single crewmember conducts the EVA. This is just not done today. Both Americans and Russians always leave their spacecraft in pairs (and in rare circumstances, as a trio) for safety's sake—if one crewmember gets in trouble the other can come immediately to their aid. However, practically speaking, both crew members did have a companion: HAL the computer, controlling the space pod. But, of course, the solo EVA, the single-point communications failure necessitating the EVA, and HAL's control of the space pod, collectively set up the greatest drama in the film: HAL trying to kill off all his crewmates.

Artificial Intelligence

Given the many different levels at which the space program (and society as a whole) use computers today, it is within this niche that the film's accuracy is most difficult to gauge.

Certainly, we have computers that can talk, and shuttle and station crews are currently experimenting with voice-activated controls of some systems, but these are superficial similarities. More importantly, we find a better comparison in the command and control realm: during large portions of a shuttle's mission the fail-operational, fail-operational, fail-safe (FO-FO-FS) primary & backup computer suite of five GPC computers *do* control the vehicle just as HAL could completely control *Discovery*. (In fact, as a particularly curious side note, the programming language for the shuttle's primary computers is actually termed *HAL/S*, for *H*igher *A*ssembler *L*anguage/*S*huttle, but this just might be a not-so-subtle homage to the film by the software development team.) However, *2001*, just like most visions of the future from the sixties, missed the PC revolution.

The film was created at a point in history when the computer's invasion of our society (including spaceflight) might have taken one of *two* paths: bigger and more powerful mainframe computers that would interface everywhere through an extensive but centrally controlled communications network, OR smaller and smaller special-purpose computers that each would do a little bit of the work. HAL certainly represents the pinnacle of achievement for the former—an artificial intelligence that could control every single aspect of the *Discovery's* operations. The distributed PC network controlling the ISS today reflects the latter.

Yet the depiction of the HAL 9000 (*H*euristically pro-

(Continued on page 12)

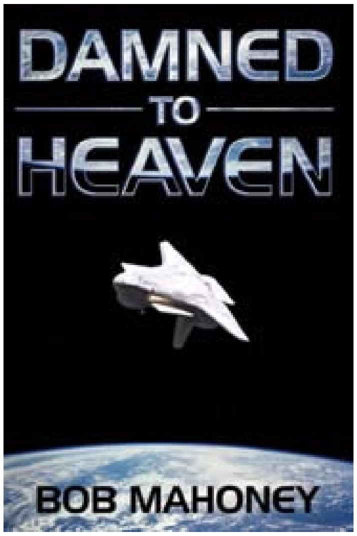
Feature Article

Continued from prior page

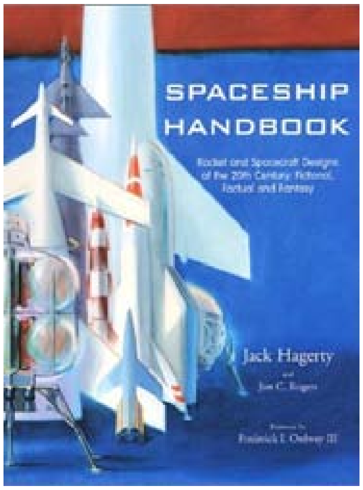
morning darkness on a Galveston beach.

His dedication earned him a Silver Snoopy Award, the NASA Public Service Medal, the NASA Space Flight Awareness Award, numerous group achievement awards, and the honor of sharing in the hanging of the STS 75 mission plaque in Mission Control.

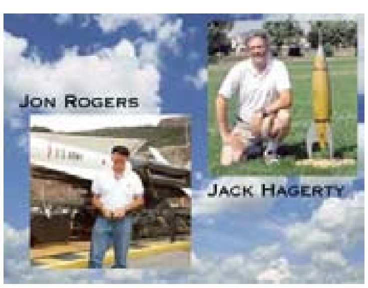
Bob is married and has four children. His interests include vertebrate paleontology and the history of technology. He gave up his career teaching astronauts to pursue something more challenging: stay-at-home dad and full-time writer. Damned to Heaven is his first novel.



Feature Article



Mr. Jon C. Rogers, I.S.E., CmfgE, is currently a private consultant (RogerService!). Mr. Rogers, an A.I.A.A. member for over 20 years, started as QA inspector on Apollo Hi-Gain antenna system, built microcircuits for the Space Shuttles, and was Sr. Mfg. Engineer on the GOES, INTELSAT-V, SCS1-4 Satellites. Mr. Rogers has written articles, co-authored/illustrated the Spaceship Handbook, and presented to the A.A.S. national convention, on the early history of spaceships. Mr. Rogers, a Tau Beta Pi, received his degree from SJSU in 2000.



(Continued from page 11)

grammed *Al*gorithmic Computer) in *2001* remains one of the film's eeriest elements. For their description of artificial intelligence, Kubrick and Clarke only had the terminology and of the mid-1960's. At that time the prevailing concept expected 'AI' to be a *programmed computer.* Thus the term 'computer', with all its implications of it being a machine, occurs repeatedly.

In the last 40 years no *true* AI has emerged. Today's corresponding term would be 'strong AI' (11); their use of mid-1960's terminology obscures the fact that Kubrick and Clarke constructed an AI that is unmistakably 'strong', that is, capable of "general intelligent action." How this would have been achieved Kubrick and Clarke left as an extrapolation.

Since HAL seems to be a 'strong AI', capable of feeling, independent thought, emotions, and almost all attributes of human intelligence, anyone viewing the film today should forget the film's and novel's use of the terms 'computer' and 'programming'. HAL seems able to reason, use strategy, solve puzzles, make judgments under uncertainty, represent knowledge including common-sense knowledge, plan, learn, communicate in natural language, perceive and especially see, have social intelligence, be able to move and manipulate objects (robotics), and integrate all these skills toward common goals. These attributes are possible not through programming as much as through 'evolving' or 'growing' a 'solid-state intelligence'. That is why it is amazing to watch the film today (despite its use of clunky, ill-suited words like computer and program) and realize that HAL was a TRUE AI. HAL likely *will* exist in a universe which we have yet to realize, but one has no idea when! (4)

Reverse Engineering

From the moment we meet HAL the impression is given that this special Artificial Intelligence has total control of everything in the *Discovery*. He can take action—open pod doors, open pod bay doors, even adjust couch cushions!—at a crewmember's spoken word. Yet after HAL kills Frank Poole and the hibernating crewmembers followed by Dave Bowman's return to the *Discovery*, what do we see? A *manual, emergency* airlock/entrance.

What is *that* doing there? Directly, to provide the film with an "action scene", but the implications are deeper. Ordway/Lange (and the mythical designers) of the *Discovery* knew their spaceships! A ship that substantial on an important mission must have redundancy; if not in the communications system, then at least to back up the onboard AI! What if HAL had been 'holed' by a very freak meteor hit? What if an ultra-high-energy cosmic ray bored a damaging track through one of HAL's solid state modules? Any of a number of possible unpredictable second and third-order failures might occur, so the crew might be forced to take care of the ship and mission "on their own."

And it is here, in the consideration of backup systems, where we catch Kubrick and Clarke, the storytellers, at odds with Kubrick and Clarke, the prognosticators of realistic spacecraft design. We find Bowman and Poole discussing how to partially shut HAL down by leaving only primitive functions operating. That could only be an option if the human crew could control the *Discovery* manually (or rather, more practically, semi-manually) with a lot of help from still-working automated systems. Thus there would have been backup systems, making the issue of disabling HAL another hint at HAL's lack of absolute control.

In fact Kubrick mildly trumps Clarke technically and dramatically in the film's narrative structure (wherein Bowman leaves the ship to rescue Poole, setting up the emergency airlock action scene). In the novel Clarke merely has HAL "blow down" the *Discovery* by opening the pod bay doors. However, examining Lange and Ordway's drawings of the *Discovery's* living quarters reveals at least two airlocks between the pod bay and the centrifuge (7, 8, and 9). Independent double and triple overrides (over which HAL would have had no control) would have come into play to prevent this very scenario from happening, whether mechanically or insane-AI-instigated.

How about HAL's control of Dave's pod? Actually one can capture a screen feature in the pod ('N/A HAL COMLK') that shows that Bowman, even though he left his helmet behind, had the sense to cut HAL's control of the pod. It is impressive but not surprising that Kubrick and his team

(Continued on page 13)

(Continued from page 12)

thought to include such a detail.

When Comes the Future?

While Kubrick and Clarke's iconic 1968 vision of spaceflight's future may have been far off the mark in terms of how much we would have accomplished by the turn of the millennium, its accurate anticipation of so many operational and technological details remains a fitting testament to the engineering talent of their supporting players, especially Fred Ordway and Harry Lange. The astounding prescience in their projections of the specifics of space operations *decades* beyond the then-current real spaceflight of *Gemini* and *Apollo*, even when constrained by storytelling aesthetics, offers the promise that their spectacular rendering of a space faring society may still come to pass.

With the United States and other nations now finally developing systems to return human crews to the Moon and enable travel beyond, and with commercial entities actively pursuing private spaceflight across a spectrum of opportunities long considered a matter of fantasy, perhaps we can take heart in the possibility that by the time another forty years have passed, Kubrick and Clarke's brilliant, expansive, and yet convincingly authentic future may finally become real in both its details and its scope.

Selected Bibliography

1. *2001: A Space Odyssey*, by Arthur C. Clarke, based on a screenplay by Stanley Kubrick and Arthur C. Clarke. Copyright 1968. The New American Library, Inc.
2. *The Making of Kubrick's* 2001, edited by Jerome Agel. Copyright 1970 The Agel Publishing Company, Inc. The New American Library, Inc.
3. 2001*: filming the future*, by Piers Bizony. Copyright 1994. Aurum Press Limited.
4. *The Lost Worlds of* 2001, by Arthur C. Clarke. Copyright 1972. The New American Library, Inc.
5. *The Odyssey File*, by Arthur C. Clarke and Peter Hyams. Copyright 1984. Ballantine Books.
6. 2001: A Space Odyssey, F.I. Ordway, *Spaceflight*, Vol. 12, No. 3, Mar. 1970, pp. 110-117. (Publisher: The British Interplanetary Society).
7. Part B: 2001: A SPACE ODYSSEY IN RETROSPECT, Frederick I Ordway, III Volume 5, And American Astronautical Society History Series SCIENCE FICTION AND SPACE FUTURES: PAST AND PRESENT, F.I. Ordway, Edited by Eugene M. Emme, 1982, pages 47 - 105. (ISBN 0-87703-173-8).
8. Jack Hagerty and Jon C. Rogers, Spaceship Handbook: Rocket and Spacecraft Designs of the 20th Century, ARA Press, Published 2001, pages 322-351, ISBN 097076040X.
9. Dieter Jacob, G Sachs, Siegfried Wagner, Basic Research and Technologies for Two-Stage-to-Orbit Vehicles: Final Report of the Collaborative Research Centres 253, 255 and 259 (Sonderforschungsberiche der Deutschen Forschung) Publisher: Wiley-VCH (August 19, 2005).
10. Realizing 2001: A Space Odyssey: Piloted Spherical Torus Nuclear Fusion Propulsion NASA/TM-2005-213559 March 2005 AIAA-2001-3805.
11. Searle, J. (1997). *The Mystery of Consciousness*. New York, New York Review Press.
12. The film 2001: A Space Odyssey, premiere date April 6 1968.

Notes

1. Thanks to Ian Walsh, personal communication, for suggesting this.
2. Thanks to Wes Kelly of Triton Systems for TSTO discussions.
3. In the mid 1960's many of the SETI pioneers were afraid that revelation of the existence of an ad-

(Continued on page 14)

An image captured from the screen from 2001: A Space Odyssey. "N/A HAL COMLK"

Feature Article

(Continued from page 13)

vanced extraterrestrial civilization might cause a social disruption; many others disagreed with this. Kubrick and Clarke decided to keep this as a plot device.

4. One aspect of the suit design included for dramatic purposes was a somewhat vulnerable oxygen supply tube from the backpack EMS unit to the suit helmet (we see Frank Poole fighting to reattach his). Even in 1965 *Apollo* space suits had much more secure fittings.

5. A technical point about the emergency entry into the *Discovery*: where did the pod hatch go? One notes that the pod doors slide 'transversely', i.e., they don't swing in or out. In the airlock entrance scene Dave launches himself from 'frame right'; normally the pod door slides open toward frame right (we're seeing the rear of the pod in the scene). Thus the door's guide track ran on both sides of the pod's hatchway. Thus the normal open/close mechanism wouldn't have to be retracted out of the way in an emergency. The pyros would be on the attach points where the door joins the mechanism, and in an emergency they'd blow the door further around the track, i.e., 'frame left', out of the way, while the regular mechanism stays put. (Thanks to Jack Hagerty for this observation.)

6. The novel *2010* explains HAL's 'insanity' in terms of his keeping the discovery of the TMA-1 monolith a secret for reasons of national security. (2) (Whatever that means.) This contradiction against his programming to never report erroneous information created a "Hofstadter-Moebius loop," which reduced HAL to paranoia. Since nothing so explicit is presented in the original film, and taking the characterization of HAL as a strong AI (for all intents and purposes making him 'human'), HAL could have just a well gone bonkers for no good reason at all!

7. "Probably no one would ever know this: it did not matter. In the 1980's Minsky and Good had shown how neural networks could be generated automatically -- self-replicated-- in accordance with an arbitrary learning program. Artificial brains could be *grown** by a process strikingly analogous to the development of the human brain. In any given case, the precise details would <u>never</u> be known, and even if they were, they would be millions of times too complex for human understanding."
A. C. Clarke (2001: A Space Odyssey, ROC edition, trade paper back, 2005, pages 92 - 93).

* This is a remarkable description of thoughts about AI, known in the 1960's, and more elaborated upon in the present, that AI's may be created by some kind of analog of biological evolution.

International Space Activities Committee (ISAC)

www.aiaa-houston.org/tc/isac

Like most people, AIAA Houston Section's ISAC is inspired by the international activity on ISS in the past few months. At right (photo: NASA), STS-123 Endeavour (ESA's Mr. Eyharts' ride home) approaches ISS for docking, similar to a scene in the 1968 movie, 2001: A Space Odyssey. This space shuttle was carrying Kibo, a Japanese module, and DEXTRE, a Canadian robot.

Photo: NASA

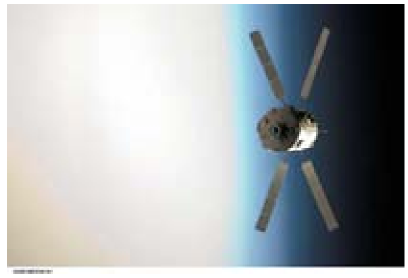
Continued on next page

International Space Activities Committee (ISAC)

(Continued from page 14)

It's a busy time for continuing international activity on ISS. Here we allow the pictures to do the talking.

Right: The historic docking of ESA's first Automated Transfer Vehicle, Jules Verne, took place 3 days after this on April 3, 2008

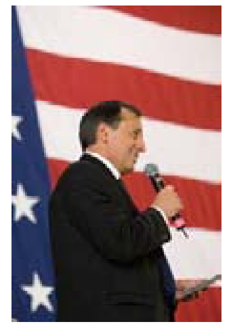


Below: ISS from STS-123: ESA's Columbus at right and Japan's Kibo laboratory to its left nearest the viewer

STS-123 ceremony at Ellington Field:

Left: Bill Mackey, Candian Space Agency in Houston

Right: Michel Tognini from the European Astronaut Center, Cologne, Germany



Below: ISS from STS-123's departure

Right: Expedition 16 Eyharts (ESA), Whitson (USA), and Malenchenko (Russia).

Below: STS-123 crew at Ellington Field in Houston. (Photo: Yazell, all other photos: NASA). Japan's Takao Doi: 3rd from right. ESA's Leopold Eyharts: far right

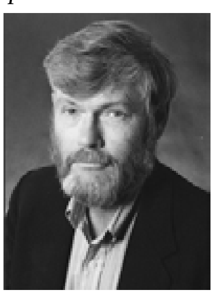
Left: DEXTRE, the SPDM, the new Canadian robot on ISS.

Right: STS-123 ceremony at Ellington Field: Japan Aerospace Exploration Agency (JAXA) Vice President Kaoru Mamiya

Cover Story Arthur C. Clarke

Gregory Benford -- physicist, educator, author -- was born in Mobile, Alabama, on January 30, 1941. In 1963, he received a B.S. from the University of Oklahoma, and then attended the University of California, San Diego, where he received his Ph.D. in 1967. He spent the next four years at Lawrence (Calif.) Radiation Laboratory as both a postdoctoral fellow and research physicist.

Benford is a professor of physics at the University of California, Irvine, where he has been a faculty member since 1971. Benford conducts research in plasma turbulence theory and experiment, and in astrophysics. He has published well over a hundred papers in fields of physics from condensed matter, particle physics, plasmas and mathematical physics, and several in biological conservation.



He is a Woodrow Wilson Fellow and a Visiting Fellow at Cambridge University, and has served as an advisor to the Department of Energy, NASA and the White House Council on Space Policy. In 1995 he received the Lord Foundation Award for contributions to science and the public comprehension of it.

In 1989 Benford was host and scriptwriter for the television

A Prophet Vindicated

GREGORY BENFORD

IN 1957 I was sitting on the chilly deck of the America, when news of the Sputnik launch arrived: a lone paragraph in the ship's newspaper. I ground my teeth, wanting more information, and thought, "I'll bet Arthur is beside himself."

He was. Arthur had no reason to believe his meticulously sketched dreams of space flight would occur in his lifetime. So he became the luckiest of prophets, a vindicated sage in his own time. While clearly the most famous and international of all science fiction writers, he is not a unique type. He stands in the tradition of English futurists who have used fiction or nonfiction to spread their visions--H.G. Wells, J.D. Bernal, Olaf Stapledon, Freeman Dyson. They were convinced that only in scientific areas is reliable prediction possible; as Clarke says"there are some general laws governing scientific extrapolation, as there are not (pace Marx) in the case of politics and economics."

Of course his fiction influenced me as much as his nonfiction. In *Profiles of the Future* (1962), an elegantly phrased "inquiry into the limits of the possible", he used his fictional side, exploring what might be achieved within the bounds of scientific law. Books on futurology date notoriously, yet this one has not, principally because Clarke was unafraid of being adventurous.

Decades later he read a review of a Russian book about the 21st century that found the work extremely reasonable and the extrapolations quite convincing. Remarks Clarke, "I hope this charge will not be leveled against me. If this book seems completely reasonable and all my extrapolations convincing, I shall not have succeeded in looking very far ahead; for the one fact about the Future of which we can be certain is that it will be utterly fantastic."

Clarke's cool, analytical tone pervades all his writing, fiction or not. He prefers a pure, dispassionate statement of facts and relationships, yet the result is not cold. Instead, he achieves a rendering of the scientific esthetic, with its respect for the universal qualities of intelligence, its tenacity and curiosity. His fiction has few villains since it neglects conflict and the broad spectrum of emotion. For me, this gives it a refreshing honesty, contrasting with the jarring, superheated prose of much fiction. Even the virtual absence of sex in his novels is not greatly limiting--writing about sex is easier to do than the strange landscapes of sf, and for Clarke's purposes, pointless.

Indeed, his vision carries precisely because he remains almost obliviously above the fray: "Politics and economics are concerned with power and wealth, neither of which should be the primary, still less the exclusive, concern of full-grown men."

Indeed, Clarke's wry wit often skewers the short- sightedness of such men. In discussing the space program, he quotes one of the early explorers of Australia "reporting proudly to his mission control, back in Whitehall, 'I have now mapped this continent so thoroughly that no one need ever go there again.' " There are echoes of this blinkered pioneer in NASA now.

Arthur firmly believes that “exact knowledge is the friend, not the enemy, of imagination and fantasy." His suggestion that satellites could serve as economical radio relays appeared in Jet Propulsion magazine, so named because "even the word 'rocket' was avoided as too Buck Rogerish; only 'jet propulsion' was respectable." Though he says "I suspect that my early disclosure may have advanced the cause of space communications by about fifteen minutes," in fact his ceaseless promotion of it did alert many to the implications.

He was no less right about even larger issues. His 1946 essay, "The Rocket and the Future of Warfare" anticipated the essentials of ICBM nuclear war, and called for measures to avoid it. Though many were concerned with "atom war" then--the United States made its proposal of international regulation of nuclear weapons to the U.S.S.R. and was turned down--few saw the fateful mating of the bomb and the rocket. Notably, most of those who did were science fiction

(Continued on page 17)

A Prophet Vindicated

GREGORY BENFORD

Cover Story Arthur C. Clarke

(Continued from prior page)

writers, who had long believed that rockets were the next big step in aeronautics.

He has made a firm case for the importance of speculation in science. "If there had been government research establishments in the Stone Age, we would have had absolutely superb flint tools. But no one would have invented steel."

He sees imaginative, science-based thinking as crucial to our future. The debate about information control, from Orwell on, "will soon be settled--by engineers, not politicians. (Just as physicists, not generals, have determined the nature of war.)" Clarke belongs to the unacknowledged legislators of our future, the visionaries. As he observed, "Politicians should read science fiction, not westerns and detective stories."

His life focused on the grandest perspectives. Stapledon, whom Clarke idolized, dragged the conflicts of his era into far-future visions, attributing Marxist--indeed, Stalinist--dynamics to even alien, insectoid races. This riddles some of Stapledon's work with anachronisms. I doubt Clarke's will face this fate.

Against the anti-technological bias of our recent times, he remains impressed with the enormous possibilities science holds out to us. In the end, "whatever other perils humanity may face in the future that lies ahead, boredom is not among them." Indeed, *"It may be that the old astrologers had the truth exactly reversed, when they believed that the stars controlled the destinies of men. The time may come when men control the destinies of stars."*

When Elisabeth and I visited him this last spring, he was cogent and engaged with the world. Arthur took us to the Swimming Club for lunch, a sunny ocean club left over from the Raj. Security was everywhere. The civil war between the Sinhalese government and the fascist Tamil Tigers has now run 23 years, killing hundreds of thousands.

A heavy machine gun on a nearby tower peered over us as we swam in the pool. It felt somehow right to watch the Indian Ocean curl in, breaking on the rocks, and speak of space: the last, greatest ocean. Arthur mused, "All this effort, all this death, when we could be building the staging area for a seaborne space elevator."

series A Galactic Odyssey, which described modern physics and astronomy from the perspective of the evolution of the galaxy. The eight-part series was produced for an international audience by Japan National Broadcasting.

Benford is the author of over twenty novels, including Jupiter Project, Artifact, Against Infinity, Eater, and Timescape. A two-time winner of the Nebula Award, Benford has also won the John W. Campbell Award, the Australian Ditmar Award, the 1995 Lord Foundation Award for achievement in the sciences, and the 1990 United Nations Medal in Literature.

Many of his best known novels are part of a six-novel sequence beginning in the near future with In the Ocean of Night, and continuing on with Across the Sea of Suns. The series then leaps to the far future, at the center of our galaxy, where a desperate human drama unfolds, beginning with Great Sky River, and proceeding through Tides of Light, Furious Gulf, and concluding with Sailing Bright Eternity. At the series' end the links to the earlier novels emerge, revealing a single unfolding tapestry against an immense background.

His television credits, in addition to the series A Galactic Odyssey, include Japan 2000. He has served as scientific consultant to the NHK Network and for Star Trek: The Next Generation.

Want to know more? Read An Introduction to Gregory Benford by Peter Nicholls.

Related Links

COMPILED BY THE EDITOR AND DR. ALBERT A. JACKSON

Arthur C. Clarke: 1917 - 2008

From the New York Times:
http://www.nytimes.com/2008/03/19/books/19clarke.html

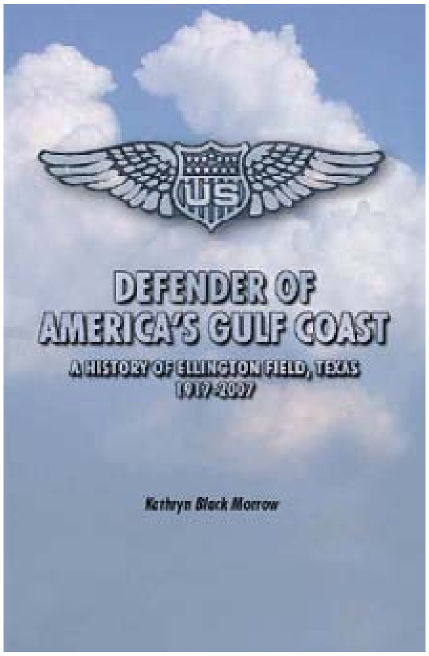
From Wikipedia:
http://en.wikipedia.org/wiki/Arthur_C._Clarke

From the British Broadcasting Company:
http://news.bbc.co.uk/2/hi/uk_news/2358011.stm

The Arthur C. Clarke Foundation:
http://www.clarkefoundation.org/

Photo: Wikipedia

Book Review



Morrow House Publishing

We appreciate this new 2007 book , Defender of America's Gulf Coast, A History of Ellington Field, Texas, 1917-2000, by Kathryn Black Morrow, whom you may contact at kathryn-MorrowResearch@att.net. Ellington Field has a rich history in Houston and with NASA/JSC.

Its seven chapters are (1) Ellington Field 1917 to WWII, (2) World War II, 1941 to 1945, Ellington Field Reopens, (3) Black Soldiers at Ellington Field: Desegregation in the Military, (4) Women at Ellington Field, (5) Ellington Air Force Base, 1947-1976, (6) The Space Program Comes to Ellington, and (7) Ellington in the 21st Century.

Short biographies are included for Lt. Eric Lamar Ellington (1889-1913), Colonel Ira Rader (1887-1958), Lt. Granville Gutterson (1897-1918), Colonel Walter H. Reid (1890-1958), the author's father Colonel Kermit Kellogg Black (1907-1983), and our country's current president, George W. Bush (born in 1946), who served at Ellington Field as an F-102 pilot with the Texas Air National Guard from 1968 to 1973 in the 147th Fighter Interceptor Group.

There are quite a few excellent photographs in this 172-page book.

Appendix One lists the personnel from the first graduating class roster of the Women's Flight Training Detachment (WFTD) Class 43-1. Appendix Two lists personnel for members of the 788t Women's Army Corps (WAC) at Ellington Field, 1943, including a Captain Louise E. Bain, Commanding Officer. Appendix Three lists personnel for the 79th Aviation Squadron. More information, including photographs of all of these men and enlistment records for some, can be obtained by contacting the author.

More information can be found at KathrynMorrowResearch.com.

From all of us who flew in and out of Ellington Field and attended memorable events there (see page 33), thank you for this book.

Review: Douglas Yazell, editor@aiaa-houston.org

"Jamar asked a question about the rovers: 'How long do you think will they last?' Well of course, I don't know. But I think that they'll last for at least another Martian year which is almost two Earth years from now. We just have to take it a Martian year at a time, since the dust storms come once every Martian year, and the following Southern Winters do as well. Either a heavy dust storm season or a hard Winter could be the last straw for one or both of the rovers."

Mark Adler, our March 10, 2008 speaker on the Mars Rovers, answering to Satori School in Galveston

Staying Informed

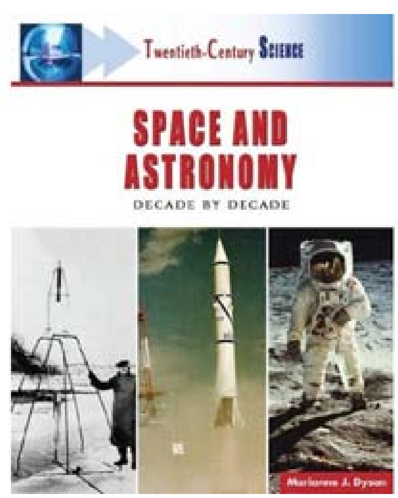
COMPILED BY THE EDITOR

Web links from the book Space and Astronomy: Decade by Decade by Marianne Dyson

For book purchases, readers may use this e-mail address: mjdyson@swbell.net

http://www2.jpl.nasa.gov/snc
Mars meteorites:
These rare meteorites created a stir throughout the world when NASA announced in August of 1996 that evidence of microfossils may be present in one of these Mars meteorites.

http://exoplanets.org
An almanac of extrasolar planets: University of California



http://www.nasa.gov/centers/goddard/about/dr_goddard.html
NASA Goddard Spaceflight Center: a good overview on the career of this rocket pioneer.

http://history.msfc.nasa.gov/vonbraun/
Marshall Space Flight Center, Werner von Braun

http://www.nasm.si.edu/research/dsh/TRANSCPT/GILRUTH1.HTM
Oral histories with NASA pioneers, this one with Robert Gilruth

http://www.lpi.usra.edu/expmoon/
Lunar and Planetary Institute, all lunar programs, including future missions

http://www.state.gov/t/ac/trt/5181.htm
Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies

2008-2009 "Spirit of Apollo" College Scholarship Annoucement

Scholarship

DOUG SCHWAAB, SCHOLARSHIP CHAIR

The Houston Section is once again accepting applications for the "Spirit of Apollo" Scholarship of $1000 for the 2008-2009 academic year. The "Spirit of Apollo" Scholarship honors the historic and unprecedented accomplishments of the Apollo Space Program by encouraging outstanding students at Texas Colleges to continue their studies in engineering, math or science. Qualified students must have completed their freshman academic year with a GPA of at least 3.0 on a 4.0 scale. The qualified applicants must provide an essay, three letters of recommendation, college transcripts, along with a description of extracurricular activities and work experience.

Last year there were several very competitive students from various Texas Colleges that applied for our Spirit of Apollo Scholarship. Please encourage the deserving college students -- especially AIAA student chapter members -- that you know to apply for the 2008-2009 academic year scholarship award! The deadline for application packages is June 1st, 2008. Additional details and the application form for our annual scholarship can be found on the AIAA Houston Section webpage (http://www.aiaa-houston.org/scholarship/).

ATS 2008

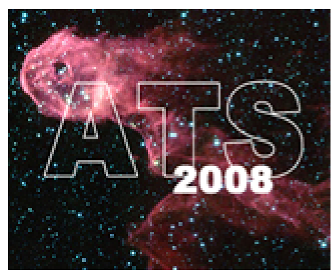
GENERAL CHAIR SEAN CARTER

Upcoming Event

Annual Technical Symposium (ATS 2008)

Friday May 9, 2008

Gilruth Center



Keynote Speakers:
Wayne Hale, NASA/JSC
Clinton Dorris, ALTAIR lunar lander program office

07:45 - Registration $10.00(Open All Day)
08:15 - Keynote speaker Wayne Hale/NASA-JSC
09:00 - Morning Sessions
12:00 - Lunch
12:45 - Luncheon Keynote Speech: ALTAIR
13:30 - Afternoon Sessions
16:30 - End of Symposium
Registration All Day at The Gilruth Center
$5 Registration for Presenters.
$10 Registration for Attendees.
Free Continental Breakfast, Compliments from our sponsors, provided in the Alamo Ballroom during registration.
Reserve online in advance or pay at the Door(Cash or Check).
Reservations in advance include a lunch buffet. Register online: www.aiaa-houston.org .
Buffet includes vegetarian option.
Advance registration is requested

AIAA membership and JSC badging not required.
No Gilruth badging is required - ATS is open to public.
No paper required
All are encouraged to attend or present, including univesity professors, NASA/JSC personnel, and NASA/JSC contractors

Lunch-and-Learn Summary March 10, 2008

Mars Rovers: Spirit & Opportunity, Dr. Mark Adler

DOUGLAS YAZELL, CHAIR

AIAA Distinguished Lecturer Dr. Mark Adler of the Jet Propulsion Laboratory contacted our section once he learned he was coming to Houston for a conference.

Nina Corley brought her elementary school class of 10 children from Satori School in Galveston, making our total attendance grow to 50 people.

Dr. Adler earned his Ph. D. in Physics from the California Institute of Technology in 1990. He is currently the Chief Mission Concept Architect and Manager for Concept Development at JPL. He is responsible for the conception, design, engineering, and cost and schedule estimation for proposed new science missions and space science instruments across JPL.

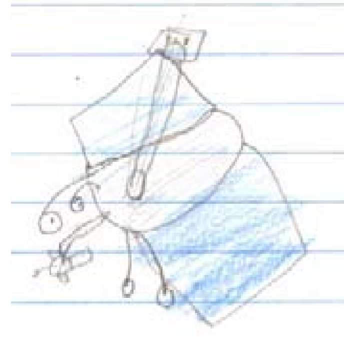
Mark Adler conceived the mission and led the proposal team for the Mars Exploration Rovers. He was responsible for the mission system of the Mars Exploration Rover Project and the operations of the Spirit rover en route to Mars through the ongoing surface mission.

Mars Exploration Rover is a NASA Space Science project which launched two scientific exploration rovers to two different sites on Mars in mid-2003, with both landing successfully in early 2004. After landing, each rover carried out a 3-month mission to explore its site and, through detailed morphological and mineralogical investigations, provide an understanding of the ancient history of each site. The rovers are continuing to explore in their extended mission, going well past their intended 90-day life spans.

The rovers offer unique contributions in pursuit of the overall Mars science strategy to "Follow the Water." Understanding the history of water on Mars is important to meeting the four science goals of NASA's long-term Mars Exploration Program:

- Determine whether Life ever arose on Mars
- Characterize the Climate of Mars
- Characterize the Geology of Mars
- Prepare for Human Exploration

Rachel from Satori School illustrates a well-packaged rover landing on Mars



Art: NASA and Rachel from Satori School

Right: from 2008: false color: Spirit's West Valley: NASA

Art by Kai from Satori School: rover Rock Abrasion Tool (RAT)

Below: Dr. Mark Adler

John Frassanito & Associates: Space Architecture

DOUGLAS YAZELL, CHAIR

Dinner Meeting Summary March 11, 2008

While the Lunar Planetary Science Conference and a space shuttle mission kept some of our potential audience busy elsewhere, an enthusiastic crowd of 25 people welcomed Mr. John Frassanito as our dinner speaker at the NASA/JSC Gilruth Center on March 11, 2008. John Frassanito trained as an industrial designer at Art Center College of Design in Los Angeles and worked as part of the renowned Raymond Loewy design team on the interior concepts for Skylab. He later began his own design firm, John Frassanito & Associates (JF&A), which has designed products for companies such as Scott Paper, Texaco, Sani-Fresh, Daniel Industries, General Foods, and EMI Corporation.

Since 1985, he has been working as a strategic planning, mission, and spacecraft design consultant to NASA engineering, scientific, and planning teams for the agency's future space missions. He was a key contributor to the architecture of the International Space Station and the Vision for Space Exploration and currently consults to NASA's Lunar and Mars Exploration and other programs. His work has been featured in major space exploration exhibits, various publications, and broadcast television.

Strategic Visualization ® is a proprietary process that works at the heart of the creative process using an arsenal of visual tools to solve problems, chart a company's future, conceptualize new products or business and supercharge engineering endeavors. It integrates computer visualization and strategic planning to address long-range issues in both the government and industry. It's the new medium of support for achieving management's goals.

Once a team has developed a sound mission design, STRATEGIC VISUALIZATION ® is used to communicate that concept to the general public. This is a vital step that Dr. Wernher von Braun used to enhance public support for space exploration. When Collier's (Magazine) presented the American public with a bold and feasible vision of excursions to Moon and other planets. Today, STRATEGIC VISUALIZATION® is used extensively both in the mission design process within the technical community, and to communicate the value of space exploration to the general public. Movies and digital images have been generated and shown on nationally broadcast television and the Internet, as well as in magazines and digital media."

Since the '04 exploration plan announcement, John Frassanito & Associates, Inc. has continued to support the Exploration Systems Mission Directorate (ESMD) at a number of levels including the Administrator's rollout of the Exploration Systems Architecture (ESAS), the Lunar Reconnaissance Orbiter, the CEV/ Constellation program, and other program elements. The firm archives and updates a library of current architectures in 3D formats that it provides to its NASA clients as part of its services so, when a new component or mission is under development, the project team has the tools at hand to help do the job.

Mr. Frassanito discussed modeling and simulation ideas for astronaut biomedical monitoring. He showed a few short films created for the NASA customer showing the newest space vehicles planned for space station support and exploration of the Moon and Mars. A copy of the 1998 book Space Architecture was used as a door prize since the subject of the book is Mr. Frassanito's career.

Poster courtesy of NASA and John Frassanito & Associates

Lunch-and-Learn Summary March 12, 2008

Look for the PowerPoint charts at www.aiaa-houston.org/tc/gnc

Sailing the Space Station with Zero-Propellant Maneuver (ZPM) Guidance

GREGORY JOSEPH, MEMBER, GN&C TECHNICAL COMMITTEE

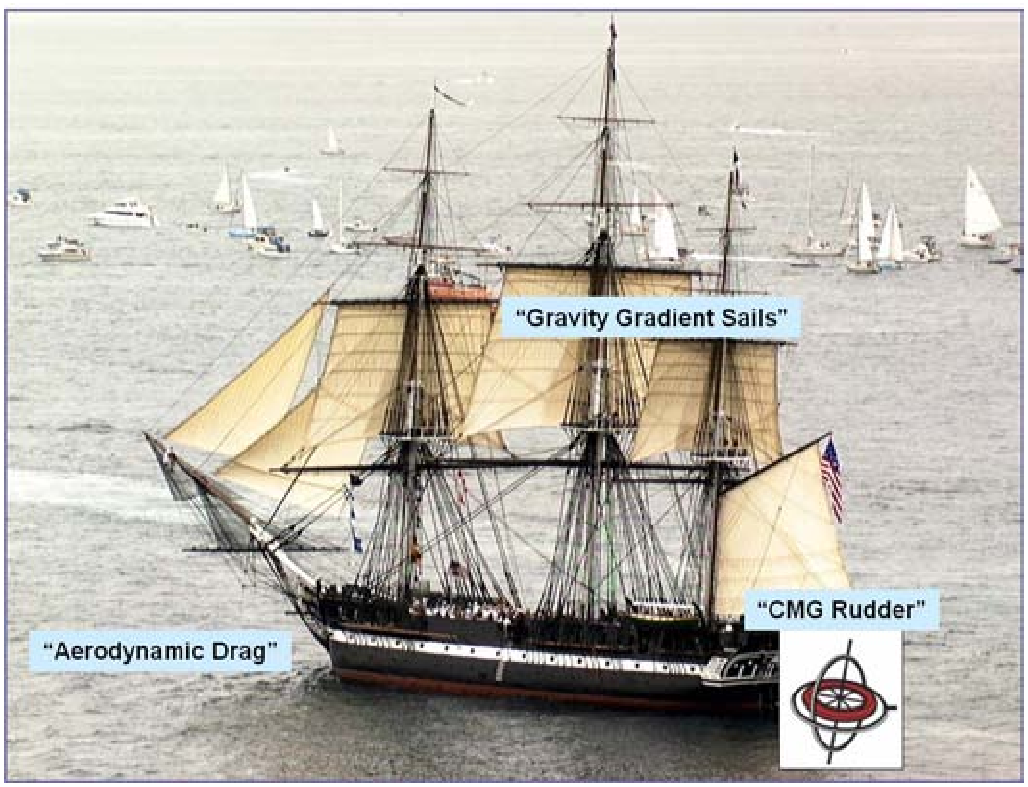
Recently, the Guidance, Navigation, and Control Technical Committee welcomed Nazareth Bedrossian of Draper Labs for a Lunch and Learn. On March 12, 2008, a group of 40 got a chance to learn about the jaw-dropping capability of ZPMs (Zero-Propellant Maneuvers). ZPMs are an extremely new capability for the International Space Station. These manuevers allow the station to alter its attitude using only CMG (Control Momentum Gyros) effectors. Although these maneuvers seem to defy the very laws of physics, Nazareth Bedrossian with help from his Draper Graduate Fellows showed just how possible (and useful) these maneuvers can be. The following is an excerpt from the publicity flyer:

On Nov 5, 2006 and March 3, 2007, the International Space Station was maneuvered 90deg and 180deg nonpropulsively using the new Zero-Propellant Maneuver (ZPM) guidance method. The identical 180deg maneuver performed propulsively on Jan 2, 2007 consumed 110lb of propellant at an estimated cost of $1.1 million. With ZPM, a new class of CMG capability previously thought impossible can now be achieved. ZPM enables non-propulsive large angle maneuvers, attitude control with saturated CMGs, and rate damping. Indeed, when the Russian GN&C computers failed during Shuttle mission STS-117, manual thruster control and ZPM provided the only two options to regain attitude control once the Orbiter undocked. Come and find out why with ZPM guidance, CMGs can never lose attitude control!

Dr. Naz Bedrossian received his Ph.D. in Mechanical Engineering from Massachusetts Institute of Technology in 1991. Since then he has been at JSC working on Shuttle and ISS control systems design and verification. Naz is currently the group leader for manned space systems at The Charles Stark Draper Laboratory, Inc.

Naz's presentation was impressive, but as the "Ginsu" knives salesman would say, "But wait, there's more!" In addition to showing the ZPM 90deg and 180deg attitude maneuver, Naz also showed LoAC recovery, CMG desaturation, and MT relocation methods using only CMG control and ZPM guidance! Although these capabilities require the ability to "look-ahead" and require ground coordination, it is always good to know there are options for ISS attitude control.

Thanks again to Naz and the hardworking Draper Graduate Fellows!



Membership

Lisa Voiles, Membership Chair

Please welcome our newest AIAA Houston Members!

Report for March 1, 2008:
MEMBERS:
Sheikh Ahsan
James Baker
Timothy Budzik
Robert Campbell
Brandon Carringer
Sean Carter, vice chair of our section's technical branch
Ryan Chambers
Robert Curbeam
Pedro Curiel
Brian Dunaway
Cynthia Evans
Nathan Hall
Jeremy Hart
Steven Hawley
Yvonne Jaurigue
Thomas Jones
Donald Kelly
Benjamin Kirk
Ramon Lebron-Velilla
Corey Logan
Chris Madden
Anthony Maloney
Eric Petersen
Elfego Pinon
Gregory Potts
James Royston
Paul Spudis
Benjamin Stahl
Patricia Stratton
Eric Stutz
Michael Wells

STUDENT MEMBERS:
Darkhan Alimzhanov
Dorothy Byford
Ryan Clyburn
Robin Federico
Patrick Harrington
Scott Johnstone
Alex Jonischkies
Connor Kelly
Tomas Lafferriere
Arin Lastufka
Amy Lucas
Alex Monchak
Tetsu Nakamura
Valliyappan Natarajan
Taylor Nault
Thanasis Varnava
Daniel Wesely
Thomas Williams

EDUCATOR ASSOCIATES:
Peggy Eddy
Lollie Garay
Janet Grout
Jim Kirkwood
Marissa Zepeda

Report for April 1, 2008:
MEMBERS:
Koorosh Araghi
Edgar Bering
Raktim Bhattacharya
Frank Bittinger
Sarah Brandt
Gary Brown
Richard Covey
Mark Craig
Bradley Fiebig
Harlan Friedman
Daniel Garcia
Simon Halbur
Radesh Iyengar
Wade Johnson
Vikram Kinra
Jeannie Kranz
Vaselia Patterson
George Radtke
David Ray
Jon Read
Natasha Rowell
Jean-Luc Rusingizandekwe
Benjamin Shoemaker
Jason Tenenbaum
Aaron Trott

STUDENT MEMBERS:
Nikhil Bhatnagar
Daniel Cannon
John Cassidy
Jahaziel Chavira
Jacalyn Cossette
Grimes Daniel
Danielle Fitch
Brady Frazier
Sara Guest
April Hughes
Sanjay Kalidindi
Vanna Keller
Daniel Kidd
Julianne Larson
Jane Nguyen
Roy Palacios
Natalie Pilzner
David Roden
Chandra Veer Singh
Albert Soto
David Taylor
Moriah Thompson
Christine Tipton
Christy Tucker
Brannon Veal
Katherine Westhoff
Michael Yager
Jason York

EDUCATOR ASSOCIATES:
Hope Smalley Jackson
Tracy Spears

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

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 dinner meetings, workshops, etc.). Visit www.aiaa.org (log in, click on My Information, then Edit) to update your member information, or call customer service at 1-800-NEW-AIAA (639-2422), or contact us at membership@aiaa-houston.org.

The membership total from February 1, 2008, was 1192, which was 842 professional members, 266 student members, and 84 educator associates. For March 1, 2008, that was 1156 members (841 members, 231 student members, and 84 educator associates). For April 1, 2008, our total membership is 1150 (839 members, 225 student members, and 86 educator associates).

May 15, 2008, is the deadline for nominating AIAA Fellows. Inputs from the related references (or referees) are due June 15, 2008. We have a few Associate Fellow nominations in work, and the inputs from their references are due May 15, 2008. All of this work can be done online. We typically prepare some documents, then cut and paste into forms at www.aiaa.org.

Space Center Lecture Series March 13, 2008

Inaugural Event

Co-sponsored by AIAA Houston Section

Space Center Lecture Series: Inaugural Event

BEN LONGMIER, PH. D., PROFESSIONAL DEVELOPMENT CHAIR

Gary Kitmacher and Ben Longmier inaugurated something they call the Space Center Lecture Series (SCLS) SpaceCenterLectureSeries.com. Gary and Ben started the lecture series with a presentation by the last person to step out onto the lunar surface, Apollo 17 astronaut Harrison 'Jack' Schmitt. A crowd of about 450 people attended this free event at the Space Center Houston Northrop Grumman IMAX Theater.

Dr. Schmitt was kind enough to sign copies of his book, Return to the Moon. Neither Schmitt nor the lecture series coordinators anticipated the nearly 2 hour line that resulted from the 200 books that were sold and signed.

Dr. Schmitt is currently the last human being to have stepped onto the Moon. As an Apollo 17 astronaut and geologist, he spent three days in December 1972 on the lunar surface, sampling, documenting, and interpreting the Moon's geological features and potential resources. Schmitt was trained at Caltech and at Harvard, where in 1965 he received his Ph.D. in geology. He was first introduced to astrogeology by the late Eugene Shoemaker, and was a Fulbright scholar in Norway in 1957-58. Schmitt has been involved in the space program, space science, and space policy for more than 40 years, including 10 years as an astronaut with NASA, 6 years with as a United States Senator, and more than 20 years as a consultant and businessman, a professor (at the University of Wisconsin), and an advocate for space-based private enterprise.

Dr. Schmitt shared his experience with the Apollo 17 mission, lunar resource utilization, and his thoughts on the future of lunar exploration. The Apollo 17 mission was the last of the great campaigns to the moon and included the longest lunar surface interval of any mission in history.

On his way back to Earth, Dr. Schmitt took a photo showing the most complete disc of the Earth at the time. It is claimed that this photo is the most widely distributed photograph in history. The 'upside down' view here recreates how the Earth appeared to Jack when he captured this photo from the Apollo 17 command module. Typically the Earth is flipped so that the South pole is at the bottom of the photograph.

A few of the volunteers who helped to make this event possible are listed here, including some who will help with the next lecture:

Munir Kundawala
Shirley Brandt
Mike Frostad
Ben Blaser
Molly White
Nathaniel Fisher
Galina Povolotskaya
Tracy Richter
George Parma
Mallory Jennings
Christina Gallegos
Scott Pritchard
Janice Larson
Doug Schwaab
Shannon Maxie
Lara Ogle
Dana Valish
Christina Hibbs
Andrew (AJ) Hartnett
Sian Terry
Ryon Stewart

AIAA Houston Section proudly co-sponsored this event and plans to continue that tradition. Future speakers listed on the Space Center Lecture Series web site include former astronaut Dr. Franklin Chang-Diaz (veteran of 7 space shuttle missions), NASA Administrator Dr. Michael Griffin, and former astronauts Dr. Tom Jones, John Young, and Brewster Shaw.

Ben Longmier is a post-doctoral fellow at the University of Houston and conducts his plasma physics research with Dr. Chang-Diaz's Ad Astra Rocket Company on Bay Area Blvd in the Houston Clear Lake area. His work on this lecture series is not related to AIAA Houston Section, but our section was happy to accept when he applied a few

(Continued on page 25)

Continued from prior page

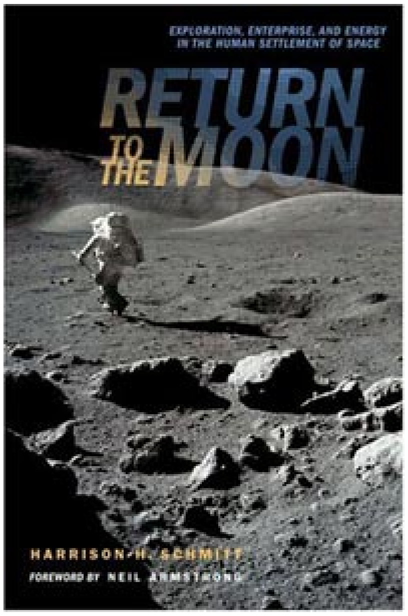
months ago to be our professional development chair.

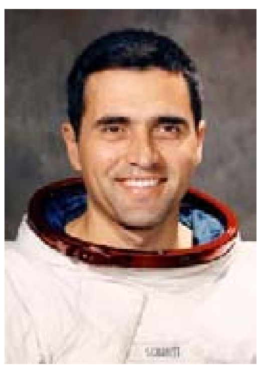
A few notes from our publicity flyer: "Space Center Lecture Series aims to bring the wonder and excitement of space science and exploration to the public in the form of monthly lectures from renowned scientists, engineers, physicians, and astronauts. From plasma rockets of the future, to scientific expeditions to the South Pole, to heroic repair missions of the international Space Station, to past and future missions to the lunar surface. Join us at Space Center Houston's IMAX theater for an hour of science, exploration, and excitement."

Space Center Lecture Series March 13, 2008

Inaugural Event

Co-sponsored by AIAA Houston Section





Chris and Carina Olsen at the lecture, holding baby Ariana, future astronaut (class of 2038) and 'Moonwalker.' "Jack Schmitt is my favorite astronaut" – Carina Olsen

Jack and Ben talk before the beginning of the first SCLS lecture

Dr. Ben Longmier and Dr. Jack Schmitt , the last person to step onto the Moon

Additional photos on the Odds and Ends page, see page 32

Yuri's Night Houston 2008 thanks to the American Astro-nautical Society

www.yurisnighthouston.net

Co-sponsored by AIAA Houston Section

Celebrating Yuri Gagarin's April 12, 1961 launch and America's STS-1 April 12, 1981 launch, Yuri's Night started April 12, 2001, as a worldwide celebration. In Houston this year, it started with the early morning 5 km fun run, then moved to Space Center Houston and continued with Space Day education events, and concluded with the evening celebration.

Motorcyclists already had Space Center Houston reserved for Bay Area Rally at the request of local cities, so we teamed up with them.

Great live music

Below: The 30-feet tall Ares I rocket model from NASA/JSC at Space Center Houston for Yuri's Night Houston 2008

Right: AIAA member BeBe Kelly-Serrato speaking on Yuri's life

Below: Red-shirted volunteers Linda Phonharath (at left), & Mike Frostad with Tara Hyland of Navigant Vacations and Virgin Galactic wearing the black shirt

Rockets from NASA Houston Rocket Club (Harold Larson & others)

Constellation Earth

Michel Bonavitacola, AAAF Toulouse - Midi-Pyrenees
Toulouse, France

From our French Sister Section

*Translation:
Douglas Yazell*

I. Introduction

The shifting pattern of day and night is one of the fundamental components of life on Earth. In fact, for hundreds of millions of years it has brought to life and regulated the biological cycles for flora, fauna, and human beings.

Human activities and excessive artificial light now invade the night. Large urban centers now look like pinball games with annoying, flashing lights. The cities are drowned in a halo of orange and pink fog, visible for tens or hundreds of kilometers. Without denying the benefits of artificial lighting, more and more people now ask about the impact of light pollution on the nocturnal environment.

During the 1980s, the International Astronomical Union and the International Lighting Commission analyzed the origin of parasitic light entering the telescopes of astronomical observatories. Its relation with urban lighting is direct and unequivocal. Recommendations were therefore published for the protection of such sites (references 1 and 2).

Some nations and regions, notably in Europe, updated their rules to reduce light pollution. Land settlement in these areas is required to conform to new requirements and to control artificial light sources in accordance with associated impact studies.

The necessary actions are implemented with a campaign of measures using maps and imaging in a variety of spectrums measured from the ground, airborne vehicles, or space vehicles.

II. Light pollution and its impacts on the environment

Light which illuminates the sky and goes up into space serves no purpose. Well-conceived lighting lights up only the targeted areas on the ground. They generate reasonable levels of light. They are turned on only during the necessary time slots.

Badly conceived lighting generates quite a few nuisances:

- Glare: this is light which travels nearly horizontally and blinds us
- Intrusive lighting: this is unwanted light coming into our homes, which we must endure

Diffused light: this is light going up into the sky which is dispersed by atmospheric molecules and particles in the atmosphere. This creates the bright halo of the cities and masks the night sky

The consequences of light pollution for the environment are numerous (reference 3):

- Impact on biodiversity (flora, fauna…)
- Impact on scenery (landscape): (day and night)
- Impacts on people (financial cost, legal impacts, cultural aspects, scientific activities, safety…)

Impact on the planet (energy savings, carbon balance, waste of natural resources…)

Simple and practical technical solutions exist to effectively limit light pollution. These solutions, often arising from common sense, are consistent with long-term development (energy savings, reduction of emissions of greenhouse gases, shrinking the ecological footprint…).

III. Light Pollution and the Protection of the Environment

Photo 2: The night "Pouncho d'Aagast" (town of Millau, in the regional natural park "des Grands Causses" in the Midi-

(Continued on page 28)

Photo 1: Europe seen at night from space (courtesy of NASA)

From our French Sister Section

Constellation Earth

Michel Bonavitacola, AAAF Toulouse - Midi-Pyrenees
Toulouse, France

(continued from page 27)

Pyrenees region) – this photo was taken as part of a suite of tests in the context of a student internship, Licorness 2005. Copyright Baduel, Antoine – Simon, Grimal 2005.

The International Community:

The International Astonomical Union (IAU), the United Nations Organization (UNO), and the International Lighting Committee (ILC) work together to encourage practical programs for the control of artificial lighting and to limit the impacts of light pollution. They encourage the work and effort of organizations, governments, and industries around the world.

The UNO granted the star-filled sky a unique value, declaring the night sky to be humanity's common heritage.

The IAU strives to intensify interdisciplinary exchanges. It maintains and develops narrow, constructive, and practical links between the organizations and the community of creators of light sources and the users of the nocturnal environment. One of the major undertakings is a coordinated effort to create, by an evolutionary process, laws, regulations, and controls at appropriate levels, whether local, regional, national, or international.

The International Dark-Sky Association (IDA) gathers together thousands of worldwide members. It is very active. In accordance with international, industrial, and professional ogranizations of lighting, notably the Illumination Engineering Society of North America (IESNA), it develops and encourages lighting material and processes which respect the environment. It encourages and helps creation of environmentally protected zones.

In France the National Association for the Protection of the Sky and the Nocturnal Environment (NAPSNE, or ANPCEN in French) and Licorness (specialized in research, education, and training) work with IDA, the IAU, and lighting creators for the rescue and classification of national sites and the reduction of light pollution (reference 4).

Laws, Rules, and Conventions:

Regional, national, and international law is always evolving.

From a legal point of view, light pollution can be approached on different levels, directly or indirectly (constitutions, subsidiary law, conventions, recommendations, norms…). Special attention is focused on areas classified as legally protected, strategic, sensitive, or fragile (scenic landscapes, national parks, seashores, natural reserves…).

Some countries already address light pollution in their rules and laws. Urban rules and land settlement processes evolve to adapt to new laws and rules. Planned work must therefore take into account new constraints and recommendations related to lighting.

Related rules depend on fundamental rules such as environmental norms (ISO 14001,

(Continued on page 29)

Photo 2: The night "Pouncho d'Aagast" (town of Millau, in the regional natural park "des Grands Causses" in the Midi-Pyrenees region) – this photo was taken as part of a suite of tests in the context of a student internship, Licorness 2005. Copyright Baduel, Antoine – Simon, Grimal 2005.

Constellation Earth

MICHEL BONAVITACOLA, AAAF TOULOUSE - MIDI-PYRENEES
TOULOUSE, FRANCE

From our French Sister Section

(continued from page 28)

for example) and recommendations defined by the International Lighting Committee and the IAU (reference 2).

Jurisprudence and experience acquired with the studies of the environmental impacts of massive lighting projects allow deveopment and refinement of judicial and legislative concepts all over the world.

Land Settlement:

Common sense says apply lighting only where needed with sufficient intensity and only when necessary.

High-quality and well-adapted lighting, as well as realistic and apprpriate rules, are also sources of important financial savings. For example, the city of Lille in France reduced related costs by 35% in one year, thanks to more eco-friendly streetlamps and other kinds of lighting.

The Lighting Plan, a recent concept, is a work plan, a way to place lighting for a touristic or industrial site, a town, an urban center, or a business or industrial zone. It targets improvement in the usefulness and layout of lighting, keeping in mind concerns about visibility, appearance, safety, and energy savings. Such improvement can act as a window shade protecting against light pollution.

To be continued next issue, the June 2008 issue, which is to be online at www.aiaa-houston.org/horizons by June 25, 2008.

Editor's note: The Houston photo and map and the box below are not part of the article from our French sister section, but they fit well with this article.

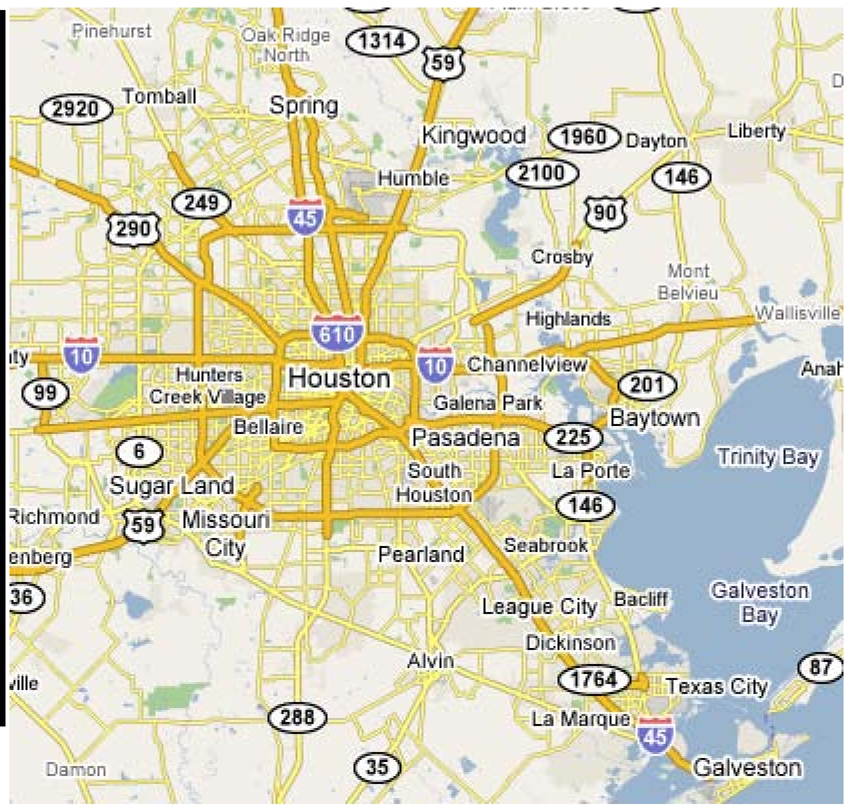


Photo of Houston : NASA astronaut Don Pettit
Map of Houston: maps.google.com

As a member of ISS Expedition 6, American astronaut Don Pettit made an outstanding movie about his photography of cities of the world at night seen from ISS. By rigging up some machinery onboard ISS to counteract the motion of ISS, he was able to obtain photos with higher resolution (about 60 meters) than available elsewhere (about 2 miles). Here is a link to a low-resolution version of his 10-minute movie:
http://www.youtube.com/watch?v=eEiy4zepuVE

CALENDAR

Calendar subject to change. See www.aiaa-houston.org for updates

Contact chair@aiaa-houston.org or events@aiaa-houston.org for further details.

April

7 Council meeting: see our org chart for contact information at www.aiaa-houston.org
11 Co-sponsoring Engineer for a Day: Boeing Black Employees Association
12 Yuri's Night indoor & outdoor at Space Center Houston: www.yurisnighthouston.net
15 Congressional Visits Day in DC (2 days): see our public policy chair for information
18 Regional (4-state) Student Paper Conference, 2 days, Friday and Saturday
25 New issue of Horizons online if we stick to this schedule, the April 2008 issue
30 Dinner meeting moved to May 2, 2008

May

2 Dinner meeting, NASA/JSC Gilruth Center, speaker: Congressman Lampson
5 Council meeting: see our org chart for contact information at www.aiaa-houston.org
9 Our section's Annual Technical Symposium: NASA/JSC Gilruth Center

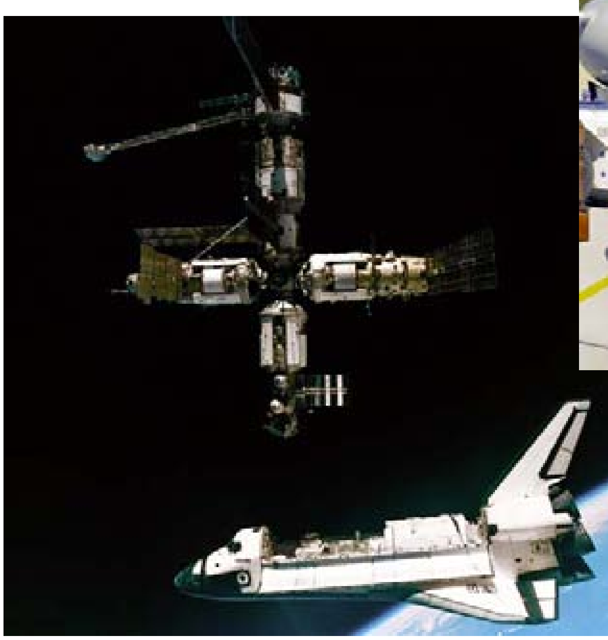
June

2 Council meeting: see our org chart for contact information at www.aiaa-houston.org
10 Dinner meeting for our section's honors & awards: speaker: Mr. Launius from the Smithsonian Institute
25 New issue of Horizons online if we stick to this schedule: quarterly again after this
30 End of this AIAA year

July (no council meeting this month: a leadership retreat might take place)

24 Regional Leadership Conference, 2 days, Thursday & Friday, 24-25th (Hartford, CT)

Date to be decided: our annual AIAA Houston Section leadership retreat modeled on the above conference, in July or August 2008



Images: NASA
GRIN web site:
Great Images In NASA
Left: Mir & space shuttle viewed from a Russian spacecraft
Right: NASA's James Fletcher & Star Trek TV crew & Enterprise

Cranium Cruncher

BILL MILLER, SENIOR MEMBER

Last issue's puzzle concerning the ages of meeting attendees was correctly solved by Greg Pierce, Murugan Subramaniam, and Tom Dillon, who deduced that the attendees' ages were 35, 35, and 2 and that the manager's age was 36.

<u>This issue's puzzle:</u>

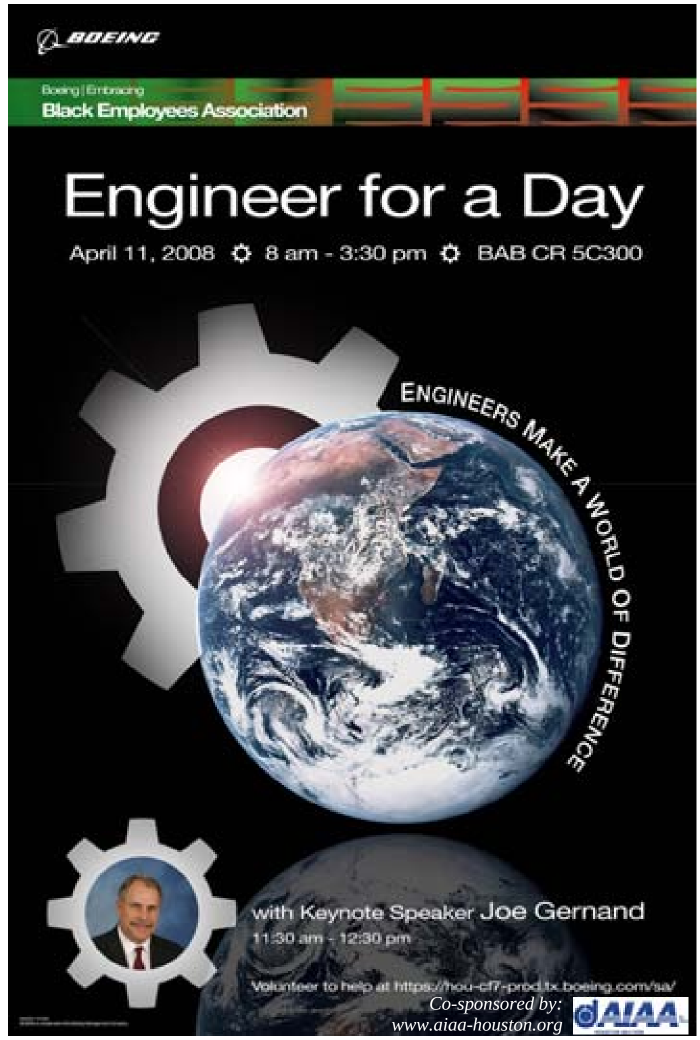
An automated Lunar rover is designed to travel in a straight line and reverse course (without pausing) when it meets an obstacle. The rover travels 4 kilometers per hour on level terrain, 3 kilometers per hour when it drives upslope, and 6 kilometers per hour when it is driving downslope.

On its first sortie the rover set off at noon and returned at six pm. Unfortunately the rover's memory had been corrupted so detailed route information could not be read out. It could be determined that the rover had traveled an unknown distance over level ground, then climbed a hill until it encountered a cliff face. The rover then reversed course and returned to base.

Using only the information given, can you determine the total distance traveled by the rover? And, for extra credit, the approximate time (within 30 minutes) that the rover encountered the obstacle?

Send your answers to wbmilleriii@comcast.net for inclusion in the next issue of Horizons.

Below: AIAA Houston Section co-sponsored this pre-college event for about 50 high school students



At left: A preliminary copy of the large poster prepared by our section (Dr. Rakesh Bhargava) to celebrate 75 years of AIAA. Over 1500 copies were printed. They were handed at events such as ATS 2007 (see our web site) and as speaker gifts. Most were hand-delivered to section members. And 100 copies were handed out at the event of March 13, 2008 (see pages 24 and 25), where the crowd size was 450.

Odds and Ends

SPECIAL EVENTS, PICTORIALS, ETC.

Above at right: Houston Chapter of the Experimental Aircraft Association www.eaa12.org
Led this year by Richard Sessions
Photo from Houston EAA e-mail note...

<u>EAA Chapter 12 Meetings for 2007 -2008:</u>
4 May 2008 – Chapter Party – Hanger Location TBD – Likely Pearland Regional (Old Clover Field)
7 May 2008 – Builder Visit – TBD – Volunteers?
4 June 2008 – Surviving Oshkosh, Neil Northington, Location: Southwest Services, Ellington Field
2 July 2008 – Oshkosh Arrival Procedures, David Staten, Location: Southwest Services, Ellington Field

Past AIAA Houston Section Chair (1971-1972) James C. McLane, Jr., has a unique souvenir of his Apollo-era career. This lunar map of the Apollo 17 landing site was used for astronaut training. This map was signed by the last person to step onto the Moon, Harrison Schmitt, when Mr. Schmitt inaugurated the Space Center Lecture Series on March 13, 2008 (www.SpaceCenterLectureSeries.com), co-sponsored by AIAA Houston Section.

European Space Agency Astronaut Leopold Eyharts Returns to Houston from ISS Expedition 16

International Space Activities Committee (ISAC)

www.aiaa-houston.org/tc/isac

Good afternoon. As you might have noticed, my body's not fully back on Earth, but I'm working on it, and I'm fully confident that it will be OK in the next days. I'd like to say that it's the same for my head, I mean, I'm still there (editor: focused on the mission according to his training). It has been a relatively short mission. I think I've got the record for the shortest long-duration mission in the history of manned spaceflight. But that was a tremendous mission, I can tell you, and it's still hard for me to believe that this was true. And this is true only, of course, because some people are working hard on the ground to make this program exist: to prepare us and also to run the operations on the ground and in space.

So yes, that was a very important mission for me because, as you know, we installed the European laboratory, Columbus module, but, of course, even though that was the highlight of my flight, there were a lot of things after that were really important for me and the other partners.

The station is amazing. It's really big! It's still hard for me to believe that there are so few people inside the station, compared to the shuttle, which is such a busy place, seven people in a small volume. I was wondering how they could live and work on it even during two days, so I really admire these guys for working on this flight and the previous flight, and all of this station preparation and assembly.

I think it would take too long to thank everybody. I've been training during three years. I've been here Houston ten years, working, training, and it would be really too long to go through the list of all the people I want to thank: here in Houston, in Moscow, of course, in Europe, without doubt, Canada, also, and I mean, twice in Japan, too, where I really loved the training.

So I would like, also, to thank all those who supported me, allowed me to prepare, and also allowd me to get ready in my head for this mission. Last but not least, of course, my family. I know it has been hard for them sometimes: a lot of my time spent out of our home and I know that was hard on them. They have been through it, and we have been through it, and I am really happy. So thank you to everybody, and I will see you very soon back at work.

Photos: Yazell: STS-123 crew at Ellington Field Thanks to NASA/JSC for the audio file from this event.

Houston Section
P.O. Box 57524
Webster, TX 77598

Non-Profit
Organization
U.S. POSTAGE PAID
PERMIT NO. 1
Webster , Texas

AIAA Mission & Vision Statement

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

The World's Forum for Aerospace Leadership

Become a Member of AIAA

Are you interested in becoming a member of AIAA, or renewing your membership? You can fill out your membership application online at the AIAA national web site:

www.aiaa.org

Select the AIAA membership option.