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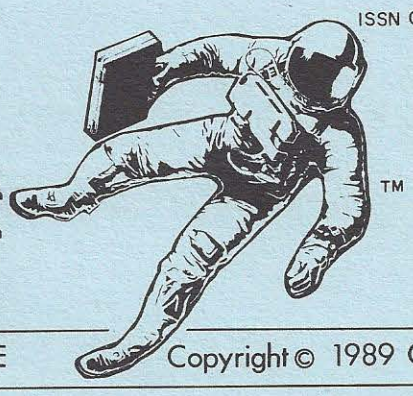
THE COMMERCIAL SPACE REPORT



A MONTHLY NEWSLETTER ON FREE ENTERPRISE IN SPACE

Volume 13, No. 4 April, 1989

Twenty Years After Apollo 11

I expected to write something inspiring for the 20th anniversary of the first landing on the Moon, but right now I'm feeling less than inspired about the U.S. space program. Anyway, after the media barrage this month I'm not sure I have anything new to say that hasn't already been said a hundred times. We went to the Moon, and after a few missions, we never went back.

President Bush made an enthusiastic but vague speech on July 20th, affirming his support for a long-range manned space program including a manned base on the Moon and manned missions to Mars. However, those hoping for a Kennedy-style call to arms were disappointed. No specifics were really outlined, and the whole thing will be tossed to the National Space Council which will eventually generate a study on the subject.

I do not hold out much hope for a serious government space effort beyond the U.S. Space Station. The long knives are already being sharpened on Capitol Hill with an eye on NASA's neck, and the space agency will be lucky to receive funding to finish the Space Station, much less to embark on major manned missions beyond that. White House estimates put the cost of a 30-year Moon/Mars program at $300 billion. For a similar program, the 1986 National Commission on Space estimated a cost of $700 billion. I believe the job could be done for far less, and it is possible that the National Space Council, which does have some talent on board, may discover this for themselves. I'm willing to be pleasantly surprised.

There are undercurrents in the private sector which hold out some hope for lunar exploration efforts outside of government programs. Most of these private lunar programs are still in the formative stages, but I am watching them closely and will report on them as they come to fruition. Any information from subscribers on such private efforts is appreciated.

Some of the aforementioned media barrage was definitely worthwhile. One television program on cable was an "as it happened" retrospective of the Apollo 11 Mission. I taped most of it, but those parts I have seen so far brought back a lot of memories. I watched the landing at a friend's house where I and the rest of an informal astronomy club sat glued to the set. Only a few other space events stand out as prominently in my mind, among them being the flight of the first Space Shuttle and that morning when I watched the first Viking photo of the Martian surface being painted stripe by stripe across my television screen.

Another program was titled "The Other Side of the Moon," and followed the careers of eight of the Apollo astronauts in the years after their flights. All of them underwent changes in beliefs and attitudes due to their flights into deep space--some of them quite profound, and most of them positive. As I mentioned in the January, 1989 issue in a review of the book The Home Planet, I believe that this broadening of vision in space travelers is one of the reasons that space should be

accessible to as many people as possible.

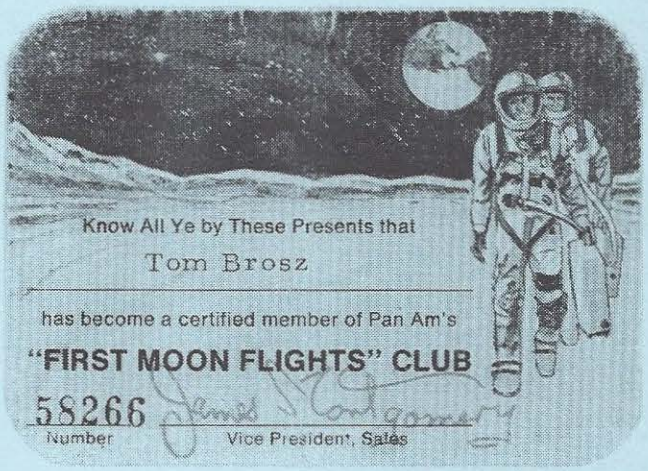
My daughter Katiana, who will be two in October, gives me a sense of perspective on this anniversary. One of her first words was "moon," and she has been able to pick it out even in the daytime sky since she was a year old. She shares my enthusiasm for rockets, and watched with interest the numerous launch films which have been playing over the past weeks.

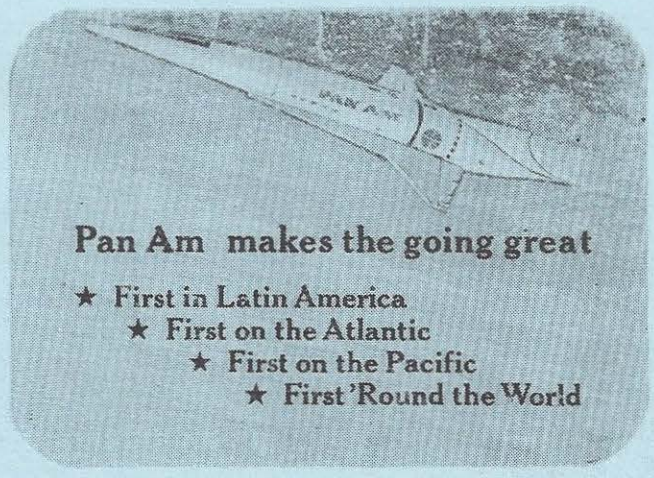
"Moon--I go," she says. She will become a teenager when the century turns--a sobering thought. She will spend most of her life in the twenty-first century. I've gotten somewhat cynical about the prospects for the Rest of Us getting into space, but she has time. Perhaps if she still wants to go someday she'll find a ship waiting.

A bright spot this month is the coming encounter of Voyager 2 with the planet Neptune. I would have bet that so far from the sun the surface of Neptune would have been a near-featureless layer of sluggishly-moving clouds, but photos so far seem to indicate a surface as interesting as that of Jupiter. In addition, a third moon has been discovered. Closest encounter is scheduled for August 24.

It is difficult to visualize the immense distances that the Voyager spacecraft has covered over the past 12 years. Consider this: when I last saw photographs that Voyager 2 had transmitted, the spacecraft was then 37 million miles from Neptune--approximately the distance between Earth and Mars when those two planets are closest together. The Voyager 2 will eat up this entire distance during only the last six weeks of its 12-year flight.

A nostalgic note: has anyone else got one of the cards shown below? I ran across mine during my recent office reorganization. These Pan Am reservations were part of the enthusiasm in the wake of the movie "2001: A Space Odyssey." At the time I thought it perfectly reasonable that there would be space liners to orbit and to the Moon by 2001. Oh well, I'm still hanging on to my reservations. Maybe I'm not as cynical as I thought.





Rocketdyne "Discovers" Low-Cost Approach To Space Transportation

Rockwell's Rocketdyne Division has unearthed a radical new idea for lowering the costs of launch vehicle engines--KISS (Keep It Simple, Stupid). Rocketdyne is working on a liquid oxygen/liquid hydrogen engine design for the proposed Advanced Launch System (ALS), the vehicle that the Air Force hopes will drastically reduce the costs of a space-based Strategic Defense system. This engine would be roughly in the same performance class as the Rocketdyne Space Shuttle Main Engine (SSME), but must be considerably less expensive and more reliable (the cost of the ALS

propulsion system is estimated to be about 40% of the total value of the ALS launch vehicle).

Rocketdyne intends to accomplish this by reducing engine performance and allowing increased engine weights. The relaxed ALS engine performance features include reduced chamber pressures and temperatures, decreased reusability requirements, simpler pumping cycles, and less complex failure modes. These reduced specifications, along with the greater allowable engine weights, combine to create drastically reduced materials, manufacturing, and operational costs.

The following table illustrates some of the differences between the simpler ALS engine and the exotic SSME (most of the information is from the June 12, 1989 issue of *Aviation Week and Space Technology*):

	SSME	ALS
Vacuum Thrust	488,800 lbs. (104%)	580,000 lbs.
Chamber Pressure	3,200 psia	2,250 psia
Specific Impulse	453 sec.	435 sec.
Engine Weight	7,000 lbs.	7,300 lbs.
Number of Fuel Pump Parts	1,021	381
Number of Oxidizer Pump Parts	1,308	222
Price per Engine	$34 million	$3 million

Rocketdyne is competing against Aerojet TechSystems and Pratt & Whitney for the rights to build this engine. These companies are also looking at liquid methane/liquid oxygen engines for booster stages. These engines, although intended for the ALS program, would also be applicable to other low-cost space transportation systems.

The prototype ALS vehicle is scheduled to fly in 1998, with operations beginning at the turn of the century.

AMROC Launch Scheduled for August 14

The American Rocket Company is planning its first sub-orbital launch on August 14 from Vandenberg Air Force Base in California.

In preparation for the launch, AMROC conducted a full-duration burn of a flight-weight hybrid rocket motor on July 11. The test took place at the AMROC engine test facility at the Air Force Astronautics Lab at Edwards Air Force Base. The case of this test motor was constructed of light-weight graphite composites, as opposed to the steel casings of earlier test motors. During the burn, the motor's liquid-injection thrust vector control mechanisms were also tested. AMROC's hybrid motors are steered by injecting hydrogen peroxide into the exhaust at the nozzle to deflect the direction of thrust. Another engine test, similar to this one, is scheduled before the August launch.

The launch is proceeding on schedule, despite the sudden death of company president George Koopman in an auto accident on July 19. Koopman was traveling to the AMROC engine test facility at AFAL when his automobile left the road and rolled several times. Although shaken by the event, company personnel feel that a successful launch in August will be an appropriate memorial to Koopman, whose entrepreneurial efforts were instrumental to AMROC's success. Company Vice President James Bennett has been appointed Acting President until further notice.

Titan 4 Makes First Launch

On June 14, the first USAF/Martin Marietta Titan 4 was launched, placing a military missile warning satellite into geosynchronous orbit. The launch marked the conclusion of an Air Force program to develop an expendable launch vehicle to supplement the U. S. Space Shuttle.

The Titan 4 ran into trouble during the flight when one of its two liquid-fueled engines suddenly gimballed to its limit in one direction, forcing the other engine to gimbal over the other way to compensate and keep the vehicle moving in the proper direction. With both engines aimed at angles instead of along the centerline of the vehicle, the net result was a loss in total thrust. Fortunately, the incident occurred late in the liquid booster's burn time, so there was already sufficient thrust to deliver the payload into the proper orbit. A suspected cause of the problem was a fuel leak into the engine chamber which acted as a liquid-injection thrust vector system, throwing the thrust of the engine out of alignment.

The Titan 4 is an uprated version of the Titan 34D, with a liquid-fueled core booster and two outboard seven-segment solid rocket boosters. The payload capacity of the Titan 4 varies, depending on the mission and on the type of upper stage used. Current configurations use either the LOX/hydrogen General Dynamics Centaur or the Boeing Inertial Upper Stage (IUS) as upper stages.

Although intended for military payloads, the Titan 4 could be used for other applications as well. Planetary missions requiring the Centaur upper stage could fall into this category. Although NASA has no plans to do so, the Titan 4 could also become a part of the U. S. Space Station program, either launching initial Space Station modules or flying later logistics missions.

For More Information

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- American Rocket Company, 847 Flynn Road, Camarillo, CA 93010 (805) 987-8970

Until next time,

Tom Brosz
July 25, 1989

The Commercial Space Report (C.S.R.) is published monthly, and endeavors to report and analyze developments in the field of private initiatives in space transportation and exploitation.

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