Quest™

The History Of Spaceflight Magazine

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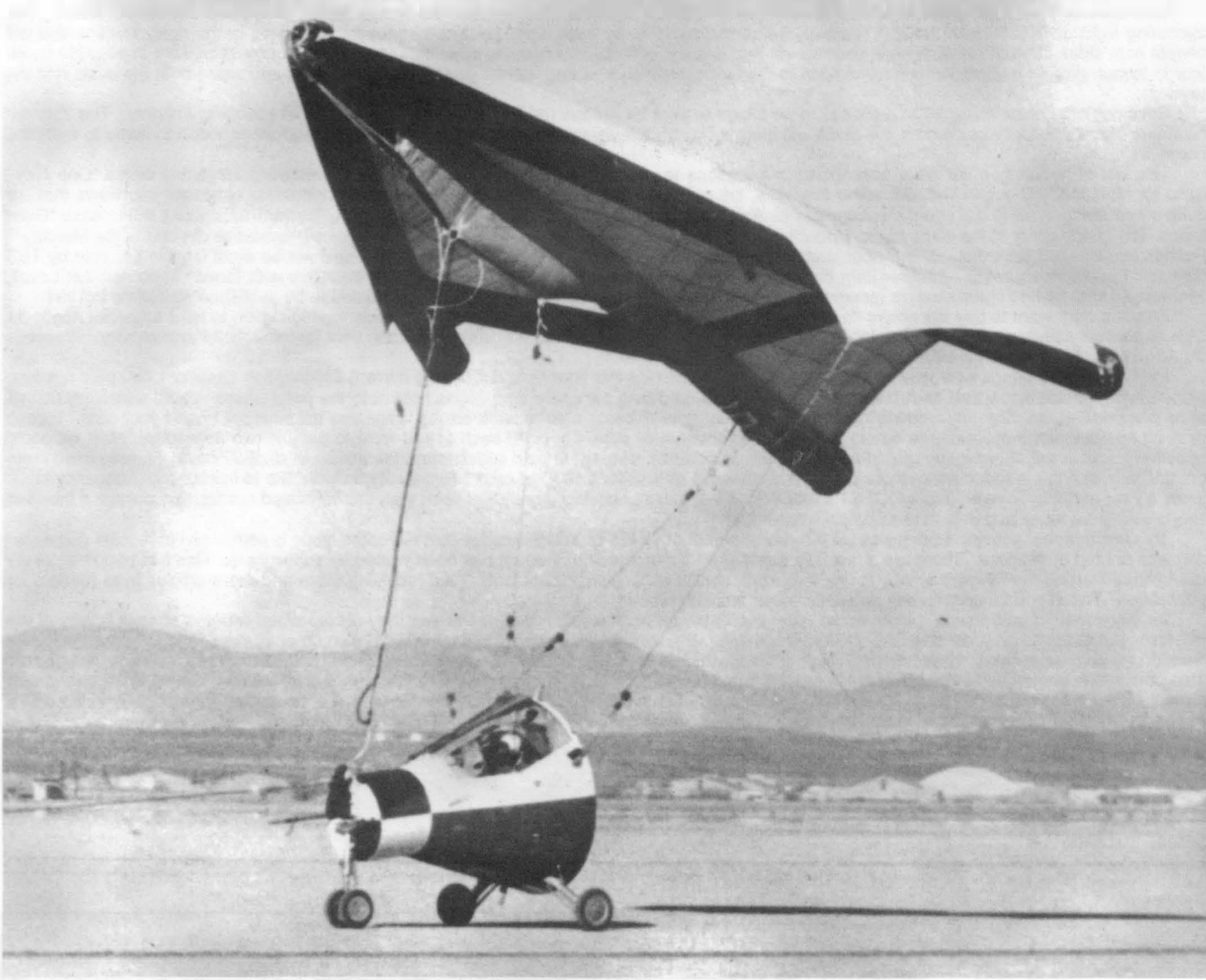
The Ultimate "Hang Glider"

Gemini's Paraglider Program



CAPCOM

As I write this editorial this holiday season, I cannot help but pause and reflect on that event of twenty-five Decembers ago when Apollo 8 realized a timeless dream. Astronauts Borman, Lovell and Anders had ventured where no one had gone before—to the moon, a quater-million miles beyond the boundaries of Earth. For a few moments, war, conflicts and daily worries were put aside as people of all faiths, all nationalities and all politics looked up to the heavens and "saw" their home planet, and themselves, for truly the first time. A Christmas gift to the world, Apollo 8 was a major turning point in America's race to the moon, second only to the crowning achievement of Apollo 11.

In spite of all the rhetoric to the contrary, there was indeed a race between the two superpowers to first get to the moon, either near it (a manned lunar flyby) or to its surface (a manned lunar landing). The first to do either could effectively boast that they were the first "to the moon." In the wake of many first achievements in space by the Soviet Union, President Kennedy polarized the American people toward a single unified direction with a single unified goal—to land a man on the moon before the end of the decade. A circumlunar flight was a critical step toward reaching that goal and by1968, it was an open question as to which side would do it first. Both sides had problems with hardware. The loss of Apollo 1, severe Pogo vibrations and premature engine shutdowns in the Saturn V along with mounting problems with the LM all contributed to major delays in the U.S. program. Not alone, the Soviets had their share of headaches as staging problems of their Proton rocket along with numerous instrument malfunctions and serious technical challenges in development of both the giant N-1 rocket and its accompanying lunar hardware all transpired against them in their lunar quest. Even though the Soviet Union had major problems within its lunar program in 1968, U.S. intelligence reports indicated that the Soviet Union would attempt a manned circumlunar flight before the year ended. Western observers expected that a pressurized cabin (i.e. Zond 7) could be sent to the Moon with two cosmonauts onboard for a historical "first" spaceflight (in fact two teams of two cosmonauts were being trained at Star City for this risky mission: Valery Bykovsky and Nikolai Rukavishnikov, Pavel Popovich and Vitali Sevastianov). Such news was perhaps *the* primary motivating force behind giving the final go ahead for the equally risky mission of Apollo 8.

In looking back, the mission of Apollo 8 and its successor Apollo 11 constituted "prizes" for winning the race to the moon. But did we really win? Twenty-five years ago, we achieved Kennedy's goal of landing a man on the moon before the end of the decade. We won the moon race but how far have we come since then? To the winners went the pride of accomplishment and the support of an endearing public. To the losers went denial that there ever was a race and dwindling political support amidst a crumbling union. Who really were the winners and losers? A space race was a mistake that should never be repeated. All races have multiple sides but only one winner. Both sides have shared similar problems and both sides can share similar solutions. Our past separate achievements in space can be the catalyst for present and future joint achievements both in space and on Earth. Space can be the "tie that binds" two great nations together.

With the new year I see great hope in a renewed joint initiative of exploration between the former Soviet Union and the United States. The upcoming flight of STS-60 with the first Russian, Sergei Krikalev, to fly aboard an American spacecraft is a step in the right direction that will benefit both sides. Space remains an expensive venture and the political and economic realities facing both countries make it impossible for either to launch greater exploration initiatives back to the Moon or to Mars alone. Let us go into space together and share both the costs and the rewards.

Speaking of anniversaries, 1994 promises to be a banner year for greater media attention on the subject of spaceflight history. The 25th anniversary of the Apollo 11 landing on the moon will bring a host of televisions specials, books, magazines, and other assorted items to mark the occasion.

The first of hopefully more lunar anniversary publications to already hit the newsstands is a commemorative magazine called "One Giant Leap for Mankind." Though filled with some mistakes, the publication is worth picking up for it contains numerous astronaut interviews that are quite informative. Among the items mentioned in its pages are the release of two new books. In March, Turner Publications will release "Giant Steps: The Inside Story of the Race to the Moon" by retired chief Associated Press aerospace writer and now executive director of the Mercury 7 Foundation, Howard Benedict. A four-hour documentary based on the book is also being developed and will be aired later in the year by TBS (see this issue's Resources). Another item on interest mentioned in this publication appears in an interview with former astronaut Jim Lovell, who reveals that he has chronicled his famous Apollo 13 voyage in a book entitled "Lost Moon" scheduled to be published sometime in 1994.

Readers may want to buy the above items with a new commemorative coin. Congress is considering legislation to mint a special Apollo 11 25th anniversary silver dollar coin. The legislation would allow the minting of 500,000 silver dollars in time for the July 24 anniversary. Proceeds would go to math and science education programs.

Every new year brings new year's resolutions. My resolution for this year is to double the current subscription base to 1,000 paid readers. Many of you already know that each issue of *QUEST* is created during my spare time and is not yet to the point where I could effectively live off of its proceeds. I am diligently working toward the eventual goal of being able to work on the magazine full time but I need your help. Please pass along word of the magazine to others in an effort to obtain new subscribers. If each of you were to get just two new subscribers, we could effectively double the subscription rate in no time at all. In addition, with 1,000 paid subscribers, the quality of *QUEST* could improve even more dramatically with the introduction of more pages in each issue as well as a dose of color. Eventually, I would like to increase its frequency to six times a year and maybe even make *QUEST* a monthly. All of these goals are dependent upon you, the dedicated reader. Encourage a friend or two to subscribe today and help make *QUEST* even better.

This issue marks another turning point in the development of *QUEST*. You will notice that the entire issue is composed of articles and materials contributed by readers. There are a few little items that I contributed but the rest has been written by subscribers. This has been one of my goals since starting the magazine and, as the magazine continues to gain in popularity, I am receiving more and more articles from readers for publication. Thank you for contributing and keep those articles coming!

As mentioned in past issues, I try to make improvements with each issue. I personally was very disappointed with the printing quality of the last issue (i.e Grechko on p. 29 and BALLOS drawings on p. 25). Along with composing each issue, I also do all of the printing and finish bindery work on my own equipment. I have a small printing press which is routinely taxed to the limit when printing *QUEST*. Some issues turn out better than others with photos and large black areas forever being a challenge to reproduce well. Starting with this issue, I am having another firm with a much larger press do the printing. As a result, you should notice a considerable improvement in overall printing quality, especially in the clarity of photos. *QUEST* deserves the best and so does its readers. Season Greetings to all and Happy New Year!

Glen E. Swanson

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Editor/Publisher, *QUEST* Magazine

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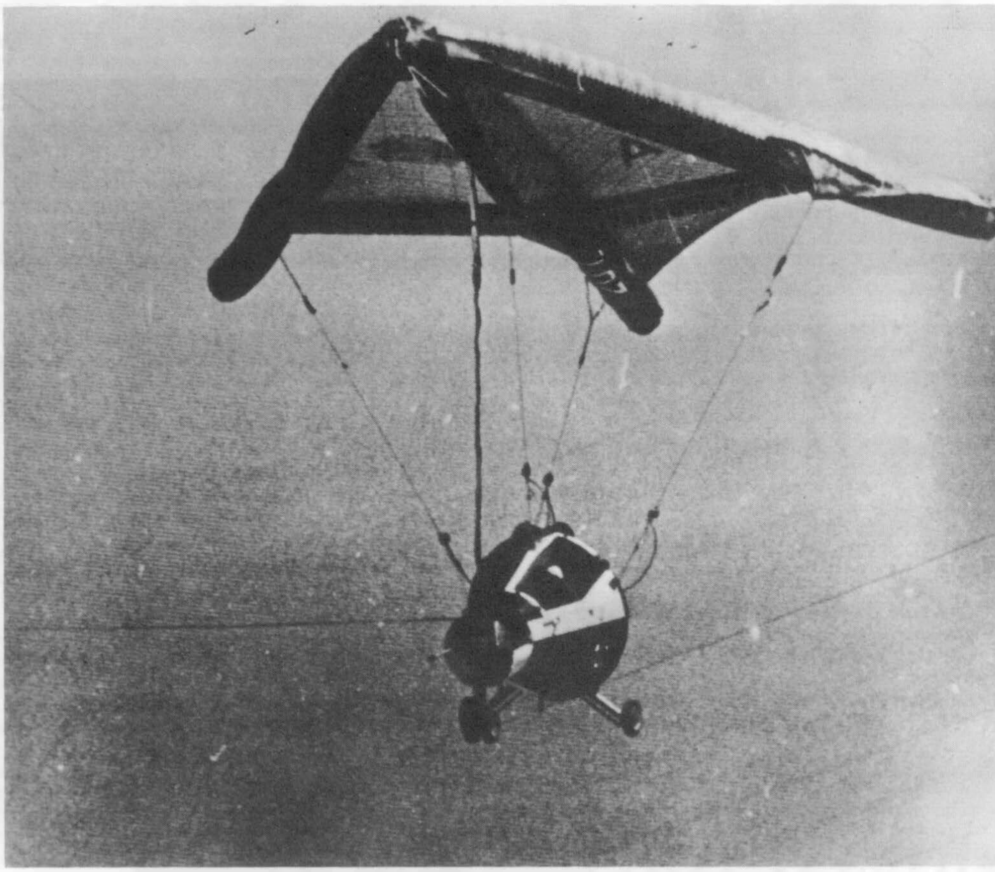
Cover: Pilot E. P. Hetzel is towed across the dry lakebed at NASA's Flight Research Center in a full-scale paraglider test vehicle. Photo No. S64-11924 courtesy NASA and Ed Hengeveld.

CSPACE

Land Landings for Gemini

As the ultimate hang glider, NASA's Gemini Paraglider Program stretched the technical limits of Francis M. Rogallo's new kite-like contraption.

by Ed Hengeveld



Above: North American pilot E.P. Hetzel is towed behind a helicopter during a captive flight in the full-scale TTV on July 29, 1964. Photo Courtesy Ed Hengeveld.

When the Space Shuttle returns from its mission and majestically touches down on a runway in Florida or California, it is sometimes hard to imagine that earlier spacecraft came back to Earth in a much more primitive manner.

The initial development of manned spacecraft in the United States in the 1940s and 1950s was directed toward an extension of the airplane, envisioning a winged glider that could be launched into space like a rocket and land on a conventional runway. However, when the Soviet Union launched Sputnik 1 on October 4, 1957, the winged glider was abandoned in favor of the ballistic capsule because this "quick-and-dirty" approach promised more immediate success.

Pinpoint landings on a runway were now clearly out of the question as such a capsule could not be maneuvered during reentry. Other ways had to be found to return the spacecraft and its occupant safely to Earth and parachute landings in the ocean emerged as a crude but acceptable method. Although this technique was subsequently chosen to be incorporated in America's first manned spacecraft, some imaginative designers came up with alternative and more unusual concepts.

PARAGLIDER

Francis M. Rogallo, an engineer at the NACA Langley Memorial Aeronautical Laboratory* near Hampton, Virginia had been working since the mid-1940s on the design of a flexible kite-like contraption that produced more lift than drag. It was a cross between a wing and a parachute and had its lifting surface stretched over an inflatable V-shaped fabric frame that could be folded into a small package. Rogallo thought that his design, called paraglider, would be suitable for the landing of future spaceships and tried to sell this idea to his bosses.

Not until 1958 did he succeed in attracting some attention. NACA had just become NASA and its newly-created Space Task Group (STG) was making plans to put Americans into space with project Mercury. After hearing Rogallo explain his design, STG's Director Robert R. Gilruth proposed in May 1959 to study the use of a paraglider for a possible successor to Mercury, tentatively called Mercury Mark II. The Mercury spacecraft was designed for a parachute landing in the ocean and it would not be practical to change that design to accommodate a land-landing capability.

Although the paraglider idea looked promising, not much action was taken. Rogallo and his team continued studying the design and became more and more convinced of its merits. However, STG remained skeptical that a paraglider could be successfully deployed in flight, something that had never been done before. They reasoned that conventional parachutes had proven their value and could be relied upon to bring a spacecraft down safely. On the other hand, water landings were extremely

* *It was renamed Langley Research Center in 1958.*

expensive because of the need for a large recovery fleet. If space travel ever were to become routine, some form of controlled recovery on land would be desirable.

On May 17, 1961, STG awarded three contracts worth $100,000 each to the Goodyear Aircraft Corporation, the Ryan Aeronautical Company and the Space and Information Systems Division of North American Aviation, to "establish the design parameters of a system to provide spacecraft maneuverability and controlled energy descent and landing by aerodynamic lift." The contracts only referred to a future manned spacecraft but STG clearly had the two-man Mercury Mark II in mind on which the McDonnell Aircraft Corporation was already working. The studies were supervised by a small technical monitoring group from STG and soon officially became known as Phase I of the Paraglider Development Program. The following phases were planned:

Phase I: Design studies to demonstrate the feasibility of the paraglider concept.

Phase II-A: Systems research and development, an eight-month effort to develop the design and determine which configuration would yield the best performance.

Phase II-B: Completion of the final design, prototype fabrication and unmanned and manned flight testing.

Phase III: Actual production of a flight model and building a training vehicle for pilot-practice.

The first phase was completed in August 1961 and proved that the concept was indeed feasible. On November 20, STG selected North American to proceed with Phase II-A because of its first-rate job in testing the design. NASA's Langley Research Center was to conduct wind tunnel tests in support of the actual flight test program which would be flown at NASA's Flight Research Center in the California Mojave Desert. STG, which had been renamed the Manned Spacecraft Center (MSC) on November 1, would coordinate the overall effort.

GEMINI IS BORN

During a meeting between all participants on November 28-29, 1961, it was decided that the paraglider research and development effort would be oriented specifically toward the as-yet unnamed Mercury successor, which at that time had not been officially approved by NASA Headquarters. That happened on December 7 and was followed on January 3, 1962, by release of the first artist impression of the new spacecraft and NASA's announcement that it would be called Gemini.

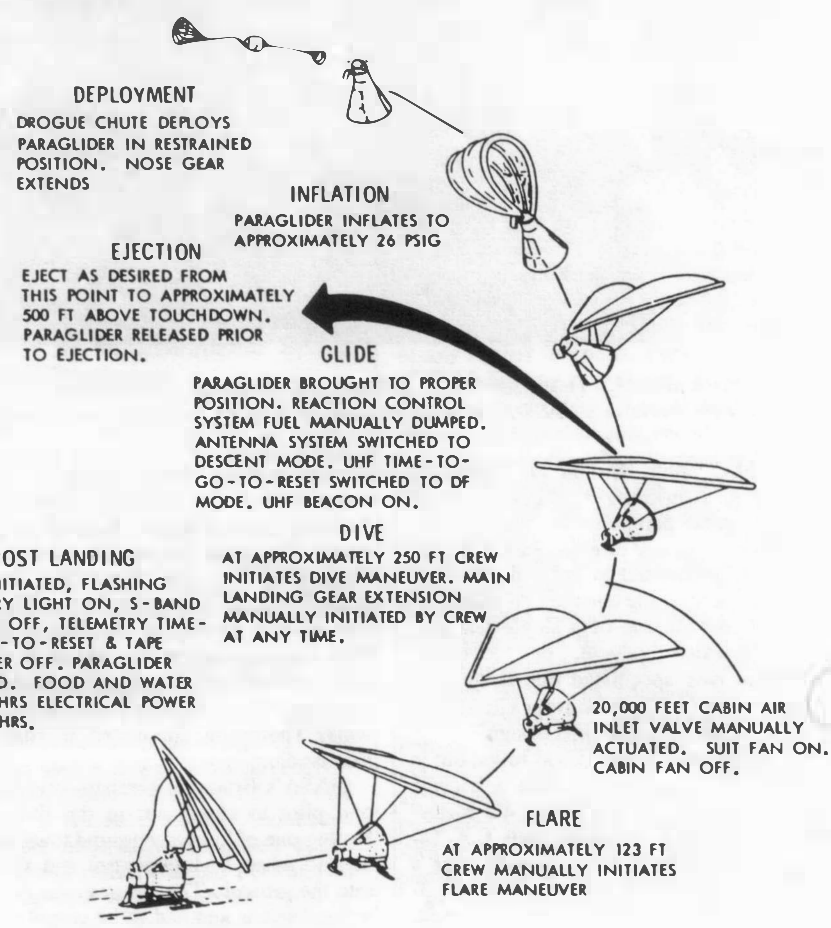
The Gemini spacecraft was basically an enlarged Mercury capsule that was made capable of longer flights. Its major purposes were to develop the technique of rendezvous and docking in space and to extend flight duration in preparation for the Apollo Moon landing program.

During a Gemini mission the paraglider equipment would be stored in the recovery compartment, or nose, of the spacecraft. After a normal reentry, a drogue parachute would pull the recovery compartment away from the spacecraft at 18,000 meters altitude and strip the paraglider from its canister at about 15,000 meters. The 10x13 meter wing would then deploy and inflate, being operational at about 14,000 meters. The astronaut crew would then be able to dive, climb or bank by actuating gas-operated cable reels, moving the spacecraft relative to the paraglider and thus shifting the center-of-gravity of the assembly forward, aft or sideways. The landing gear, consisting of a nose skid and two outrigger skids for stability and support, would be extended manually at about 80 meters. Just before landing, the astronauts would raise the nose of the spacecraft in a so-called flare-maneuver, to increase wing lift and slow the rate of descent. After touching down at about 75 km/hr, the paraglider would be jettisoned.

An optimistic schedule called for the first unmanned Gemini mission to be flown in August 1963, with recovery planned by parachute. The second flight would be the first to be manned and the first to carry the paraglider. It was planned for mid-September. Because the schedule was very tight, there were contingency plans to recover the second and subsequent flights by parachute should the paraglider development run into trouble at any stage.

PARESEV

After the November 1961 meeting where paraglider became part of the Gemini program, engineers from the Flight Research Center (FRC) returned home with serious doubts about the whole idea. They felt that NASA should first gain some experience in flying a Rogallo-type wing before relying on it to safely land a returning spacecraft.



Proposed sequence of events in deploying the paraglider to land the Gemini spacecraft. Drawing courtesy McDonnell, "Project Gemini Familiarization Manual: Manned Spacecraft Rendezvous Configuration," SEDR 300, June 1, 1962, p. 12-8.

NASA research pilot Milt Thompson (right) speaking with astronaut Gus Grissom before a flight in the Paresev at Flight Research Center. Photo No. E8936 courtesy NASA Ames Research Center, Dryden Flight Research Facility and Ed Hengeveld.

Two FRC pilots, Milton O. Thompson and Neil A. Armstrong**, wanted to build and fly a simple paraglider but failed to win the support of center director Paul F. Bikle. When they proceeded to build the craft in their spare time, Bikle changed his mind and approved construction of a single-seat paraglider research vehicle, or "Paresev". Thompson later speculated that Bikle "did this to prevent Neil and me from killing ourselves with our own marginal design."

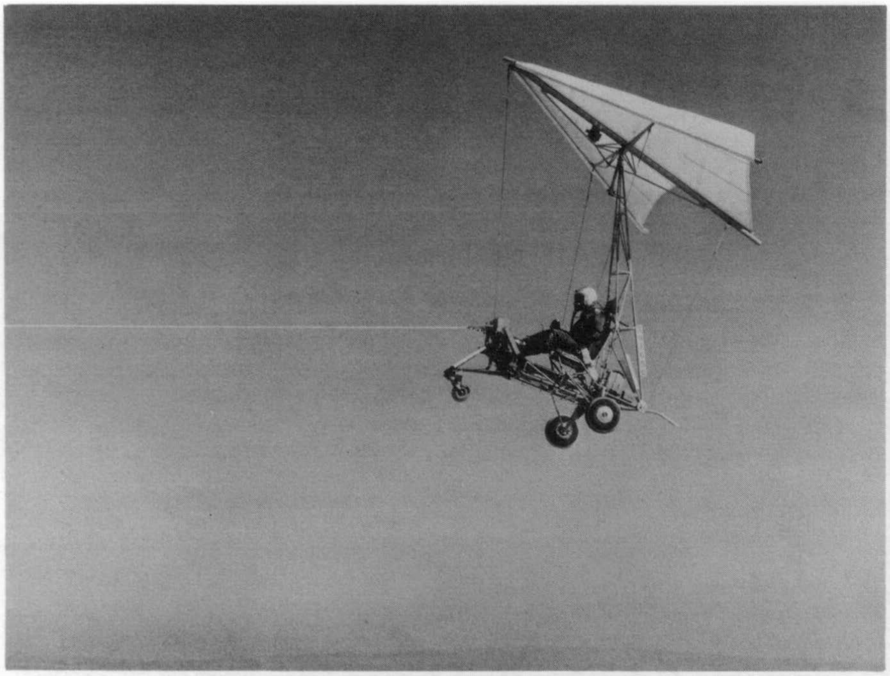
The completed Paresev I was rolled out in February 1962 and looked like a tricycle with a pilot seat. It was about 4.5 meters long and weighed 272 kilograms. A 14-square-meter Rogallo-wing, draped over a V-shaped metal frame, was attached to a 3-meter-high vertical mast behind the seat. The vehicle was controlled simply by tilting the wing fore or aft and left or right.

Thompson began flying the Paresev by being towed behind a truck across the dry lakebed at FRC. After soaring into the air at about 65 km/hr, he would play with the "controls" and feel how the little craft reacted. Flying the Paresev turned out to be a challenging task, but after several hundred ground tows, Thompson felt sufficiently confident to go higher. In March 1962 a Piper Supercub towed the vehicle to a 1,600 meter altitude where it was released for its first free flight. Despite a number of problems, Thompson succeeded in making a safe landing.

NASA's Bruce A. Peterson was the second pilot to check out in the little craft. During one of his early ground tows, he was injured when he lost control and slammed into the ground. The Paresev was damaged beyond repair and had to be completely rebuilt. It re-emerged as the Paresev I-A with a more sophisticated control system consisting of a conventional stick-and-rudder combination. It handled a lot better than the first version and was subsequently flown by Thompson and Peterson as well as Neil Armstrong, Army pilot Emil E. Kluever and Robert A. Champine of the Langley Research Center. In late 1962, Thompson also checked out astronaut Virgil I. Grissom in the Paresev. Grissom had been assigned to project Gemini almost from its inception and was slated to command one of the early missions.

Paresev was a very successful and low-cost way to obtain basic data on the flying characteristics of a Rogallo-wing. However, there was a significant difference between flying a predeployed wing with a fixed framework and deploying a full-scale flexible and inflatable paraglider from a two-ton spacecraft that was falling like a rock through the atmosphere. Important though the Paresev flights were, they were only the beginning of an extensive test program.

** *Armstrong became an astronaut in September 1962.*



Paresev being towed into the air behind an aircraft during one of the test flights. Photo No. E8710 courtesy NASA Ames Research Center and Ed Hengeveld.

EMERGENCY PARACHUTES

Although North American had optimistically begun work on the paraglider program in early 1962, MSC was reluctant to risk expensive test equipment on an untried concept and demanded that the company first design and develop an emergency parachute recovery system for the half-scale and full-scale drop test vehicles that would demonstrate wing deployment later on. On March 16, 1962, North American awarded a $225,000 subcontract for the emergency system to Northrop's Radioplane Division in Van Nuys, California.

Ames Research Center started testing a half-scale inflatable paraglider wing in the facility's wind tunnel on May 23, 1962. The purpose was to obtain basic aerodynamic data on the combined wing and spacecraft and to identify any problems that might occur during the real test flights. The complete sequence of events from deployment through landing was demonstrated and, although the wing ripped during the last stages of the test program, the basic objectives had been achieved and tests were concluded on July 25.

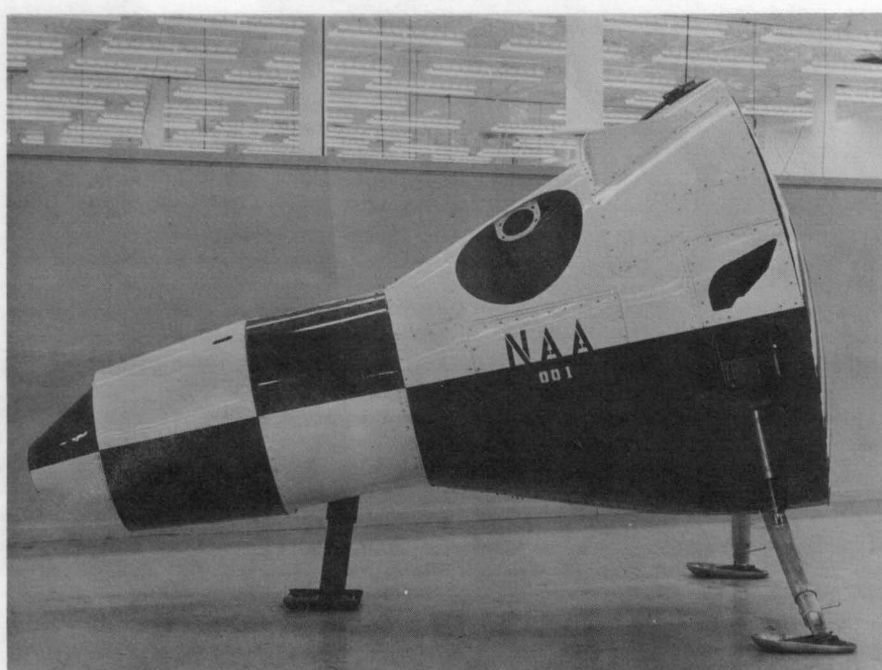
Next priority was to qualify Northrop's emergency parachute system for the paraglider deployment tests. This involved dropping first a half-scale and later a full-scale boilerplate capsule from a high-flying aircraft over the Naval Parachute Facility in El Centro, California. These boilerplates were metal replicas of the Gemini spacecraft, having the same shape as the actual flight article but lacking its internal systems. They were fabricated especially for these tests by North American, not by Gemini's prime contractor McDonnell.

The first drop, on May 24, 1962, was successful. After two failures, the next test on June 20 also provided good results. On June 26, however, the single Mercury-type parachute failed and the test model was returned to the factory in Downey, California, where a design-flaw was corrected. During a new attempt on July 10, the parachute failed again. Following additional repairs, a final successful drop was made on September 4, after which the system was considered qualified.

The emergency parachute system for the full-scale capsule consisted of three parachutes instead of one, obviously because of the heavier loads. The problems that were encountered, however, were similar to the single parachute system. The first drop test was delayed until August 2, 1962 and the schedule kept slipping. In the second test, on August 21, one of the parachutes was lost after deployment but the other two safely lowered the capsule to the ground. On September 7, two parachutes were lost and the test model was slightly damaged. After repairs, a fourth test on November 15 ended in disaster when all three parachutes were lost and the capsule crashed. The drops were halted, but MSC instructed McDonnell to supply North American with a spare boilerplate capsule so that testing could be resumed at a later date.

TROUBLES CONTINUE

Although these problems were a serious setback, they only involved a back-up system that was not part of the actual paraglider concept. Nevertheless, the string of failures persisted when North American began tow-tests with the two half-scale test vehicles



North American's first half-scale test vehicle (HSTV) is shown before shipment to NASA's Flight Research Center. Photo No. NASA S-63-1444 courtesy NASA and Ed Hengeveld.

A Gemini capsule is dropped from an aircraft during the 10th parasail test on July 17, 1963. NASA Photo S63-11169 courtesy Lyndon B. Johnson Space Center and Ed Hengeveld.

(HSTVs) at Flight Research Center 100 kilometers north of Downey. The paraglider would be deployed and inflated on the ground before the wing and instrumented capsule were towed aloft by an Army helicopter. At the desired altitude, a ground command would release the tow cable and the capsule would make a radio-controlled descent to evaluate the handling characteristics in flight.

The first test was on August 14, 1962. The wing was folded in half and tied down for takeoff but when the helicopter reached the altitude where it would be released, it refused to do so. During the next try, on August 17, the wing released too soon, although the capsule did go briefly into a stable glide. On August 23, a faulty radio command caused the vehicle to descend too fast causing some damage on landing.

Minor problems twice delayed the fourth test, which finally took place on September 17. This time the tow-line failed to release from the vehicle forcing the helicopter to return to base. A fifth attempt was also postponed twice, the second time on September 21. This prompted MSC to take charge and order a hold in testing until all problems had been solved. The test-model was inspected in the factory. After repairs, it was returned to Flight Research Center on October 15, where minor problems again delayed the fifth test. Finally, on October 23, the test went off without a hitch showing that the paraglider was stable in free flight. However, months of valuable time had been lost.

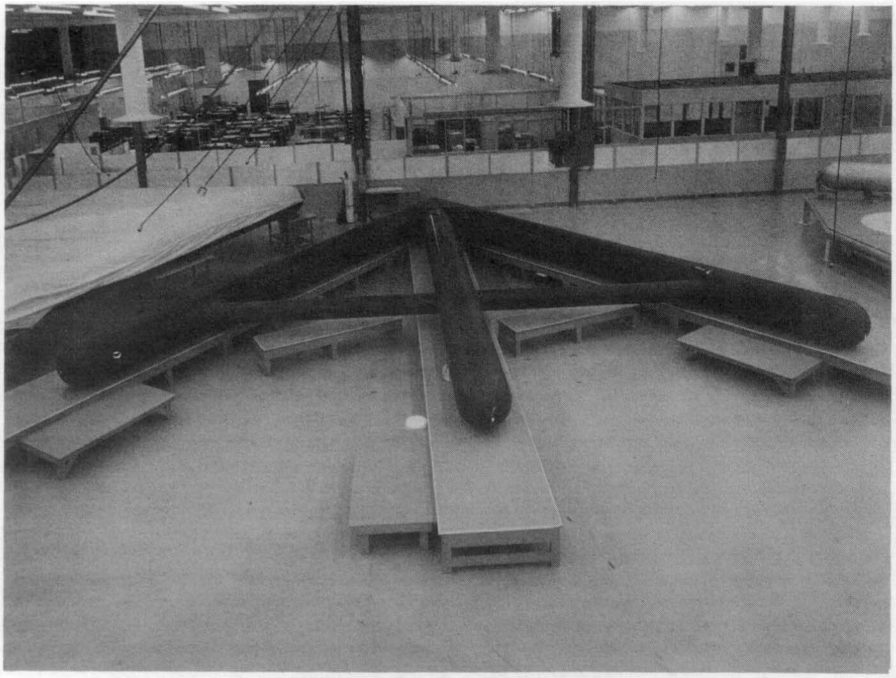
Next step was attempting to deploy the wing in fight. After modifications in the factory, the half-scale models were returned to Edwards, where testing was to begin on November 27, 1962. The now familiar pattern of delays pushed that date back to December 10. On that day, the HSTV was dropped from beneath a helicopter with the paraglider folded in a storage can. However, the drogue parachute that released the can became fouled up. When the paraglider was deployed it only made things worse. At 160 meters, the tangled assembly was jettisoned by radio command and the capsule landed using its emergency parachute immediately demonstrating the wisdom of such a backup system.

After more delays, the second attempt was made on January 8, 1963. This time the storage can was released too late and the capsule was dropping too fast when the wing was deployed, causing it to tear. When the capsule fell below 1,600 meters the command was given to deploy the emergency parachute, but nothing happened and the capsule crashed.

After one month, North American had found and corrected five separate problems and wanted to resume testing. MSC's Gemini Program Office (GPO) wanted to give North American the benefit of the doubt and made plans to award the contract for Phase III. However, Washington's Office of Manned Spaceflight objected. As early as October 1962, budget pressure had prompted some consideration of dropping paraglider from the Gemini program. Washington wanted to wait for a successful demonstration of the deployment system before committing more money to the program.

The third attempt to deploy the wing in flight, using the second HSTV on March 11, 1963, did not provide this much-needed success. After all the promises by North American that the problems had been solved, the storage can failed to separate. The paraglider could not be deployed and could not be jettisoned either. To make the failure com-

Two engineers examine the remains of one of the half-scale vehicles after an unsuccessful landing test. NASA Photo S-63-1476 courtesy NASA and Ed Hengeveld.



The inflatable frame of a paraglider wing is shown at North American's factory in Downey, California. Partially visible at left is an identical frame covered by the actual sail. NASA Photo S-63-1443 courtesy NASA and Ed Hengeveld.

plete, the radio command for the emergency parachute did not work and the capsule plunged to its destruction on the desert floor. Both half-scale capsules were now destroyed and paraglider testing came to an abrupt halt.

PARAGLIDER REDIRECTED

On March 27-28, 1963, representatives from NASA and North American met to discuss the status of the program. By now, use of the paraglider had been delayed until the seventh Gemini mission at the earliest, planned for October 1965. North American's money for Phase II would run out by the end of April and the company waited for NASA's instructions.

Opponents of paraglider suggested switching to an alternative land-landing technique using a so-called parasail. This was a special type of parachute that could be maneuvered to a certain degree. A distinct disadvantage of this concept was that, because of the relatively high rate of descent, it required the use of landing rockets to cushion the capsule's impact with the ground. Although several successful tests of the parasail were performed, most astronauts had reservations about the use of landing rockets that required "waiting until the last split-second to find out if you will be around for the next second," as astronaut Walter Cunningham once remarked. In addition, too much money had already been spent on paraglider to simply drop it just before the beginning of full-scale flight testing.

As a result of all the problems, it was decided that paraglider would be downgraded to a research and development program. All earlier contracts were terminated and North American was awarded a new contract on May 5 for what was now called the Paraglider Landing System Program. The purpose of the year-long, $20 million dollar effort was to complete the design, development and testing and come up with a prototype wing, stopping short of beginning actual production.

The new plan was to test the paraglider deployment and landing in two separate stages. Two-full-scale test vehicles (FSTVs) would be used to test spreading the wing in flight. They would be dropped from a high-flying aircraft to demonstrate the deployment sequence only. After gliding down to an altitude of about 3,000 meters, the paraglider would be jettisoned and the capsule would land by parachute. In the meantime, the rest of the descent would be tested by towing manned vehicles behind a helicopter to 3,000 meters and releasing them there to glide down to a piloted landing. Only when both phases had been separately completed would the tests be combined into one demonstration of the entire sequence from deployment through landing.

One half-scale boilerplate, left over from the emergency parachute qualification program, would now be used as a half-scale tow test vehicle (HSTTV) to practice take-off techniques for the full-scale model. The paraglider trainer that North American was building would now be converted to a full-scale TTV and a second one would be built.

North American began testing of the HSTTV on May 27, 1963. It was towed behind an automobile to determine the best wing angle setting and attach points so that the full-scale model could later be safely towed to the planned 3,000 meter release altitude. The first series of 121 tows was completed on July 29 and the half-scale model was delivered to the Flight Research Center on August 19. The following day, FRC started its own series of 133 ground tows. These were completed in September and followed by 11 helicopter tow tests in October to see what would happen to the deployed wing at higher speeds and altitudes.

Deployment testing with the full-scale test vehicles had to wait until a new emergency parachute had been qualified, which would be needed to lower the capsule to the ground from 3,000 meters after the paraglider had been jettisoned. A single, standard Gemini parachute was chosen to do the job with a second one to back up the first. On May 22 and June 3 two successful drops were made with ballast only. In the first drop test using a boilerplate, on July 24, both parachute and capsule suffered minor damage but on the next three drops (on July 2, 12 and 18) everything worked flawlessly. Hopes that the system could soon be qualified were shattered on July 30, however, when both parachutes failed and the test vehicle was destroyed on impact.

After this failure, North American requested that the parachute program be considered completed. They reasoned that they had isolated the problem and could correct it, so there was no need to repeat the test. But MSC did not agree and ordered the company to conduct two further drops with a new boilerplate spacecraft. These were successfully conducted on November 12 and December 3, 1963, after which the parachute recovery system for the FSTV was considered fully qualified.

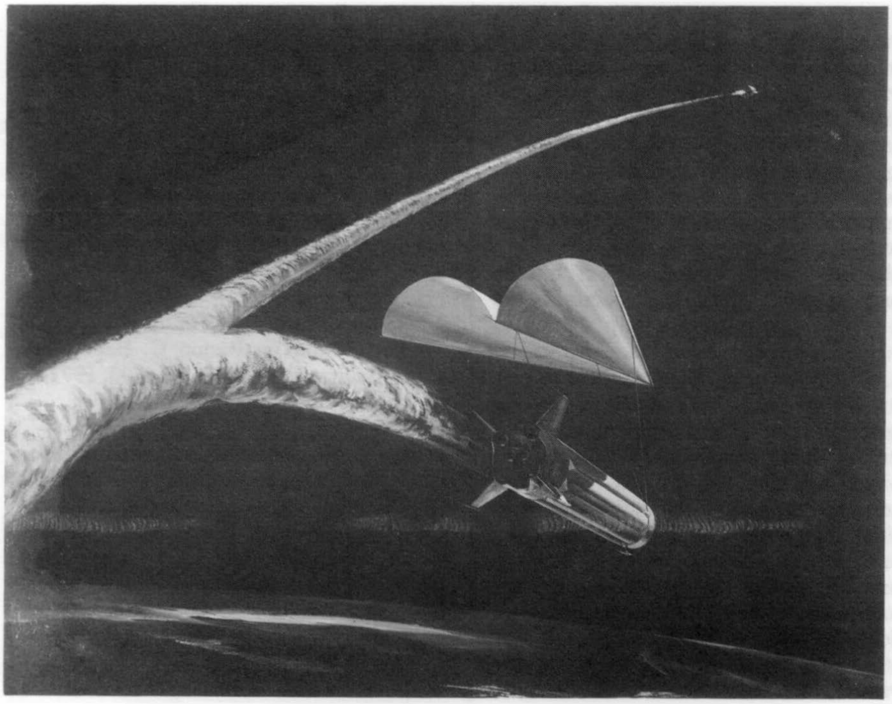
Work on North American's first full-scale prototype paraglider wing was completed on October 14, 1963. It was shipped to Ames Research Center for wind tunnel tests but these yielded not enough data and had to be repeated in early December.

Despite the continuous series of problems with the paraglider and its associated equipment, NASA apparently was still sufficiently pleased with the design to present a $35,000 cash award to Francis Rogallo in mid-July for early development work on the concept. At that time it was the largest such award every made by the space agency.

TESTING RESUMES

Meanwhile, construction of the full-scale vehicles was nearing completion. Factory


NASA
NASA



An artist rendering featuring a possible advanced paraglider application concept studied by North American Aviation for the recovery of space boosters. The Paraglider would guide the booster back to earth after it separated from an instrumented or manned space capsule. Photo No. AJL060861 courtesy North American Aviation and Randy Liebermann.

inspection of the FSTVs on August 1 and the full-scale tow test vehicles (TTVs) on September 27 had resulted in the usual number of minor modifications. The no. 1 TTV (formerly the paraglider trainer) was completed on October 25, 1963 and shipped to Flight Research Center in late November. Preliminary ground tows were conducted in December and January, following which installation of control system hardware began to prepare for manned testing. The two FSTVs had arrived at FRC in mid-December, followed by the second TTV on February 14, 1964. All hardware for the long-awaited tests was now in place.

North American wanted to conduct 20 tests with the FSTV to demonstrate deployment of the full-scale paraglider from its canister, followed by radio-controlled glide down to 3,000 meters. Each test was to be terminated by release of the wing and recovery by the emergency parachute. If everything went well, there was still a chance that paraglider could be used on the last three Gemini missions.

On January 22, 1964, the FSTV was dropped from a Lockheed C-130 flying high over FRC. The paraglider failed to deploy correctly and the test was only considered a partial success. Three more flights were attempted on February 8, March 6 and April 10, but due to various minor problems they were all considered failures. After another unsuccessful try on April 22, NASA Headquarters had had enough and decided that no more Gemini money would be spent on the paraglider. One week later, MSC started to reduce the level of activity on the program and informed North American that paraglider was dead as far as Gemini was concerned. The company could use the remaining funds and hardware to complete the test program but that was it.

Ironically, the sixth FSTV test, on April 30, was a flawless demonstration of the deployment sequence. Following the drop from the C-130 at 11,000 meters the wing deployed and the glider, for the first time ever, assumed the trimmed glide attitude as planned. Flight No. 7 on May 28 was also successful. From June through October, drop tests no. 8 through 22 again experienced various difficulties. The deployment sequence in these flights was generally satisfactory but achieving a stable glide remained elusive. Finally, the last three flights on October 23, November 6 and December 1 were completely successful. However, it was too little too late. The public announcement that paraglider had definitely been canceled from the Gemini program had been made on August 10, 1964 and North American had already begun laying off 2,500 employees.

Opposite: Taken shortly after their selection on July 27, 1964, this rare photo shows Gemini 4 Primary Crew Astronauts Jim McDivitt and Ed White gathered around a "land landing equipped" Gemini model. Another similar photo was taken which includes the backup crews (Borman and Lovell). NASA Photo No. 64-H-2211 courtesy NASA and Mike Mitchell, SASA.

SUCCESS COMES TOO LATE

Using the remaining money from the May 1963 contract as well as additional funds of its own, the company had also begun manned demonstrations of the landing technique using the full-scale TTV at FRC. On July 29, 1964, a helicopter towed the capsule with its wing deployed to an altitude of about 850 meters. After flying around the test area for about 20 minutes with the tow cable attached, North American pilot E.P. Hetzel made a smooth landing. He released the cable immediately after touchdown and jettisoned the paraglider about four seconds later.

The first free flight was made on August 7 and it nearly ended in disaster. The cable was released when the TTV was flying at about 5,000 meters altitude but the vehicle immediately went into a tight left-hand turn and descended to the desert floor. At 1,000 meters Hetzel parachuted out of the uncontrollable craft, breaking a rib in the process. The paraglider and capsule sustained minor damage upon impact.

Following this failure, North American attempted to isolate the problem by flying 14 radio-controlled flights using the half-scale TTV between August 24 and December 13. These were followed by two successful radio-controlled full-scale TTV free flights on December 15 and 17.

Finally, on December 19, 1964, pilot Donald F. McCusker was towed aloft in the TTV with a slightly modified paraglider to improve stability. After tow-cable release at about 3,000 meters he flew a successful 5-minute glide flight down to the landing area. Due to a late flare maneuver the touchdown was too hard and McCusker sustained minor injuries. Nevertheless, it was a posthumous triumph for the paraglider program.

In retrospect, it seems that the project was doomed from the start. One of the main reasons may be that on November 28, 1961, one week after North American was awarded the paraglider contract, the company was named prime contractor for the Apollo spacecraft. This put a considerable strain on North American's workforce and it wasn't long before engineers were taken off the paraglider program and put to work on Apollo. The technical problems that plagued paraglider from the beginning were not insurmountable but the declining project staff, in combination with tight schedules and budgets, prevented NASA and North American from coming up with the right solutions.

Paraglider was dead and almost forgotten by the time the first manned Gemini flights began generating interest around the globe. The general public was largely unaware of the early tests and may have been puzzled by some obscure references to the paraglider such as the 1964 plastic Gemini scale model by Revell that could be built with the spacecraft's landing gear extended. Also, an early portrait photo of the Gemini 4 prime and backup crews, taken shortly after their selection on July 27, 1964, showed the four space-suited astronauts posing with a large Gemini model that prominently displayed the three landing skids.

WRONG SOLUTION

Although paraglider's future for the space program was now nonexistent, NASA and North American still considered the concept promising enough to keep it alive for a little while longer. The armed services had expressed an interest in using paraglider-type vehicles as part of an air-dropped cargo delivery system. The Ryan Aeronautical Company, one of the original bidders for the paraglider contract, had been building an experimental light-weight "flex-wing" aircraft based on Francis Rogallo's ideas.

North American also saw possibilities in this field and in May 1965 embarked on a seven-month test program using the hardware left over from the Gemini effort. On September 3 of that year, pilot McCusker was towed aloft in the TTV behind a Sikorsky S-61L helicopter and released at 2,500 meters altitude over the Flight Research Center.. In a four-and-a-half-minute flight he made a series of turn and pitch maneuvers and guided the vehicle to a preselected landing site. McCusker and other company pilots flew 12 such flights, the last one on November 5, 1965 and were able to touch down consistently within 150 meters of their landing target.

Rogallo's wing turned out to be the wrong solution for landing spacecraft but the idea was later successfully applied to hanggliders all over the world. As it turned out, all twelve Gemini flights landed by parachute in the ocean. After commanding the Gemini 10 mission in July 1966, astronaut John W. Young remarked: "Of course I'm always glad to get down and it's always nice to see the U.S. Navy sitting out there waiting for you but I think the country can't afford to keep sending out the U.S. Navy every time just to bring a couple of astronauts home. I think that land landings are indeed feasible and the development of a land-landing capability must be vigorously pursued."

Of course, John Young was at the controls of the Space Shuttle *Columbia* on April 14, 1981 when it made its first touchdown on a runway at NASA's Hugh L. Dryden Flight Research Center after a two-day spaceflight. And the rest is history... ●

ACKNOWLEDGEMENTS:

The two main sources of information for this article were:

1.) *Project Gemini: A Chronology* by James M. Grimwood, Barton C. Hacker and Peter J. Vorzimmer (NASA SP-4002, 1969)

2.) *On the Shoulders of Titans: A History of Project Gemini* by Barton C. Hacker and James Grimwood (NASA SP-4203, 1977)

Photos were generously supplied by Don Haley and Ronnie Boghosian of NASA's Dryden Flight Research Center and Mike Gentry and Debbie Dodds of Media Services Corporation. NASA's Audio Visual Section in Washington was also very helpful.

Ed Hengeveld is a spaceflight historian and space artist living and working in the Netherlands. He has an extensive space photo collection many of which were used in this article. This is his first article for "QUEST".

"El Kabong 1"

Today, very little hardware remains of the Gemini Paraglider Program. One of North American's full-scale test vehicles is on loan at the Michigan Space Center in Jackson, Michigan. The condition of this vehicle is extremely poor after apparently having sat outside exposed to the weather for a number of years. Severe rust and corrosion has taken its toll and the vehicle is presently stored in a warehouse. Historical data on this vehicle is sketchy but it appears to have been used during the last manned TTV flights in 1965. An interesting feature appearing on this particular vehicle is the name "El Kabong 1" which is prominently painted on one of its exterior hatches. The name was taken from a popular cartoon character who was always getting hit on the head in the "Lil Abner" comic strip. The name connection is not certain but perhaps it is in reference to the many tumbles and crashes that this and other vehicles (plus their pilots) endured during the course of the test program.

In addition to the above piece of hardware, an article by Joshua Stoff and Devera Pine entitled "Where Have All the Spacecraft Gone?" (*Space World*, October 1985, pp. 8-11) included an interesting list of the then known location of many pieces of space hardware. Among the items listed is a "Gemini Paraglider" at the Manchester Air & Space Museum in Manchester, England. *QUEST* has tried to verify this but has been unable to confirm either the existence of the item or the Museum. If readers have any further information on this or know of other Gemini Paraglider related hardware that is still in existence, please write to let us know.

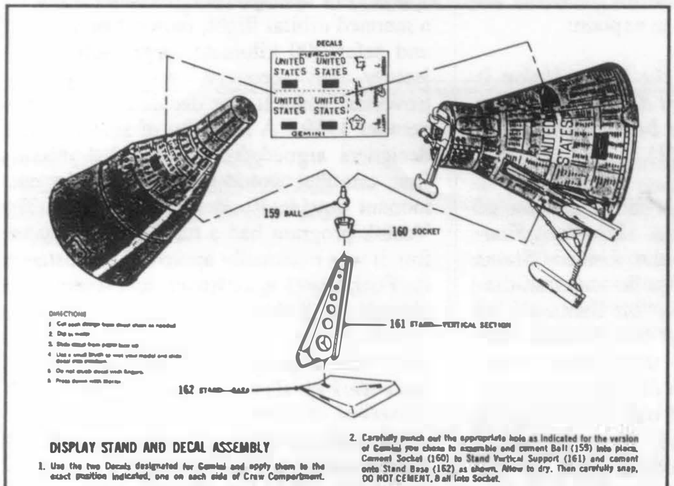
—Glen E. Swanson

Photo Courtesy Michigan Space Center

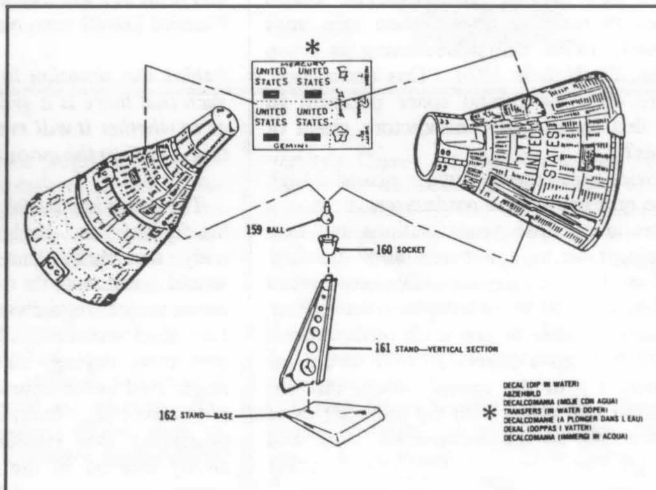
NOW YOU SEE IT, NOW YOU DON'T

Two different versions of the same model kit illustrate the Gemini Paraglider history.

Obscure references to the Gemini Paraglider Program were released to the general public in 1964. In addition to the NASA released photos showing the Gemini 4 prime and backup crews standing behind a "land landing" Gemini model, Revell released a 1/48 scale Mercury/Gemini plastic model kit with the Gemini portion of the kit featuring optional parts and instructions to build the spacecraft with its landing gear extended. In 1987 when Revell-Monogram re-released the same kit, it featured a "politically" correct Gemini minus landing skids. Perceptive model builders will notice, however, that the "new" kit still includes the landing skid "doors" or covers which, when glued in place, hide the changes made to both the model and its history.



A portion of the instruction sheet from the 1964 Revell Mercury and Gemini 1/48 scale plastic model kit. Note the optional display variation featuring the extended landing gear. Drawing courtesy Revell Models, Inc. Copyright 1964.



A portion of the instruction sheet from the 1987 re-released Revell-Monogram Mercury and Gemini 1/48 scale plastic model kit. Note absence of landing gear but continued inclusion of skid cover doors. Drawing courtesy Monogram Models, Inc. Copyright 1987.

Box art from the original 1964 Mercury and Gemini Revell plastic model kit. Photo courtesy Monogram Models, Inc. Copyright 1964.

* Special thanks to *QUEST* reader Ltjg. Donald D. Pealer of San Diego, California for providing the above drawings and photo.

The 1963 Soviet Space Platform Project

Was a withdrawal from the moon race seriously considered by the Soviet Union in favor of an orbiting space station?

by Brian Harvey

In the autumn of 1963, the Soviet Union formally announced that is was not in a race to beat the Americans to the moon. Instead, the USSR would build an orbital space platform: this was now to be the priority of the Soviet space program.

We now know that the Soviet Union stayed in the man-on-the-moon race until the early 1970s, only abandoning its moon rocket, the N-1, in 1974. This understood, where does the orbital space platform fit into this seemingly contradictory chain of events?

Soviet space theory always placed a high value on earth orbital rendezvous, both as a means to establish space stations and as a steppingstone to a manned lunar landing. Studies by the Korolov Design Bureau (OKB) in 1960 included plans for linking vehicles together in low earth orbit; tankers would fuel up a spaceship that would ultimately fly to the moon. Such theories were put into effect with the joint flights of Vostok 3-4 in the autumn of 1962 and through the flights of the Soyuz rocket block (as envisaged in the 1960 studies).

The Lovell Visit: July and August 1963

In July 1963, Sir Bernard Lovell, the leading radio astronomer responsible for the Jodrell Bank Telescope in England, visited some of the major optical and radio observatories of the USSR. He spoke to leading members of the Soviet Academy of Science, including its President, Mstislav Keldysh.

On his return, Sir Bernard Lovell revealed that a moon landing was no longer the centerpiece of the Soviet space program. Instead, a "space platform" would be built designed to be operated by astronomer-cosmonauts. Teams of cosmonauts would fly up to the platform and view the heavens on a rotating basis. Artist impressions were even issued.

The moon landing, said Sir Bernard Lovell, had been found to be too difficult for three main reasons: the lethal effects of solar radiation; the difficulty of ensuring a safe return to Earth; and the expense compared to the scientific information that could be obtained from automatic probes.

The Space Platform Design

The orbital space platform would be launched by 1968. Two cosmonauts at a time would work on the platform for missions expected to last five or six days – then considered a long period for a manned space mission. The platform would carry an optical telescope 9 meters in diameter, and orbit 322 kilometers from the earth. Sir Bernard Lovell went on to explain:

I think the situation in the Soviet Union is such that there is a great deal of discussion as to whether it will ever be worthwhile getting a man to the moon (1).

The Americans took a different view of his findings and analysis. President Kennedy announced that the United States would continue its Apollo man-on-the-moon project regardless. "Sir Bernard's information was not final," the President was quoted as saying, and the United States might find in the course of time that it was not correct (2). Even if one allows for the possibility that President Kennedy had a strong interest in the continuation of the moon race that he had declared, there was a strong hint that the United States had its own independent intelligence information indicating that the moon race was still very much alive. We now know how right this intelligence was.

Sir Bernard Lovell's comments, which were made after his return, were published a second time less than one month later in an interview in *U.S. News & World Report.* Simultaneously he wrote a long memorandum on Soviet space intentions (it should be noted that this was done at Soviet request) to Dr. Hugh Dryden, NASA Deputy Administrator. Sir Bernard added that the high cost of the moon race was another reason for the Soviet withdrawal:

The Russians are realists. There are a lot of things they must spend money on. Their standard of living –although it is increasing rapidly– is still very far behind what we enjoy in Britain or America (3).

Lovell did not rule out a Soviet reentry to the moon race, but for the time being, the USSR would concentrate on the space platform and soft-landing a probe on the Moon. This latter project was planned for 1965-1966 and certainly this prediction was vindicated by subsequent events in the Luna series (4).

Internal Russian Conflict Over Objectives

There was nothing new about Soviet scientists and designers taking differing opinions and views as to the best way to conquer space. For example, the decision to opt for a manned orbital flight, rather than a shorter and safer 200 kilometer high ballistic trajectory and recovery, was highly controversial when it was decided upon in November 1959. A minority of scientists and designers argued for a suborbital mission first, one that would not risk a Soviet cosmonaut outside Russian airspace (5). The Vostok program had a turbulent history before it was eventually approved. Konstantin P. Feoktistov, a designer and cosmonaut himself recalled:

[The Vostok program] had its opponents, there were rival projects (6).

He gave an example. In August 1958, several space projects were under consideration in Russian scientific circles, each contending for the position of flagship project for the early 1960s. One was for a "sophisticated automatic satellite" in preference to a piloted craft. Development of the ambitious Soyuz project was likewise fraught with difficulty. Work on Soyuz began in 1960, even before the Vostok design was tested. Konstantin P. Feoktistov explains:

At the time there was no consensus among the designers about what should be the future of space technology. Some thought that the next stage should be the development of orbital stations, others felt the moon should be the next target... All agreed however that the realization of any of these projects involved space vehicles approaching one another and docking (7).

A special group was then set up to resolve these design conflicts:

The next problem that arose was whether to modify the Vostok or design basically new vehicles to try out approach and docking procedures (8).

The latter choice was made and in the Spring of 1962 the decision was taken to initiate the design and construction of Soyuz. The general point about this debate is not so much the outcome, but the fact that it took place at all: there were rival approaches, philosophies, designs and schools of thought as to the best way forward.

Khrushchev: October 1963

Lovell's version of events in July and August 1963 was contradicted by Mstislav Keldysh and Lovell himself issued a corrective statement. There matters might have rested until October 1963 when Soviet Premier Nikita Khrushchev took it upon himself to redefine his country's space objectives. His remarks were interpreted unambiguously to mean that the USSR had withdrawn from the moon race. Speaking to journalists in the Kremlin about economic policy on October 27, 1963 he announced:

I read a report that the Americans want to land a man on the moon by 1970. We wish them luck and we will watch to see how they fly there, how they will land there and what is more important, how they will take off and return. We shall make use of their experience. Racing to the moon in competition would not bring any good, but on the contrary would cause harm, because it might lead to the death of people. There is still a lot of work to be done to prepare for a successful manned flight to the moon. Soviet scientists are working on this problem. They are studying it as a scientific problem and are doing the necessary research. We do not want to compete in sending people to the moon without careful preparation (9).

This announcement came at a time of economies being taken in the Soviet economy. Khrushchev was preparing new projects for the chemical industry and in the area of irrigation, but these had to be paid for by other sectors of the economy. This context received little attention at the time. Disputes over the allocation of internal economic resources were believed to be a feature of Khrushchev's premiership and ultimately a factor that led to his overthrow a year later.

Khruschev's announcement was variously interpreted at the time and many saw it as a trick. Was it a deliberate attempt to undermine the American moon program? Would it encourage the Congress of the United States to withdraw funds from Project Apollo, thus leaving the field clear for the Russians to move ahead? President Kennedy was very quick to insist that America was not going to "take the easy way out" [and withdraw as well]; nor did he accept that Russia had indeed withdrawn from the race altogether.

At this very time, Yuri Gagarin told the International Astronautical Federation that techniques were being developed for the assembly of components of spacecraft in Earth orbit and for the transfer of propellant. He implied that earth Orbit Rendezvous was the key objective, and he stressed time and again the questions of maneuverability, communications, refueling and assembly. His remarks did not necessarily point one way or the other in terms of the moon race, but they indicated unequivocally the priority being given to work in Earth orbit.

Changing American Perceptions

Intentionally or not, Soviet space activities in the following two to three years lent credence to the belief that construction of an orbiting space platform was being pursued rather than a lunar target. Polyot 2, in April 1964, was considered by the *New York Times* to be "a further step in the building of space platforms." (10)

By the time Voskhod 1 flew in October 1964 with a doctor, scientist and pilot aboard, such a consensus had hardened. The leading American periodical *Newsweek* assessed Soviet objectives accordingly:

Soviet statements and actions seem to be pointing toward multi-manned crews in prolonged Earth orbits carry out scientific and biological studies... it appears the moon is a second priority (11).

By the time Voskhod 2 had returned the following spring, American observers had made a more detailed assessment of the 1963 Soviet "withdrawal":

Khrushchev may have been out to trick the Americans; but it is more than likely that the statement was true. In fact, Khrushchev's statement may have contributed to his downfall... The belief, held by many U.S. experts [is] that the prime object of the Soviet program is to build platforms in Earth orbit (12).

By the end of 1965, which the Americans rounded off triumphantly with the first orbital rendezvous between Gemini 6 and 7, it seemed that Soviet lunar ambitions had indeed receded. The appearance of the Proton booster in July 1965 was interpreted as a preference for a lunar flyby, rather that a landing, if there was to be a flight to the moon at all. One commentator explained:

It appears that 1963 was the year in which Russia seriously revised her plans for lunar conquest. It seems that priority was given to the simpler task of achieving a circumlunar flight (13).

Some Conclusions

The promised space platform as described in 1963 never materialized and little further was heard of it. Was it a serious project?

Despite all that we now know about the Soviet moon program in the 1960s, it is still difficult to interpret the strange turn of events in 1963. It is impossible to reach any firm conclusion as to whether the USSR did (temporarily at least) withdraw from the moon race in 1963. The final decision to proceed with the N-1 man-on-the-moon was not taken until 1966 (14). However, the briefing Lovell received in the USSR in July 1963 and the Khrushchev remarks of October 1963 suggest withdrawal was, at least, very seriously considered.

The details of the "space platform" described by Keldysh and in turn by Lovell are sufficiently informative to imply that a less costly alternative to the Moon project had reached an advanced stage of planning and may even have been adopted as a project. Despite all that has emerged concerning the Soviet Moon projects over 1980-1993, little has come to light concerning this project. Following the termination of the Vostok series in June 1963, the summer and autumn of 1963 seem to have been times of detailed reevaluation of Soviet space objectives. The events of that autumn were a rare example of that internal debate spilling out to the West. Only the post-glastnost epoch will, in the fullness of time, reveal the full story. ●

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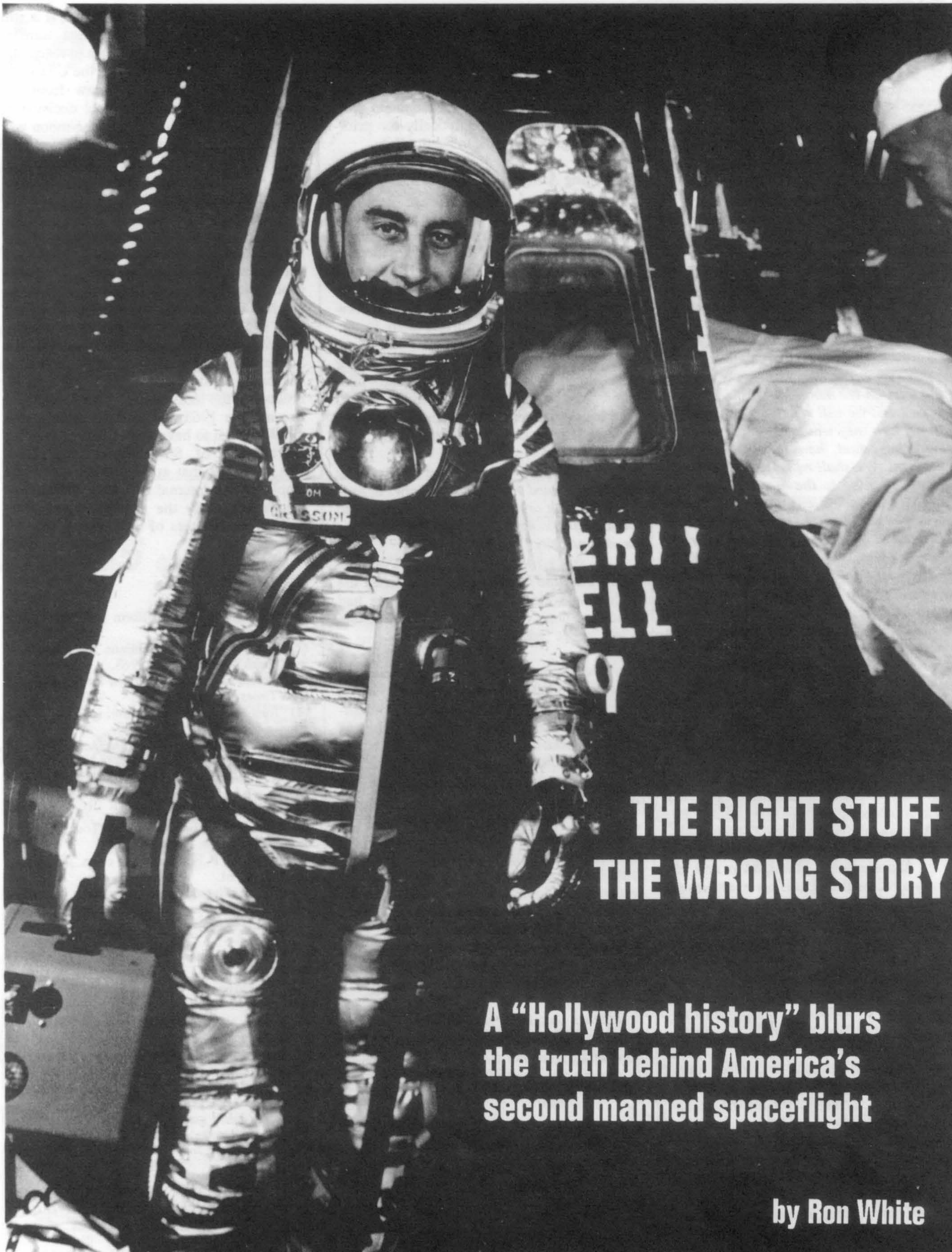


THE RIGHT STUFF
THE WRONG STORY

A "Hollywood history" blurs the truth behind America's second manned spaceflight

by Ron White

The 1983 movie, *The Right Stuff*, in a gross misrepresentation of fact, portrayed a panicky Gus Grissom struggling to unlatch his helmet as his Mercury capsule, dubbed the Liberty Bell 7, bobbed in the Atlantic Ocean. The astronaut was seen on the big screen breathing heavily and sweating profusely, seemingly concerned only with how soon the rescue helicopter could latch on and let him blow the escape hatch so that he could return to the safety of the awaiting recovery ships. The viewer is then led to consider that Grissom somehow blew the escape hatch himself, causing the loss of his vehicle and his reputation as an astronaut with "the right stuff." Unfortunately, due to the immense popularity of both the book and the film , this vision of Grissom's first flight will be the only one remembered by most Americans. Such is the fate of events transformed as "Hollywood history" which so often includes a disproportionately larger dose of fiction than fact.

On the morning of July 21, 1961, Virgil I. "Gus" Grissom, after two previous mission scrubs, was awakened at 1 a.m. by Bill Douglas, his physician. Douglas informed the astronaut that the launch of MR-4 (Mercury Redstone 4), donned "Liberty Bell 7," had been pushed ahead by one hour in order to beat approaching bad weather.

Grissom consumed a low-residue breakfast and went through a last medical check. By 3:58 a.m., suite technician Joe Schmitt was strapping Gus into his capsule, Spacecraft No. 11, the first operational capsule with a centerline window. In addition to the window, another innovation to Grissom's spacecraft was an explosive side hatch to relieve the astronauts from the cumbersome chore of egressing through the antenna compartment. To activate the hatch, the astronaut could pull a pin and with a force of 5-6 pounds, press a plunger located 6-8 inches from his right arm. If the pin was not removed, a considerably greater fist-force of at least 40 pounds was required to activate it.

At 4:50 a.m., technicians secured the hatch's 70 explosive bolts. Shortly thereafter a cabin purge began. At 4:58 a.m., a gantry technician reported that a hatch bolt was misaligned. Grissom waited patiently in the Liberty Bell, hoping another mission scrub would not ensue. During the thirty-minute hold that followed, engineers determined that the hatch was capable of separating at fuse detonation. The count resumed at 5:45 a.m.

Finally, after two more minor holds, the Liberty Bell lifted off from Cape Canaveral's Pad 5 at 1 second after 7:20 a.m. EST, Grissom was on his way toward becoming America's second man in space and the last to make the ride using the sub-orbital Redstone booster.

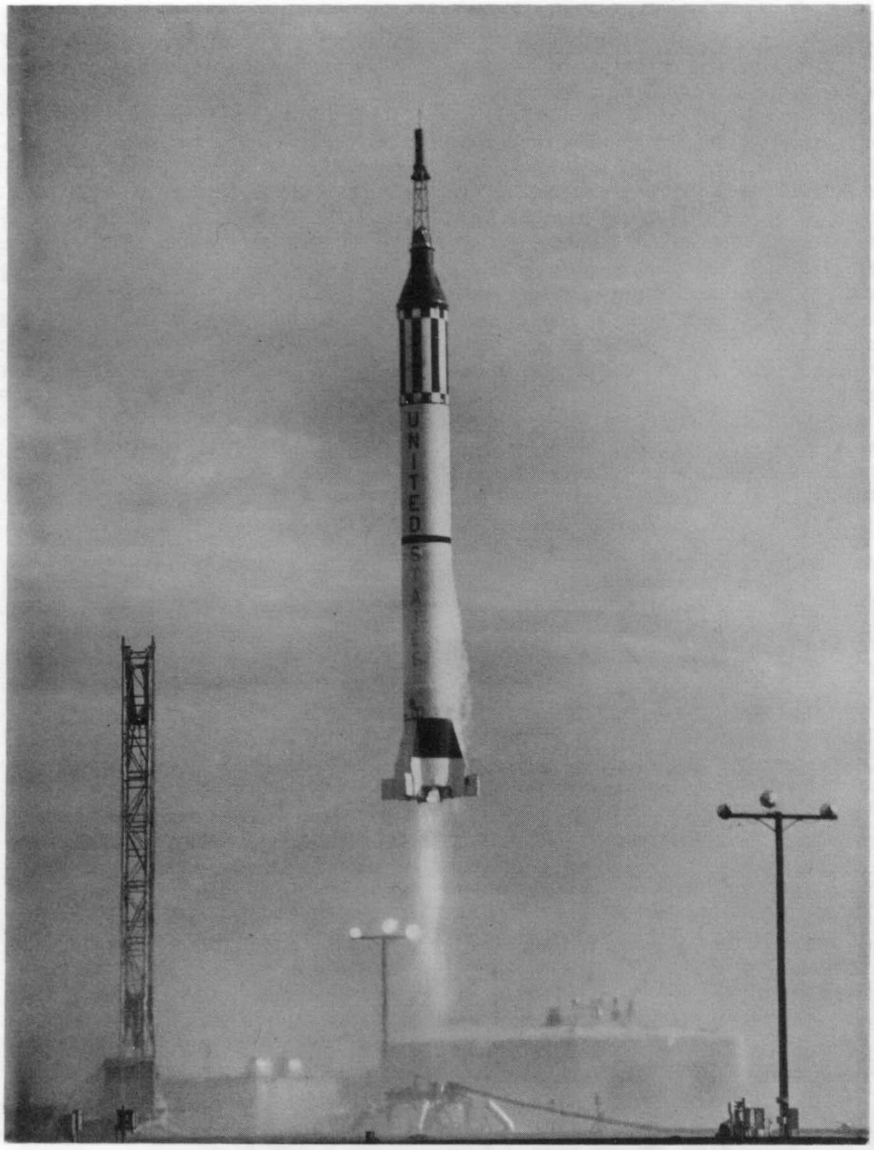
"Loud and clear, Jose, don't cry too much" Cap Com Alan Shepard joked in response to Grissom's announcement that "the clock has started." Shepard was referencing humorist Bill Dana's fictional, frightened "astronaut", Jose Jimenez. When asked how he would spend the long, lonely hours of space flight, Jimenez would always respond, "Cry a lot!" The phrase became somewhat of a watchword among the seven Mercury Astronauts.

Grissom reported his condition as "one by one through Q," the period of maximum aerodynamic pressure. At T+2 minutes 33 seconds, the Liberty Bell was traveling 13,385 miles per hour and separated from the Redstone rocket. The solitary astronaut and ex-test pilot with 100 combat missions to his credit in Korea, showed no significant emotional swing except to enjoy the view of earth as his capsule turned around to face backward and pitch down to -34 degrees (retro-fire attitude).

Grissom, taking advantage of the breathtaking view, persistently looked out his trapezoidal window as he assumed Manual-Proportional (MP) control of pitch, yaw and roll. This was a departure from the MR-3 mission where Alan Shepard had switched to MP in pitch, then yaw and finally roll, rather than full MP from the start.

Going through basic maneuvers in the three axes, Grissom then attempted to hold the Liberty Bell in its proper attitude by using the earth as a visual reference to determine if future orbiting astronauts could do the same in case of instrument failure. This experiment was cut short due to retro-fire which gave him "a kick in the pants" in the process. He reported that he noticed a definite yaw to the right during retro-fire so he quickly switched back to instruments. Because MR-4 was on a ballistic path, the firing of the retro-rockets was carried out mostly for practice to help prepare for orbital flights. Grissom held attitude control on the MP system as he monitored the retro-fire sequence. He manually

Astronaut Virgil I. Grissom climbs into Liberty Bell 7 on the morning of July 21, 1961. Backup Astronaut John Glenn assists in the operation. NASA Photo 61-MR4-77 courtesy NASA and Ron White.



The launch of MR-4. NASA Photo 61-MR4-80 courtesy NASA and Ron White

punched the retro-rocket ignition button at T+5 minutes 10 seconds and then switched to the Rate Stabilization Control System (RSCS). The RSCS was incorporated into the manual controls for MR-4 and for the first time, the astronaut with the RSCS was able to control the rate of attitude movements by small turns of his hand controller versus jockeying the device to obtain position. The rate damping provided by the RSCS allowed for smoother handling and a second means of driving the pitch, yaw and roll thrusters. In general, Grissom seemed pleased with the responsiveness of the RSCS.

Re-entry began at T+7 minutes 46 seconds. Deceleration reached a maximum 11.1 g's in 34 seconds. At T+9 minutes 41 seconds the drougue parachute deployed and was released seconds later, leaving the capsule once again in free fall. The main chute then deployed. Grissom opened his faceplate and disconnected the visor seal hose in preparation for splashdown. Then, at 15 minutes 37 seconds into the flight, Liberty Bell splashed down safely into the Atlantic Ocean.

Liberty Bell's splashdown signaled the end of a then record setting flight. MR-4's booster burned for eight-tenths of second longer than Shepard's MR-3 rocket and Grissom's flight was 30 mph faster, 1.5 miles higher, three miles longer in downrange distance and he was weightless for 37 seconds longer than Shepard. Even though Grissom's performance was deemed "superb" by Mercury officials, it was his spacecraft that would soon mar his achievement.

After Grissom ejected the reserve parachute, the Liberty Bell nosed over in the water but righted itself in less than one minute. The recovery team, called Hunt Club, arrived within three minutes after splashdown. The first of two recovery helicopters, Hunt Club I, piloted by Lt. James L. Lewis, hovered near the Liberty Bell inquiring of Grissom regarding his readiness for egress.

During this brief time, Tom Wolfe's popular film adaptation of his best selling book, *The Right Stuff*, portrays a panicky Grissom. The viewer is led to conclude that the astronaut, wriggling around in a frantic state, accidentally "blew the hatch."

It would be highly unlikely that a man in a heightened state of anxiety for his safety, as both book and movie lead us to believe, would respond matter-of-factly to the rescue helicopter: "Roger, give me about 5 minutes here to mark these switch positions before I give you a call to come in and hook on. Are you ready to come in and hook on anytime?" asked Grissom.

The recovery helicopter responded affirmatively.

"Ok, give me about another 3 or 4 minutes here to take these switch positions, then I'll be ready for you."

Grissom completed logging the panel data and ten minutes after splashdown he called the recovery helicopters to move into position.

"Ok, latch on, then give me a call and I'll power down and blow the hatch, ok?"

Grissom then removed the pin from the hatch-cover detonator and lay back, apparently in complete control of himself. Suddenly, Grissom said that he had heard a "dull thud." The hatch-cover had blown away allowing salt water to rush into the capsule. The Liberty Bell was sinking.

Only then did Grissom remove his helmet. Within seconds, he was out the hatch and into the ocean. Pilot Lewis had, by this time, moved the helicopter close above the Liberty Bell while co-pilot Lt. John Reinhard was preparing to cut the 4.2 meter long whip antenna from the top of the capsule. They could see Grissom was safely away from the bobbing capsule with his shoulders out of the water.

Lewis and Reinhard were able to snare the Liberty Bell and it appeared for a moment like the helicopter would rescue the water-filled capsule.

By this time, Grissom had swam back in the vicinity of the capsule to help if needed when a flashing red light on the instrument console of the helicopter indicated an overheated engine. Lewis advised Reinhard to refrain from recovering Grissom and call the second recovery helicopter in to pick up the astronaut.

The movie never showed Grissom swimming toward the sinking capsule but had him, instead, in the ocean flailing around shouting at the recovery team.

With Hunt Club I and II in close proximity, the downwash of two hovering helicopters was fighting against Grissom, pushing him beneath the waves. In addition, air had been escaping through his suit's neck dam as well as through the suit inlet valve which he had forgotten to secure. His suit began filling with water as he struggled to stay afloat while the first helicopter began moving away dragging the now completely submerged capsule with it.

Finally, Grissom recognized the co-pilot of the second helicopter, George Cox, and his spirits were lifted as Cox tossed the "horse collar" lifeline to him.

Lt. Lewis, pilot of the first helicopter, relented to the persistent warning light and cast loose. The Liberty Bell sank into water over three miles deep. Grissom was hoisted aboard Cox's helicopter and on his way to the waiting carrier *Randolf*.

The recovery incident lasted only a few minutes but it seemed like an eternity to Grissom and the recovery teams aboard the helicopters.

Tom Wolf in his book *The Right Stuff*, the "stuff" of which the movie was made, weaves somewhat of a fantasy concerning the events between splashdown and recovery. He makes Grissom's pulse rate during the mission, which jumped from 64 to 170 beats per minute, an issue to render the astronaut's performance suspect.

Continuing to portray him in less than favorable terms, Wolf in writing about Grissom waving from the water to the helicopters, quotes Grissom as saying, "I'm drowning! – you bastards– I'm drowning!"

Wolf's forays into Grissom's mind are particularly interesting: "Deke... Where was Deke!... Surely Deke would be here... Somehow Deke would materialize and save me..." Grissom later recalled an incident during recovery training in Pensacola when he and Schirra rescued Slayton when Slayton was taking on water in his suit and sinking. Grissom remarked that he would have liked someone close at hand to do the same during his recovery. Wolf may have determined from this that Grissom was fantasizing about Slayton.

In addition to the above, there are other construed portrayals that were obviously included for dramatic effect even though the real story needs no added theatrics.

Wolf could have more realistically portrayed Grissom as a well-trained, resolute man focused on his mission and, at the same time, succeeded in preserving his own life during a risky and hazardous situation. There is simply no evidence to support the caricature as portrayed in the book and movie. There is no evidence to even insinuate that Grissom "screwed the pooch."

The movie conveniently left out crucial portions of the communications between Grissom and Hunt Club I –portions that demonstrated the astronaut's control over himself and his mission. The film director left a not-so-subtle impression that Grissom may have blown the hatch on purpose in his haste to egress. If this were the case, why would Grissom have asked the rescue helicopter to wait a few minutes while he completed logging instrument readings if he were inordinately anxious to exit the capsule and hyperventilating?

If one is to believe the book and film version of the flight of the Liberty Bell 7, then one question becomes compelling: Why would NASA keep an astronaut on active flight status and later assign him to be commander of the first Gemini mission (Gemini 3) and the first Apollo flight (Apollo 1) if they even remotely suspected that he was the man portrayed by Wolf?

Its seems unthinkable.

Though the mystery still remains as to why the hatch blew, there were several theories discussed as to what might have happened. Among them were: the seal on the detonation plunger had been left out; static electricity from the rescue helicopter had detonated the hatch.

Whatever the reason, a committee put together by the Space Task Group, which included Mercury astronaut Wally Schirra, studied the incident. The group had many extensive tests conducted on the hatch but could not replicate the problem. Tests were also conducted using people operating the panel switches nearest the plunger to try and prove if someone could accidentally hit the plunger. All tests showed adequate clearance. Schirra later said that, "There was only a very remote possibility that the plunger could have been activated inadvertently by the pilot."

One final point. If Grissom had used the hatch plunger to blow the hatch, he would have been the only astronaut to do so without receiving an injury from the action. Hardly an indictment.

Even a cursory review of the facts tells us the man in the movie bears little resemblance to the man who was in the Liberty Bell on July 21, 1961, the same man who gave his life for his country in the pursuit of manned exploration of space not six years later. ●

Marine helicopter "Hunt Club 2" bringing a near drowned astronaut Gus Grissom out of the water. NASA Photo 61-MR4-82, courtesy NASA and Ron White.

Ron White is a freelance writer and a computer analyst at NASA's Kennedy Space Center.

Semyorka Family Values by Daniel James Gauthier, FBIS

For nearly forty years, one family of space launchers has been operating nearly non-stop since orbiting the first artificial satellite, and the legacy of "Old Number Seven" will apparently continue well into the 21st century.

In the mid '40s German designers at Peenemunde drew up plans for several new missiles, including a tapered, conical missile powered by four gimballed engines, the Pfiel (Arrow). At the end of the Second World War in Europe came Soviet occupation of eastern Europe and much of Germany, including Peenemunde. Many of the German rocket team found themselves "contracted" to a new assignment, assisting in the development of long-range rocketry for the USSR.

A er a lengthly trip through Poland, Byelorussia, the Ukraine, and into Russia, the Germans were secured in a tightly-guarded research compound on the east bank of the Volga River near a town named Kapustin Yar, and proceeded to work. hey helped establish Soviet production of the German A-4/V-2, now renamed R-1 by the USSR, designated SS-1 by the US Department of Defense and Skunner by the North Atlantic Treaty Organization. Plus, they created an improved version of the R-1, the SS-2/Pobeda (Victory), designated SS-2/Sibling by the DoD and NATO, and resurrected plans for many proposed German missiles, including the Pfiel. By mid-1952, a er pretty much wringing their Germans "contractees" dry of what information they had, the Soviets sent the last of them back to what was now the German Democratic Republic (East Germany).

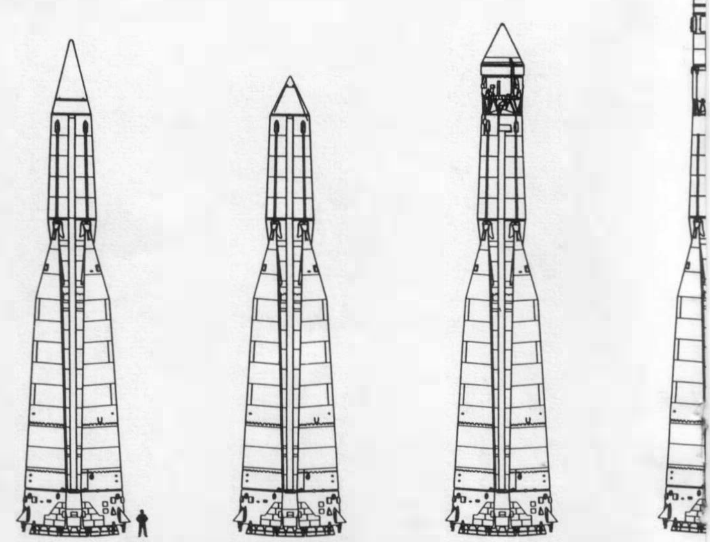
Sergei Korolev, the head of Soviet rocketry efforts, integrated this German research and development into the USSR's missile programs, and by the mid 1950's, plans were completed on a new intercontinental-range rocket, the R-7, nicknamed Semyorka (old number seven). Semyorka used a "cluster of clusters" approach to its design- a cluster of four boosters strapped to a central core booster, each of the five powered by a cluster of engines at its base. When Semyorka's design was publicly revealed in the '60s, several of the Peenemunde Germans noted a startling resemblance between Semorkya's strap-on boosters and the Pfiel, the two were within 10% of each other's dimensions.

On 3 August 1957, the R-7, now designated SS-6 by the DoD and Sapwood by NATO, made its first successful launch from Tyuratam Cosmodrome, impacting near the Kamchatka Peninsula. Semyorka proved to be unwieldy as an offensive weapon and a great target defensively since it took hours to set up, fuel, and launch. During its deployment with the Soviet Strategic Rocket Forces from 1960 to 1968, no more than four Semyorkas were ever deployed at one time, mainly at special sites constructed on spurs off the Trans-Siberian Railroad. By stark contrast is the deployment of the SS-7/Saddler ICBM from 1961 through 1977, with a peak deployment of 186 missiles from 1965 through 1975. Semyorka, however, would serve even longer, but in a new role.

On 4 October 1957, a modified Semyorka, designated SL-1 by the DoD and A in the Library of Congress Sheldon system) orbited Sputnik 1, and was followed by five more launches- the orbiting of Sputnik 2 on 3 November 1957, a launch failure on 3 February 1958, the orbiting of the 1-metric-ton Sputnik 3 on 15 May 1958, and the launches of Polyot 1 & 2 on 1 November 1963 and 12 April 1964, respectively. (There has been some confusion with both the DoD and LoC designators at this point, some sources apply SL-1 or A to all six launches, while others apply SL-1 or A to Sputnik 1, SL-2 or A to the next three, and SL-5 or A-m to the Polyot missions.)

On 25 June 1958, an uprated version of Semyorka made an inauspicious debut by failing to orbit the first Luna probe. This modified Semyorka featured an added upper stage and would later launch the early Luna probes, all the Vostok manned spacecraft, the first Cosmos reconsats, Meteor metsats, and more. This Semyorka version, called Vostok by the Russians, is designated SL-3 by the

From left to right:
R-7 / SS-6 / Sapwood (note person to scale)
Sputnik / SL-1 / A (Sputnik 1 shown)
Vostok / SL-3 / A-1 (Luna 1 shown)
Soyuz / SL-4 / A-2 (Soyuz 1 shown)
Molniya / SL-6 / A-2-e (Molniya 1-1 shown)
Rus-2 (Soyuz TM version)
Rus-3



Some Semyorka Statistics...

SS-6/Sapwood/R-7 ICBM
8000-kilometer range
2-kilometer CEP*
6.8 metric tons throw weight
Carried a single 5-megaton thermonuclear warhead

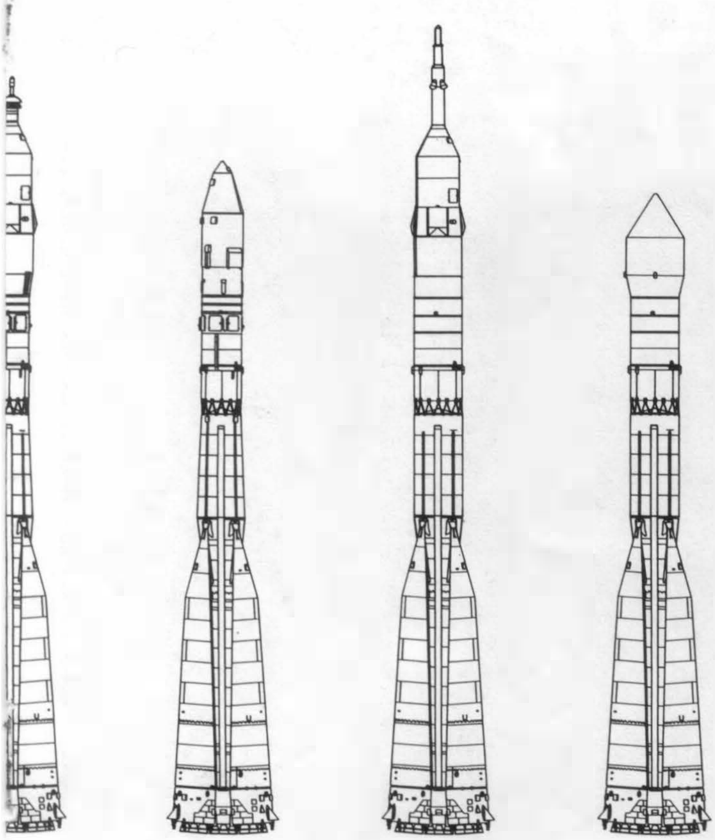
SL-1/SL-2/A SL-5/A-m Sputnik
1.3 metric tons to LEO

SL-3/A-1 SL-10/A-
4.7 metric tons to LE
2.2 metric tons to pola

SL-4/A-2 Soyuz
7.5 metric tons to LE

SL-6/A-2-e Molniy
1.8 metric tons to "M
1.7 metric tons to tran
1 metric ton to transpl

	Launcher							
Year	SL-1	SL-2	SL-3	SL-4	SL-5	SL-6	SL-10	Total
1957	1	1						2
1958		2	4					6
1959			4					4
1960			6			2		8
1961			5			4		9
1962			7			6		13
1963			9		1	6		16
1964			15	2	1	9		27
1965			19	3		12	1	35
1966			25	2		11	1	39
1967			28	4		7		39
1968			28	8		6		42
1969			28	11		4		43
1970			16	19		7		42
1971			5	32		4		41
1972			5	30		11		46
1973			3	40		9		52
1974			6	35		7		48
1975			5	41		12		58
1976			6	37		11		54



l-m Vostok
)
r orbit

olniya" orbit
slunar orbit
anetary orbit

Rus 2
8.2 metric tons to LEO

Rus 3
2.3 metric tons to "Molniya" orbit
2.2 metric tons to translunar orbit
1.3 metric tons to transplanetary orbit

*Circular Error Probable,
a measure of the size of the target impact "footprint" of a reentry vehicle.

	Launcher							
Year	SL-1	SL-2	SL-3	SL-4	SL-5	SL-6	SL-10	Total
1977			7	37		10		54
1978			5	46		8		59
1979			8	45		7		60
1980			6	45		12		63
1981			6	44		14		64
1982			5	43		10		58
1983			3	43		10		56
1984				44		11		55
1985			1	40		16		57
1986				35		14		49
1987				43		4		47
1988			2	42		11		55
1989				38		6		44
1990				28		12		40
1991			1	24		5		30
1992				24		8		32
1993**				16		7		23
Total**	1	3	268	901	2	293	2	1470

**Launches through 30 September 1993.

DoD, A-1 by the LoC. Two recsats, Cosmos 102 and Cosmos 125, launched on 27 December 1965 & 20 July 1966, respectively, tested new maneuvering systems, their launchers were designated SL-10 by the DoD and A-1-m by the LoC. On 17 March 1966, the Vostok booster launch of Cosmos 112 premiered a new Soviet launch site, the Northern Cosmodrome at Plesetsk. In the late '60s, a decline in SL-3 launches began, caused by a shift of reconsat launches to the SL-4/A-2/Soyuz booster (to be discussed later) and a shift of metsat launches to the SL-14/F-2/Cyclone booster in the early '70's.

On 10 October 1960, like the first SL-3 launch, a new version of Semyorka made an inauspicious debut- it failed to orbit the Soviet's first Mars probe. This booster replaced the SL-3's final stage with a larger stage, and topped the stack with a modified Vostok final stage. This booster, named Molniya by the Russians, was designated SL-6 by the DoD and A-2-e by the LoC, launched the Soviet's early planetary missions, second-generation Lunas, Molniya comsats, and early-warning satellites. On 19 February 1970, Molniya 1-13 was orbited, the first Molniya booster launch from Plesetsk. Since the late '80s, a decline in Molniya booster launches has occured, spurred by the development of longer-lived comsats and warnsats, along with launches of geosynchronous comsats and warnsats by the SL-12/D-1-E/Proton 4.

On 6 October 1964, a modified Molniya booster orbited Cosmos 47, a Voskhod 1 precursor. This Semyorka varient, called Soyuz by Russia, SL-4 by the DoD, and A-2 by the LoC, deletes the Molniya final stage, and has orbited all Voskhod, Soyuz, and Progress spacecraft along with Cosmos reconsats. On 8 November 1969, the first Soyuz launch occured from Plesetsk, orbiting Cosmos 309, a reconsat. Since the late '80s, improved, long-life reconsats and a reduction in manned flights have led to a decline in the SL-4 launch rate.

The Vostok, Molniya, and Soyuz versions of Semyorka have been improved over time, but, to increase orbital and escape payloads any further, especially when launching from Plesetsk, the Russians faced two options- either manufacture a new booster or substantially modify the basic Semyorka design- they have taken the latter course. This latest Semyorka varient, Rus, modifies the basic Semyorka design is modified by enlarging the upper, conical section of the central core along with the stage placed above it, increasing fuel capacity and burn time, and boosting performance by 10%. For launches to "Molniya" orbits or lunar/planetary missions a new hypergolic-fuelled final stage, based on the Phobos maneuvering block, will be added. The first test launch of Rus may occur as early as 1996, and its capabilities would give Russia some added flexibility with launch operations.

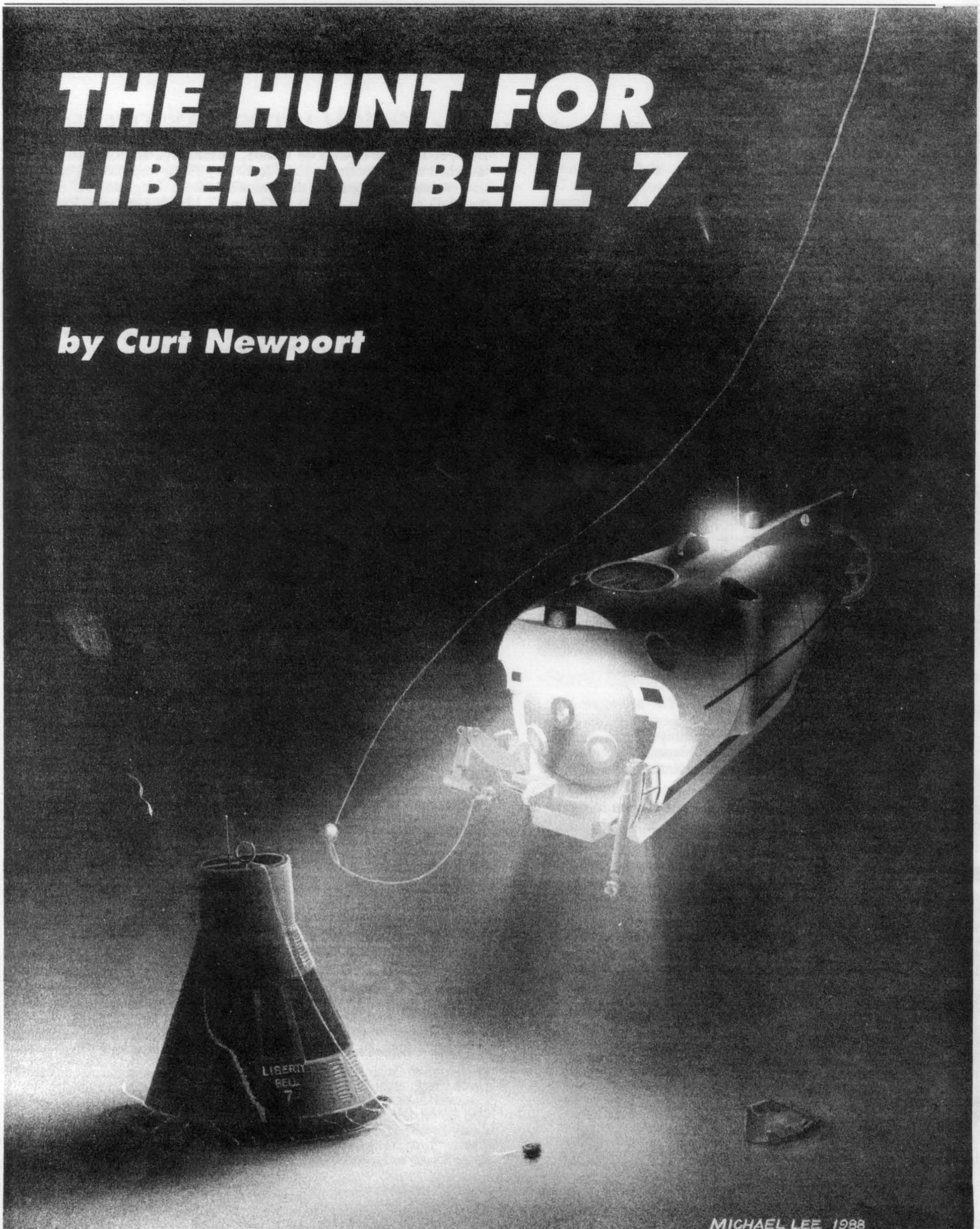
If relations between the Russian Federation and Kazakhstan were to continue to worsen, Rus would allow Russia to shift 52-degree inclination launch operations from Baikonur to Plesetsk. If relations between Russia and Kazakhstan were to normalize somewhat, launching Rus from Baikonur would give the Russians greater payload capacity, perhaps as much as 8.3 metric tons to LEO. Other enhancements to Rus might include higher-energy LOX/LH upper stages to replace the LOX/kerosene and hypergolic-fuelled stages currently being proposed for the new launcher.

With over 1400 launches to date and more to come, Semyorka and its kin have helped lay the foundation of the road to the stars.

Daniel James Gauthier is an aerospace analyst, artist, and writer residing in Battle Creek, Michigan. His services are utilized by ANSER, The Library of Congress, NASA, the White House Office of Science, Technology, and Space (and its predecessor). His work appears in *Ad Astra*, *Aviation Week and Space Technology*, *ABC News Nightline*, *Final Frontier*, *The New York Times*, *Space News*, and *Spaceflight*. He is a life member of the National Space Society and a British Interplanetary Society Fellow.

THE HUNT FOR LIBERTY BELL 7

by Curt Newport



Aboard the prime recovery ship, carrier *USS Randolph*, Captain Harry E. Cook, Jr. anxiously strained his eyes to the skies in search of the ringsail parachute. Cook's ship was part of the prime recovery task force for MR-4 stationed 302 miles off the Florida coast, holding position just south of astronaut Gus Grissom's predicted landing point. Simultaneously, Marine Lieutenant James Lewis and co-pilot John Rinehart took off aboard "Hunt Club One," one of four recovery helicopters with one objective in mind: recover the capsule and the astronaut at all costs. A nine knot wind was blowing with calm seas and good visibility, ideal conditions for the recovery that they had practiced many times before in training.

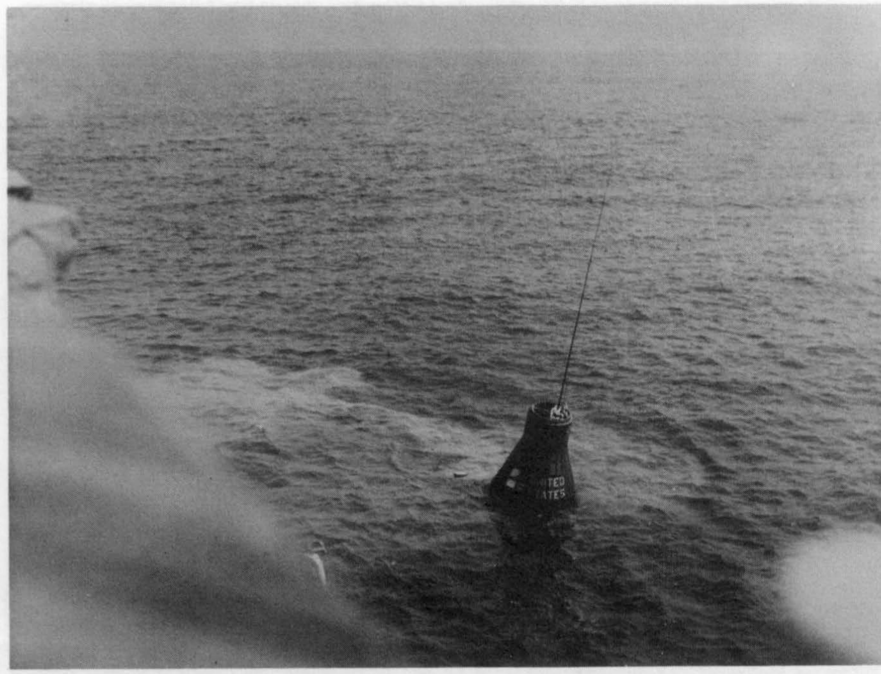
The loud report of a sonic boom gave recovery forces the signal they had been waiting for that morning. Grissom's Mercury spacecraft, the Liberty Bell 7, could be seen falling toward the ocean during the final minutes of flight, first showing as a vertical contrail then as a small speck following deployment of the capsule's main parachute.

Observing splashdown six miles from his carrier, Captain Cook ordered the *Randolph's* speed increased to 25 knots with a heading directly bound for the floating spacecraft which was now being circled by the helicopter recovery force.

Lewis and Rinehart were the first to arrive near the spacecraft. The basic recovery plan called for them to hover near the top of the bobbing capsule and cut off the long antenna extending from the recovery aids section. Next, they would use a long shephards hook to attach the helicopter's lift-line to a small dacron loop on the capsule top. After the helicopter had lifted the bulk of the spacecraft clear of the water, the astronaut would blow the hatch, exit and be lifted up to the chopper with a sling.

Up to this point in the mission it had been a "textbook" flight. What followed next however was definitely not according to plan. As co-pilot Rinehart explained, "I saw beyond the capsule in the direction the wind was coming from, the hatch blown off the spacecraft. It flew about five feet flat and then turned and went skipping across the water." This was not supposed to be happening. Grissom recalls, "I was just laying there (sic) minding my own business and Pow! – the hatch went." He chucked off his space helmet, ripped off the oxygen hose tying him to the vehicle and half floated and squeezed through the small hatch opening trying to get clear of the flooding capsule. On his way out he became tangled in the spacecraft's dye marker canister and, fearful of being dragged down with the sinking spacecraft, frantically pulled it clear of his harness.

By now, only two feet of the top of Liberty Bell 7 was above the surface as Lewis and Rinehart hovered nearby. In a daring maneuver, Lieutenant Lewis put the wheels of the chopper underwater next to the sinking spacecraft. His co-pilot Rinehart quickly chopped off the long antenna and grabbed the recovery pole, turned on the movie cameras and snagged the loop in record time. He made the hook-up while the capsule was totally submerged – an amazing feat.



Liberty Bell 7 floating in the Atlantic Ocean shortly after splashdown with Gus Grissom onboard. Note floating dye marker and long antenna extending from the top of the capsule. NASA photo S61-3882 courtesy NASA Lyndon B. Johnson Space Center and Ron White.

Meanwhile Grissom, who had forgotten to close an oxygen inlet valve in his spacesuit, was also sinking but no one knew it. "I was getting lower and lower in the water all the time" recalled Grissom, "and it was quite hard to stay afloat...There were three helicopters there. I guess there were four – I don't remember seeing but three. I was caught in the center of all three of them and couldn't get to any of them...I thought to myself, 'Well, you've gone through the whole flight and now you're going to sink right there in front of all these people.'"

Finally, after some strong swimming, Grissom was able to reach the vicinity of Lewis' horse collar. But now Lewis had another problem. Lewis recalls, "Rinehart had lowered down the horse collar for Gus when I got a chip warning light on the chopper control panel (an indication of metal chips in the engine oil sump). John raised the sling while I tried to move the helicopter and the capsule away from Grissom so that if I lost the engine, I would not crash down on top of him."

Grissom was saved by a second helicopter while Lewis desperately tried to keep the Liberty Bell 7 and his helicopter out of the water. Lewis explains, "What I wanted to do was to hold the capsule underwater until the *Randolph* got close enough to pass a line down to the submerged spacecraft, but with that warning light there was nothing I could do."

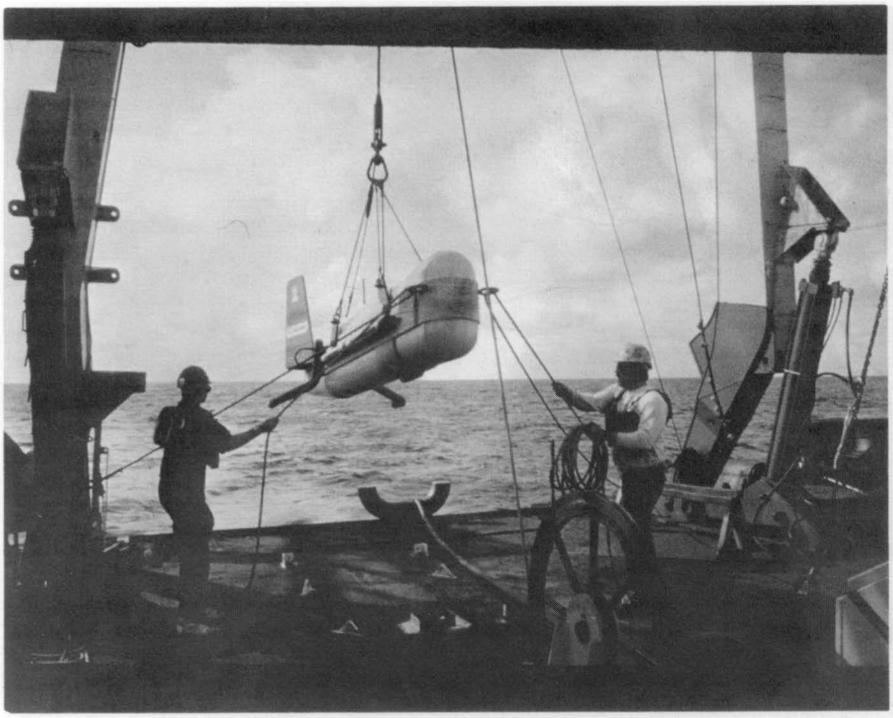
Lewis had the flooded spacecraft nearly clear of the water many times but simply could not keep it suspended above the ocean long enough to drain the water out of the capsule's landing bag and then translate to forward flight.

Unlike the Gemini and Apollo capsules, the Mercury spacecraft were fitted with an impact landing skirt. This was a cylindrical fabric construction deployed after the spacecraft was hanging on its main parachute. After softening the capsule's landing in the ocean, it functioned as a sea anchor filling with water (over four tons worth) to help keep the vehicle upright during recovery.

Despite Lewis' best efforts, the weight of the sea water in the landing skirt along with the added ton of water inside the flooded capsule made it physically impossible for the pilot to lift the spacecraft clear of the ocean. This coupled with a chip warning light, dropping oil pressure and a rapidly overheating engine made for a critical situation.

On board the *Randolph*, as soon as it became apparent that a real emergency was developing, Captain Cook advised Lewis that, "if it was getting dangerous...cut it loose and let it go."

Lewis radioed the carrier, declared an inflight emergency and ordered his co-pilot to sever the cable attached to the flooded capsule. Liberty Bell 7 splashed into the water on its side, slowly uprighted itself and began a long three mile descent to the seafloor. Lewis' chopper, free of the overload, lunged upward and forward across the ocean. "Hunt Club One" landed on the carrier minutes before a dripping Astronaut Grissom returned



Deep Ocean Search System vehicle being deployed off the Florida coast in March 1992 during the first recovery expedition for the Liberty Bell 7. Photo courtesy Curt Newport.

aboard one of the other helicopters. Interestingly enough, mechanics on the *Randolph* were never able to find anything wrong with the engine on Lewis' helicopter and they reasoned that the chip-warning sensor was probably triggered by an errant metal flake drifting in the engine's oil sump.

For almost 30 years the question of how Liberty Bell 7's hatch fired prematurely has been debated by many spaceflight historians and enthusiasts.

The explosive hatch fitted to Grissom's capsule was indoctrinated into the design of the Mercury spacecraft as a result of complaints by the astronauts that there was no satisfactory way to exit the vehicle in an emergency. The original design of the spacecraft required that the pilot exit via the small end of the capsule, through the area that held the main and reserve parachutes. This procedure however, required the astronaut to remove a section of the control panel, pull out a small pressure bulkhead, detach several electrical connectors and finally push out a fiberglass liner that had formerly held two parachutes. It was altogether a very time consuming operation that was deemed unacceptable. This forward hatch was used only once during Project Mercury, by Scott Carpenter following his mission in Aurora 7. Thus, the explosive hatch was baselined as part of the Mercury design.

The Mercury hatch was not actually held in place by "explosive bolts." Rather, the hatch, weighing 23 pounds in air, was fastened to the side of the capsule by 70 titanium bolts, each of which had been modified (and purposely weakened) by the drilling of a small hole through the bolt shafts. The hatch was sealed by a magnesium gasket and an inlaid rubber seal. In close proximity to the bolts, a length of "Mild Detonating Fuse" (MDF), a rope-like explosive similar to primacord, was fitted into a channel that surrounded the perimeter of the hatch. The two ends of the fuse terminated at the hatch plunger mechanism which was mounted on the inside of the door. Following actuation of the hatch plunger, the MDF would fire causing the hatch bolts to fail in tension.

The hatch plunger was a relatively simple device that used two firing pins and percussion caps to detonate the fuse described previously. Operation of the plunger took place in two stages: Initially, the astronaut had to remove a small screw cap that covered the plunger (which looked like a large push button). At this point, the mechanism was "safed" by a safety pin and required at least 40 pounds of force to fire. The astronaut could then either fire the hatch or remove the safety pin and depress the plunger with only four pounds of pressure. The plunger mechanism could also be fired from outside the capsule without any action by the astronaut. This aspect of the design made it possible for rescuers to blow the hatch and save an incapacitated pilot. The rescue personnel would have to remove a small screw from the outside of the hatch and pull out a wire lanyard with sufficient force to break the interior safety pin (and fire the plunger). The problem was that the lanyard was only 42" long and the hatch could easily travel 20 feet from the side of the spacecraft. As a result, NASA post recovery procedures described an elaborate rope and pulley arrangement that would enable shipboard personnel to safely fire the hatch from outside. To correct this awkward deficiency, the hatch was also held in place from the inside by two short lengths of soft iron coils which would limit the distance the door would fly to one foot. On Grissom's mission, the flight plan called for the astronaut to install these coils while the spacecraft was floating on its main parachute. Unfortunately, Grissom was unable to complete the task with his spacesuit gloves on, hence, when the hatch detonated, its sailed clear of the spacecraft and promptly sank.

During Grissom's postflight debriefing with NASA, he indicated that he had already removed the plunger cap and safety pin and was waiting for the recovery helicopter to call and tell him that they had hooked onto his capsule. Recalled Grissom, "I was just waiting for their call when all at once, the hatch went. I had the cap off and the safety pin out, but I don't think I hit the button. The capsule was rocking around a little, but there weren't any loose items in the capsule so I don't see how I could have hit it, but possibly I did." However, later in the debriefing, Grissom discounted even the possibility that he could have accidentally hit the plunger. This fact is supported in part by astronauts John Glenn and Wally Schirra, who both used the explosive hatch at the end of their Mercury orbital flights. Because of the recoil of the hatch plunger from the explosive gases, they both had suffered minor injuries to their hands during the firing of the hatch. Grissom was given a thorough physical examination after his flight and no evidence was found of any similar injury.

The two most likely theories as to how the hatch could have fired on its own have to do with the possible release of the external actuation lanyard from the side of the spacecraft and the existence of a vacuum in the hatch plunger mechanism. If the lanyard handle had become dislodged during the flight then the end (and the small handle) would have been dangling down near the capsule's landing bag straps while the Liberty Bell 7 floated in the ocean. With Grissom pulling out the safety pin, it is not at all inconceivable that the handle could have been snagged by one of the straps causing the hatch to fire. In the second possibility, the cable used to make up the external lanyard was sealed into the outside of the plunger mechanism by potting compound. If the sealant had leaked slightly in space, a vacuum could have been created inside the plunger which may have made it move on its own after Grissom removed the safety pin. The only problem with this explanation is that Grissom had indicated that he had pulled the safety pin some time before the hatch blew. If this was the case, it seems that if a vacuum had indeed existed inside the plunger mechanism, the hatch would have detonated immediately following the removal of the pin.

After Grissom's flight, NASA solved the hatch problem with a procedural change requiring the astronaut to not remove the plunger safety cap until the recovery helicopter had hooked onto the spacecraft.

24 years after the Liberty Bell 7 sank into the Atlantic Ocean, I began a personal pursuit into the feasibility of locating and recovering Grissom's lost spacecraft. For a seven-year period beginning in 1985, extensive research was conducted into the flight of Liberty Bell 7, its subsequent loss, the likely location of the capsule and its expected condition. Among the data studied were previously classified NASA documents such as *Post-Launch Memorandum* and *Trajectory Reports, Configuration Specifications* and the decklogs of all U.S. Navy ships involved in the recovery effort including the *USS Randolph, Cony* and *Conway*.

I also investigated the probable condition of Liberty Bell 7 following its 30-year stay on the seafloor. This was accomplished by examining Mercury capsule wreckage from the Mercury-Atlas 1 mission (MA-1) and by interviewing several key individuals formerly involved in Project Mercury including Max Faget, the designer of the spacecraft, John Yardley, the chief engineer of the Mercury spacecraft and several former Mercury astronauts including Wally Schirra and Scott Carpenter. Such data served to help identify the equipment needed to successfully locate and recover the capsule.

On March 4, 1992, a search expedition was organized. We departed from Florida and, in waters 15,600 feet deep in an area known as the Blake Basin, we deployed a side-scan sonar search vehicle called Deep Ocean Search System (DOSS).

The DOSS locates objects on the ocean floor by sending out pings of sound which reflect off the sea floor and any other objects within its range. This raw, unprocessed sonar data is sent to the surface via a six-mile tow cable where the information is processed using surface mounted computers. The DOSS is maneuvered and dragged from the surface via its long armored tow cable to ride 100 feet above the seafloor.

Less than two hours into the first DOSS search line, two hard sonar contacts were discovered on the port side of the search vehicle's trackline. Initial on-site computer enhancement and analysis of the targets' composition indicated that the larger of the two contacts was similar in size and composition to that expected for the Liberty Bell 7. In addition, the size of the second smaller contact was estimated to be consistent with the spacecraft's missing explosive hatch. A second sonar run was made on the two contacts the next day and successfully confirmed the geographical location of the two sonar contacts.

Following the return of the expedition to Fort Lauderdale, a more extensive investigation was made into the accuracy of the precision tracking radars used to track Grissom's spacecraft during the final stages of his mission. In addition, a study was made to determine the likely separation distances between the capsule and hatch. The results seemed to indicate that both the Liberty Bell 7 and its missing explosive hatch had been found. Subsequently, operational planning was begun to return to the site as soon as the required equipment became available.

The next step in the project was to dive a Remotely Operated Vehicle (ROV) to the bottom and positively identify the two sonar contacts. Due to on-going priorities with Naval activities, it took over 17 months before mobilization of a second expedition to the site could occur. In early September 1993, the research vessel *Acoustic Pioneer*, operated by the Naval Air Warfare Center out of Key West, Florida, departed the Trident Wharf at Cape Canaveral and headed out into the Atlantic Ocean, mirroring Grissom's flight path. On Board the ship was the latest in underwater vehicle technology which included the *Magellan 725 ROV*.

Curt Newport (looking at periscope opening) examining Mercury Capsule #14 during preliminary engineering studies in January 1992. Photo courtesy Curt Newport.

The *Magellan ROV* functions as an unmanned counterpart to manned submersibles. It is a remote-controlled underwater vehicle fitted with television cameras, lights, sonar, manipulators and propulsion units. It is controlled from the surface via a fiber-optics umbilical and can operate indefinitely on the ocean floor in water depths down to 25,000 feet.

The plan was to dive on the targets found the previous year and, assuming the larger of the two was the capsule, complete recovery. The actual procedure for lifting the capsule was fairly simple. Once Liberty Bell 7 had been found, two specially designed attachment tools would be hydraulically connected to the end of the spacecraft. The capsule would then be lifted to the surface by simply hauling in *Magellan's* steel-armored electrical umbilical. Once at the surface, Liberty Bell 7 would be lifted from the ocean using a large nylon cargo net and an on-board ship's crane.

After a 26-hour transit, the support vessel arrived at the worksite and began deploying *Magellan* over the side. Anticipation was high as *Magellan* began its four-hour descent to the ocean floor. Finally, after over 15 hours on the bottom in waters 15,584 feet deep, the ringing of *Magellan's* sonar indicated that something had been found. The blinding lights of the ROV illuminated the seafloor which looked remarkably similar to the moonscape explored by Apollo. After maneuvering through various compass courses, a flat-looking white shape appeared out of the darkness. The object discovered was revealed to be a wing from a crashed twin-engine aircraft. Was this the object which created the earlier sonar image?

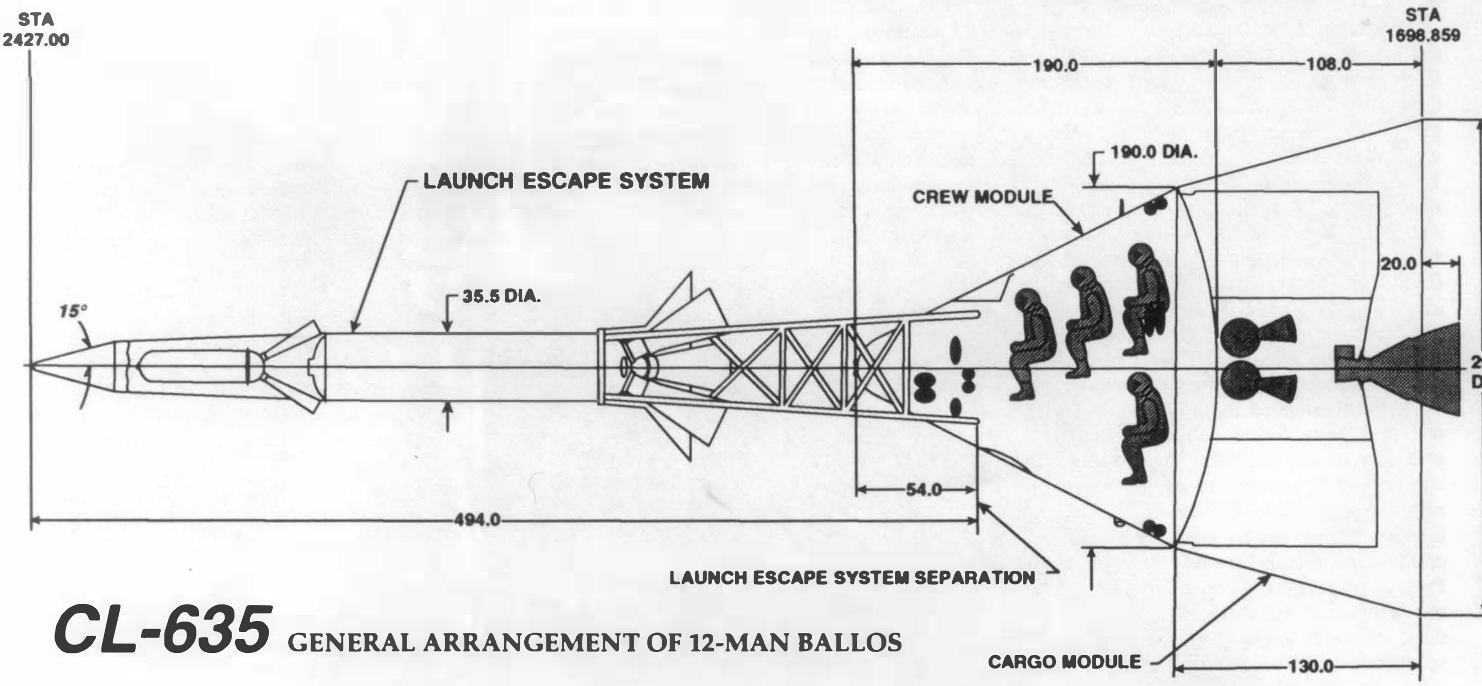
Problems with *Magellan's* on-board sonar along with budgetary constraints prevented further exploration of the area after finding the aircraft wing. *Magellan* was finally hauled up to the surface and the *Acoustic Pioneer* headed back for Florida –empty handed.

While it is possible that the wing section discovered is the sonar contact found in 1992, there are some significant discrepancies. Not one but two objects were located during the 1992 search, one large and one small. During the last dive with *Magellan*, the second smaller object was not found. While several other smaller chunks of aircraft debris were located, there was nothing discovered on the bottom around the wing which was consistent with the sonar targets found the previous year. Hence, it is possible that Liberty Bell 7 was found during the 1992 search but we were unable to relocate it during our second expedition. To conclusively answer the questions created during the 1993 expedition will require a third, and hopefully last, expedition to the site. ●

Curt Newport has spent over ten years working with remote deep sea research vehicles and participated in the Challenger recovery efforts.

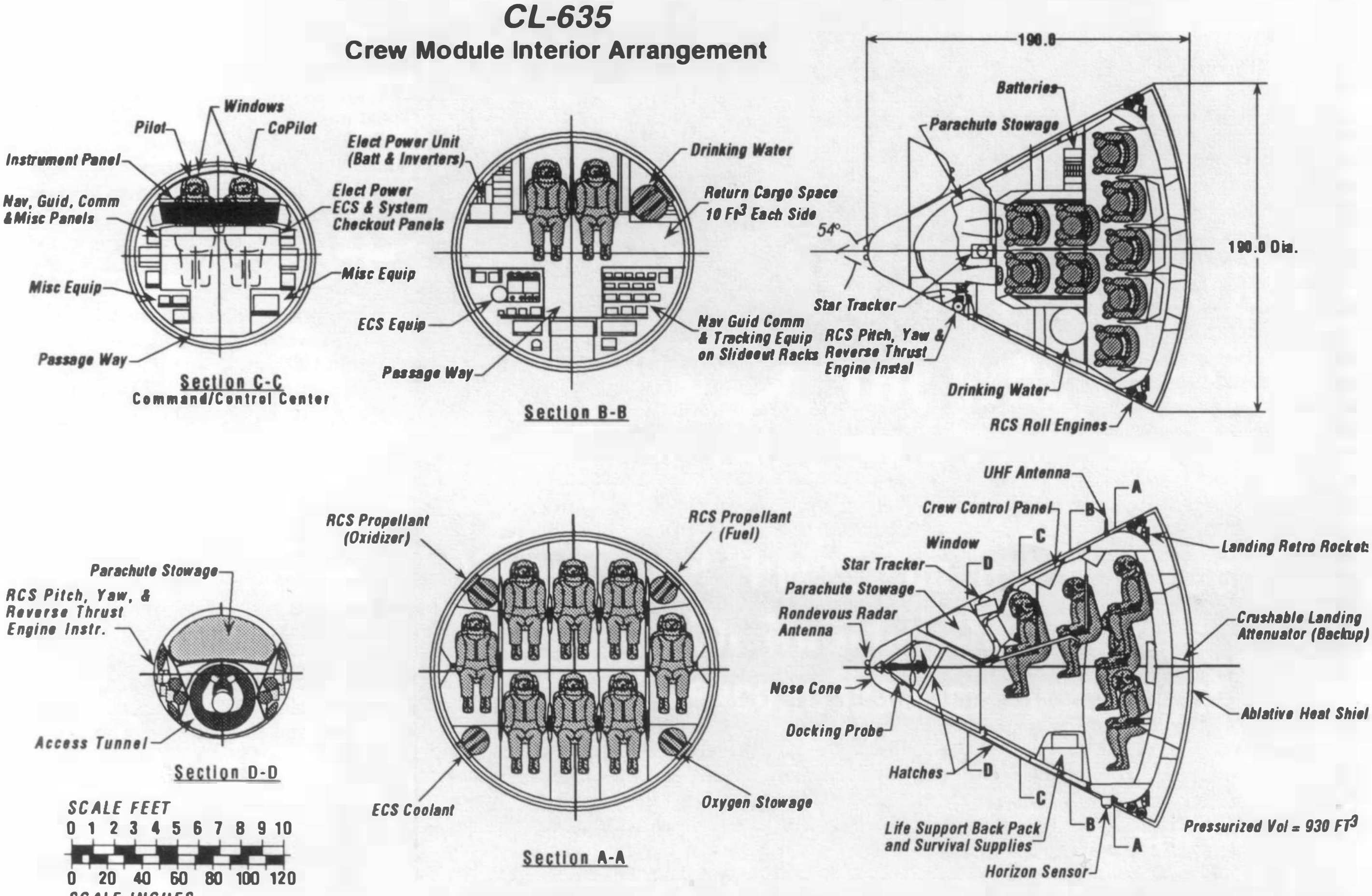
Let's Try It Again

EDITOR'S NOTE: In the last issue of *QUEST (Vol. 2 No. 2 Summer 1993)*, pages 24-25 featured an article and extensive drawings of a unique concept vehicle called BALLOS (Ballistic Reentry Type Logistics Spacecraft) designed by Lockheed in 1964. Unfortunately, the drawings did not reproduce well (they were downright horrible in fact!). *QUEST* reader Rick Pavek came to the rescue and volunteered his time and talents to redraw the original drawings which are reproduce here. A great big thanks to Rick for helping *QUEST* maintain its quality for I hope you will agree, our readers are worth it!



CL-635 GENERAL ARRANGEMENT OF 12-MAN BALLOS

CL-635
Crew Module Interior Arrangement



Rick Pavek is a graphic artist who lives in the mountains east of Seattle with a midwife, two sons (15 and 2) and a cat and remembers fondly how his father would get him up in the wee hours of the morning so he could watch the Mercury astronauts going to places he could only dream of.

NASA HISTORY
News and Notes

by
Roger D. Launius
NASA Chief Historian
Director, History Office NASA Headquarters

SYMPOSIUM HELD ON PRESIDENTIAL LEADERSHIP, CONGRESS, AND THE SPACE PROGRAM

On March 26-27, 1993 the Center for Congressional and Presidential Studies at the American University and the NASA History Office co-sponsored a symposium on "Presidential Leadership, Congress, and the U.S. Space Program," at The American University in Washington, DC. It was an interesting meeting. The sessions were stimulating, and the meeting itself attracted considerable attention both within and without NASA. About 130 people registered for the symposium, straining the conference room's capacity.

There was a sizable contingent of NASA personnel, but the majority of attendees represented the Canadian Space Agency, European Space Agency, aerospace industry, university, and Department of Defense. Major papers were delivered by such noted scholars as John M. Logsdon, George Washington University; Fred I. Greenstein and David Callahan, Princeton University; Michael R. Beschloss, Washington, D.C.; Robert Dallek, University of California, Los Angeles; Robert H. Ferrell, Indiana University; Joan Hoff, Indiana University; and Lyn Ragsdale, University of Arizona. Comments were delivered by such authorities as Willis Shapley, former NASA Associate Deputy Administrator; Philip E. Culbertson, former NASA General Manager; Rip Bulkeley, author of *The Sputniks Crisis and Early United States Space Policy*; Glen P. Wilson, former Senate Staffer; Ken Hechler, former Congressman; John Pike, Director of Space Policy, Federation of American Scientists; and Mark J. Albrecht, former Director of the National Aeronautics and Space Council.

Many of the papers presented reinterpretations of the history of the civil space program. The symposium represented, furthermore, a unique opportunity to discuss issues of concern in the delineation of public policy affecting the space program. The overall quality of the presentations, as well as the wide divergence of opinions expressed at the meeting, fostered unusually stimulating sessions. The dialogue that took place was an especially important result of this meeting, as individuals with widely differing and sometimes conflicting perspectives wrestled with the historical evolution of the U.S. space program. Certainly, everyone in attendance learned a great deal from the formal and informal comments made at the sessions. We are working toward publication of the major presentations in the next year.

RECENT PUBLICATIONS

The History Office has available the *Aeronautics and Space Report of the President, FY 1992 Activities* for any who might be interested. Organized by subject, this report presents an encapsulation of air and space activities within the government between 1 October 1991 and 30 September 1992.

The History Office has also released the 1993 version of *NASA Pocket Statistics*, a handy reference on the agency's organization and activities. A few extra copies of both reports are available and can be obtained by calling the office at 202-358-0384.

1993-1994 FELLOW IN AEROSPACE HISTORY NAMED

Chris Hables Gray is the eighth annual recipient of the Fellowship in Aerospace History. The fellowship, sponsored by the NASA History Office and administered by the American Historical Association in cooperation with the Economic History Association, the History of Science Society, and the Society for the History of Technology, is awarded in an annual competition by a joint committee of representatives from each organization. Dr. Alfred Hurley, University of North Texas, is chair of this committee.

Dr. Gray is a fellow at Oregon State University's Center for the Humanities. He received his doctorate in the History of Consciousness from the University of California at Santa Cruz in 1991. His book, *Postmodern War: Computers as Weapons and Metaphors*, is forthcoming. As a companion to this work, he is also researching a book-length study of the influence of military funding priorities on U.S. computer science, especially artificial intelligence research.

During the fellowship term, Dr. Gray will continue research on this larger topic with a special emphasis on *Cyborgs in Space: Space Research and the Spread of Cybernetic Organisms*. He suggests that the study of cybernetics is "perhaps the most useful concept we have to help us explore exactly how the extraordinary powers of today's technoscience are transforming, some say transcending, the human." Dr. Gray believes that research into the history of cybernetics will help illustrate the importance of space exploration to the conceptions of the human being and how, as a result, humans are changed physically and culturally. He would welcome any suggestions about this research project, and can be reached in care of the NASA History Office, Code ICH, NASA Headquarters, Washington, DC 20546.

NEW BOOKS OF INTEREST TO AEROSPACE HISTORIANS

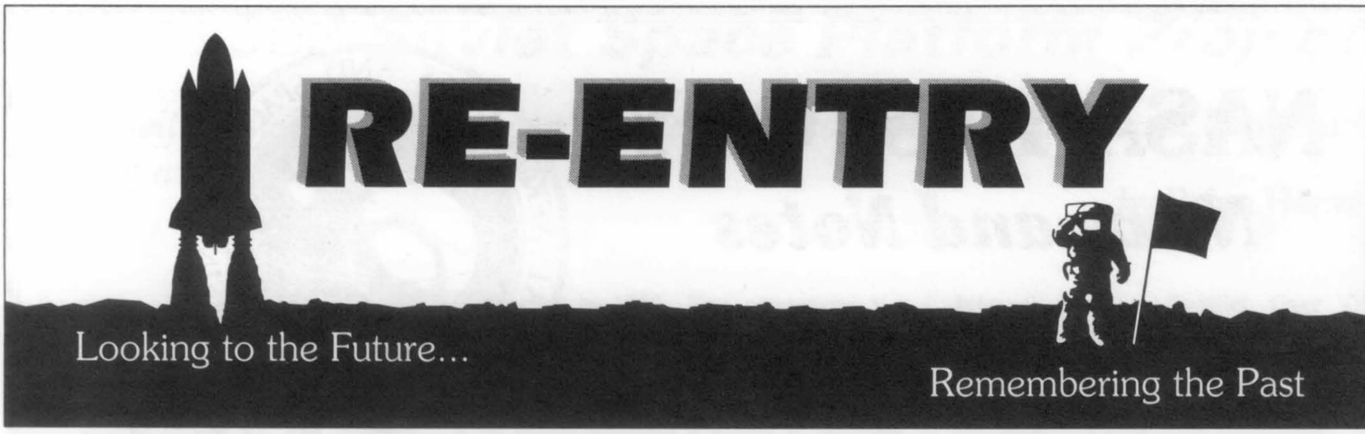
A few new books on aerospace history have come to our attention. We thought they might be of interest to you.

Grace Corrigan, *A Journal for Christa: Christa McAuliffe, Teacher in Space* (Lincoln: University of Nebraska Press, 1993).

Frank Drake and Dava Sobel, *Is Anyone Out There? The Scientific Search for Extraterrestrial Intelligence* (New York: Delacorte Press, 1993).

Phillip K. Tompkins, *Organizational Communication Imperatives: Lessons of the Space Program* (Los Angeles: Roxbury Press, 1993).

Don E. Wilhelms, *To a Rocky Moon: A Geologist's History of Lunar Exploration* (Tucson: University of Arizona Press, 1993). ●



ALSOR: Air-Launched Sounding Rocket

BY PETER ALWAY

One of the least glamorous of the applications of rocket technology is the meteorological sounding rocket. Small rockets such as the Arcas (see "Rockets of the Keweenaw Range" *QUEST*, Vol. 1, No. 2, Summer 1992) and Super Loki Dart routinely ply the skies without mention in even the most obscure technical journals. While balloons return weather soundings from the troposphere and stratosphere for conventional and aeronautical weather forecasts, meteorological rockets reach the upper stratosphere and mesosphere, measuring winds, densities and temperatures for the benefit of missile and space launches. One program requiring high-altitude weather data was the X-15 hypersonic rocket plane flown from June 8, 1959 to October 25, 1968. In support of the X-15, NASA initiated a special program of rocket-borne meteorological soundings—the Air Launched Sounding Rocket program (ALSOR).

ALSOR was not the first attempt at launching sounding rockets from aircraft. Hermann Oberth suggested the technique in 1929, and by 1955, the University of Maryland and the Navy had successfully shot a 2.75" diameter Folding-Fin Aircraft Rocket (adapted from a Korean War "Mighty Mouse" missile) to an altitude of 180,000 feet. By 1957, the Air Force was testing a larger "Rockair" vehicle. The economy and flexibility of the re-usable aircraft "first stage" attracted NASA to the air-launch technique.

The ALSOR rockets were propelled by Zimney Corporation Viper rockets, one of a class of rockets that included the NACA Cajun, the ABL Cajun, Thiokol Apache and Grand Central Rocket Company ASP. The payload was an inflatable sphere, whose descent rate would indicate air density up to 380,000 feet. Inside the balloon was a corner-cube radar reflector made of flexible aluminized mylar. The balloon would be deployed at apogee.

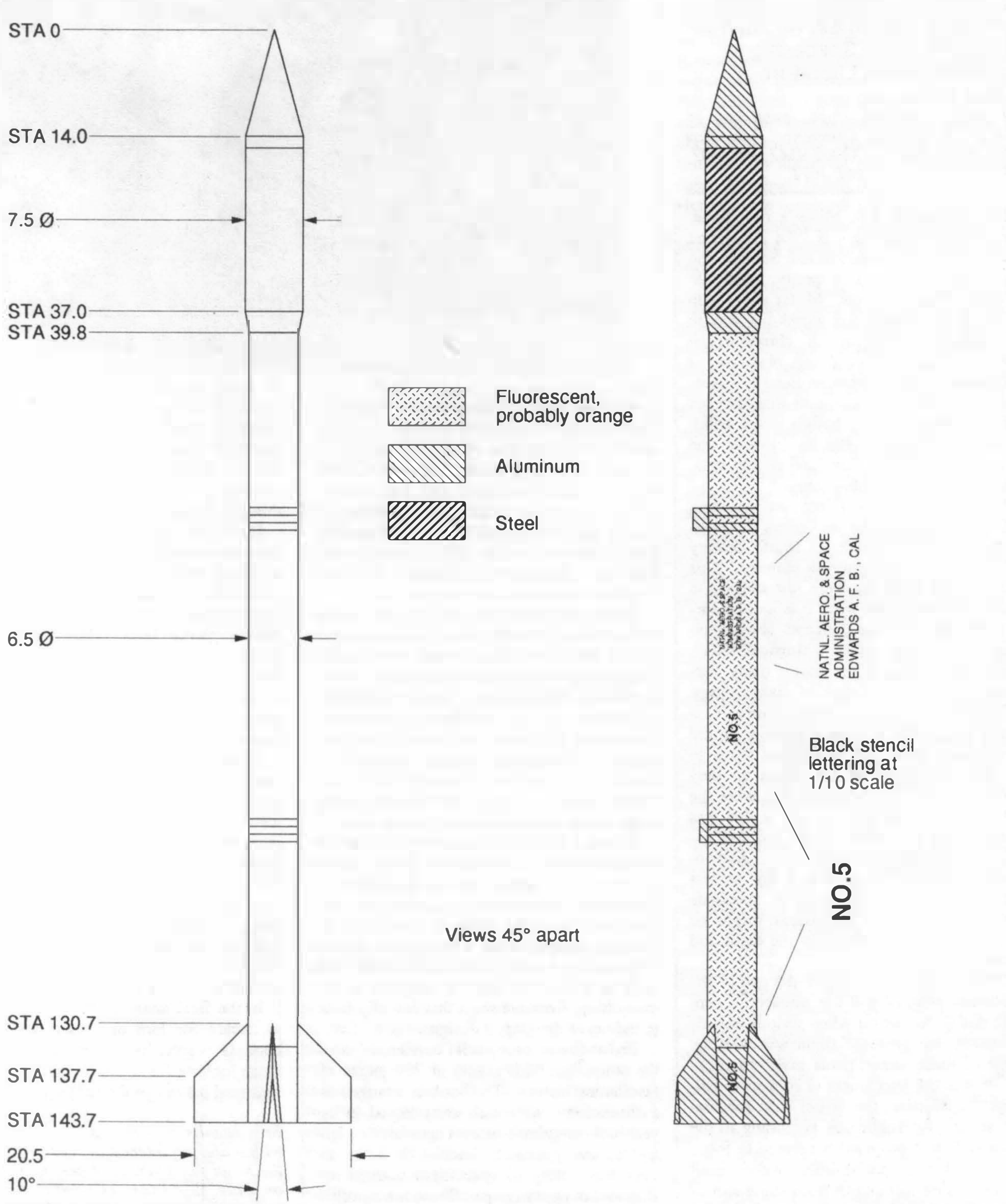
The "first stage" of ALSOR was an Air Force F-104 equipped with a special retractable launch rack under its belly. Like the X-15, this aircraft was based at Edwards Air Force Base in California. Launching the balloon required some tricky flying. As Milton Thompson wrote in his book, At the *Edge of Space: The X-15 Flight Program*, "[the ALSOR rocket was] fired vertically from the aircraft as we pulled up in a loop. We started the loop at Mach 2 at 35,000 feet. We were vertical at 50,000 feet still indicating about 1.5 Mach number, and went over the top above 60,000 feet. It was quite a maneuver. Every once and a while we would lose the engine or fall out of the loop..."

Pilots Thompson and Forrest Peterson were able to launch five ALSOR rockets within the required half-degree pointing accuracy. But the rockets were not cooperative, landing unpredictably. In addition, the balloon payloads did not deploy as planned. After no less than five flights, including one off the California coast, NASA abandoned the ALSOR program.

I would like to thank Fred Williams for uncovering the data used in this article and drawing. ●

ALSOR
Air-Launched Viper
1/20 scale
Dimensions in inches

Sources:
Some Operational Aspects of Using a High-Performance Airplane as a First-Stage Booster for Air-Launching Solid-Fuel Sounding Rockets, Victor W. Horton and Wesley E. Messing, NASA TN D-1279, January, 1963.



BOOK REVIEWS

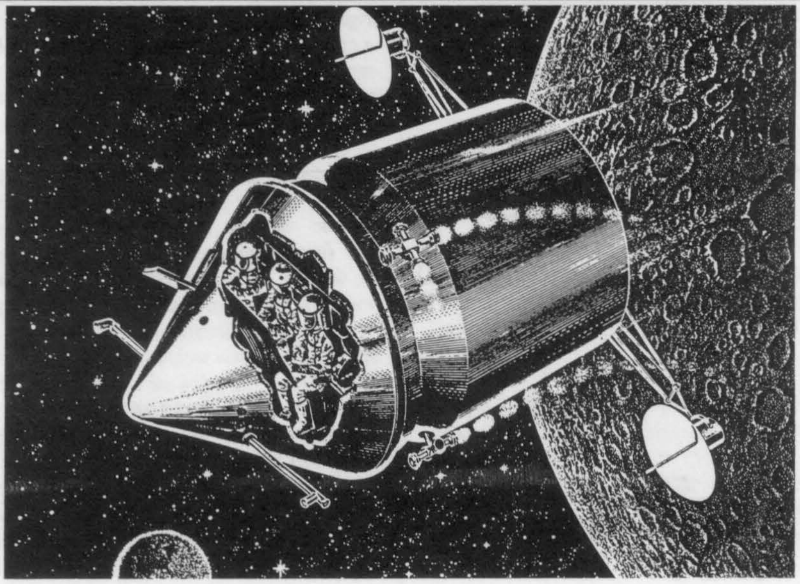
Book of Dreams

By Eric Janulis

The Dream Machines: An Illustrated History of the Spaceship In Art, Science and Literature

By Ron Miller

744 pages, hrdbd./$112.50, published by Krieger Publishing Company, P.O. Box 9542. Melbourne, FL 32902-9542; PH: 407-727-7270; FAX: 407-951-3671.



The subtitle of Ron Miller's new book, *The Dream Machines,* is "An Illustrated History of the Spaceship in Art, Science and Literature." That is a pretty good description of the contents; Miller starts with the Classical Greeks and works his way to the present, describing in chronological form what people were doing, planning, or just dreaming about when it came to spaceflight. One can trace concepts that start out as hazy images in somebody's mind, solidify a few centuries later as theories and speculative, hopeful plans, and finally crystallize in the form of hardware.

The book is divided into six chapters. The first is the shortest but covers the longest period of time, from the fourth century B.C. through the eighteenth century. This is the period when we were just starting to figure out what space was. It is no real surprise that most of the concepts about travelling in it seem rather whimsical today. People are flying to the moon using harnessed swans, vials of dew, or giant springs. In fairness, most of these authors weren't seriously suggesting that their methods would work; these were just convenient ways to get their characters to the moon so they could learn the moral lessons that were the real heart of these stories. But as this was going on, the first experiments and applications of rocketry were happening. And towards the end of this period, a few writers and scientists were beginning to speculate that these controlled explosions might be harnessed for travel, both on the earth and beyond it.

The second chapter covers the end of the eighteenth century and the nineteenth century; this is the period when serious experimentation into powered flight was starting. Some of these experiments involved rockets, such as the attachment of rockets to balloons. In addition, the earlier wild speculation about spaceflight was beginning to die down and most proponents seemed to focus on one of two possibilities: either craft would be shot from earth from some sort of gun or they would use some sort of reaction drive.

The third chapter covers the twentieth century prior to the Second World War. This is the time of Goddard and Tsiolkovsky. During this period, people come to generally accept that rocket propulsion is the way to go into space. Heavier-than air flight is also developed and rocket propulsion is used on some experimental craft. This is also the time of the birth of modern science fiction, and Mr. Miller includes entries for a fair number of purely fictional spacecraft.

The fourth chapter covers the giant leaps in technology brought about by the Second World War. Working rockets are brought into (fairly) widespread production, and a wealth of experience is gained in the application of rocketry to both manned and unmanned flight. In addition, many developments are made in those systems that would soon become necessary to spaceflight, such as radar, life support, long range communication and remote guidance.

Chapters Five and Six cover the period most likely to be of interest to *Quest* readers, the era of spaceflight as we know it. Chapter Five covers the immediate postwar years and the birth of the Soviet and U.S. space programs, while Chapter Six begins with John Glenn's first orbital flight and ends in 1992. These two chapters cover everything, from the ships that actually flew to the never-developed designs.

The above is a very brief condensation of the story Ron Miller tells in 700 pages of fascinating history. The book is arranged as a chronology, with each entry keyed in by year and sometimes date. There isn't an entry for every launch. Instead, it seeks to trace the history of spaceflight both in reality and in human hopes. There are a multitude of entries for serious speculative projects, such as the BIS plans, early studies for Mars and moon projects and early versions of space shuttles. An interesting feature of the book is that, as time progresses, Miller includes fewer and fewer entries for science fictional spaceships. As more became known about space and space travel, less science fiction became relevant to serious thought about it.

But all of these words don't do justice to the central feature of this book: the hundreds of wonderful illustrations by Miller and Rick Dunning. From the Dyna Soar to Buran, from the Dean Drive to Energia, there's plenty here. There are also old woodcuts, movie stills, and photographs. It's a little disheartening to see some of the wonderful designs that never got off the ground or read of the missions that never happened.

I had two problems with the book. The first is inadequate documentation. Although there is a good bibliography, detailed notes would have allowed the researcher to delve more deeply into any of the projects mentioned. Secondly, many of the illustrations are uncaptioned and it often takes a bit of hunting to find the name of a particular craft. In fairness, it should be mentioned that this review is based on an advance copy and the regular print run may be better in both of these respects.

In the final analysis, the reader will have to decide for him or herself whether this book is worth the rather hefty price. For those looking for a comprehensive but nontechnical history of the subject, I think it is. ●

Eric Janulis is a professional archeologist with a lifelong interest in science fiction and the history of science. When not in the field on a dig, Eric lives in Grand Rapids, Michigan.

Organizational Communication Imperatives: Lessons of the Space Program

By Phillip K. Tompkins

238 pages, $14.95, published by Roxbury Publishing Company, Los Angeles, CA., 1993; ISBN 0-935732-40-3; LCCN TL862.G4T66 1992.

During the summer of 1967 Phillip K. Tompkins, then a young associate professor of communication at Wayne State University, carried out field research in organizational communication at the Marshall Space Flight Center (MSFC) in Huntsville, Alabama. Invited to the center by Walter Wiesman, who then managed an internal communication program for Wernher von Braun at MSFC, Tompkins was asked to review the internal communication program at the center and make recommendations for improvements, as well as conduct original research into aspects of the program. Von Braun gave Tompkins a broad mandate to explore the communication program and to interview people throughout MSFC. His approach was simple, beginning by asking interviewees what worked and didn't work in the internal communication structure. From there Tompkins pursued questions as appropriate to explore the communications structure.

Organizational Communications Imperatives reflects on Tompkins' work at MSFC during the latter 1960s--he went back to the center in the summer of 1968--and analyzes the internal communication structure in NASA and MSFC at the time of the Challenger accident in 1986. He then compares and contrasts the communications practices present during those two periods and found a subtle but persistent derogation of the system in the 1970s and early 1980s. Tompkins appreciates the intricacy of the internal communications structure of a complex organization in modern America, and his most useful contribution to present-day leaders of the U.S. space program is in his description of the processes at play and how they lead to perceptions, attitudes, and actions.

For example, Tompkins is at his best in describing the management tool known as the "Monday Notes," used at MSFC in the 1960s. Beginning in the early 1960s Wernher von Braun required these notes from his key staff as a means of enhancing communication among managers. The notes had specific parameters: they could be only one page long, had to be written in paragraph style, and were expected to be totally candid in describing each week's progress and problems. Von Braun read each note and wrote marginal comments congratulating people on their successes, asking questions, making suggestions, or in some instances chiding people for failures or lapses. Afterwards, von Braun's secretary duplicated the entire package of Monday Notes and marginalia, and sent a set to each of those who submitted them. As time passed and the notes proved to be a successful communications tool, von Braun expanded their use so that managers two or three levels below the center director sent them in as well.

The Monday notes accomplished several positive things according to Tompkins. They allowed for bottom to top communication for important issues free from interference by middle-level managers. Since the center director made comments on the notes and sent them back, they also provided valuable feedback from top to bottom. Packages of all the notes were also distributed to all contributors, thereby providing a useful horizontal communication structure. Various managers debated issues from their perspectives in the notes, allowing for a healthy competition in which everyone expressed their views before the center director. Finally, since managers submitting Monday notes to the MSFC director needed information from their subordinates, it forced a focusing at least once a week by all organizations at MSFC on the progress made and the challenges remaining in the accomplishment of particular missions. The communications system that grew as a result of the notes was particularly useful in identifying problems, developing solutions, and keeping everyone informed.

Tompkins juxtaposes the success of the Monday notes in the von Braun era to what he views as the decline of the internal communication structure at MSFC after the completion of Project Apollo. When a later center director stopped making comments on the notes, for instance, they ceased to be useful for top to bottom communication. Most managers came to think of them as just one more report to file, and the time taken in doing so was time wasted in the accomplishment of the mission. Immediately, the quality of the notes declined, and they ceased to provide as much useful information to the leadership as before.

Although he also used other examples, for Tompkins the decline of the Monday notes was symptomatic of the overall deterioration of the MSFC communication system in the 1970s and 1980s. The destruction of Challenger in 1986 and the criticisms about internal communications at MSFC made in the Presidential Commission's accident investigation under the leadership of William Rogers solidified Tompkins' position on the center's weakened communication structure. Tompkins suggests that MSFC personnel knew about the probability of catastrophic O-ring failure but that the "organizational neuroses" present prohibited the word going to senior decision-makers. He writes that "to know about a technical problem that can cause the loss of human life, and then fail to act upon that problem, is also a failure of communication and morality"(p. 150). Most of the rest of the book is an explication of how communication at Marshall had degenerated to the point that an accident like Challenger could happen.

The book offers some important insights into communication systems for complex technical organizations. In that sense, Tompkins has provided a valuable primer on setting up and managing the free flow not only of information but of ideas that increase efficiency and productivity. It should be read by all space program managers for that purpose.

Tompkins is less convincing when he seeks to analyze the communications issues that were a part of the Challenger failure as compared with the success of MSFC in the 1960s. He accepts at face value the conclusions of the Rogers Commission on the Shuttle accident. With the benefit of hindsight, the Commission took the accident as a starting point and read history backwards on a trail that led directly to faulty communications of known dangers concerning the O-rings of the Solid Rocket Booster. The Commission quickly decided that the joint the O-rings were supposed to seal was hazardous and that project engineers knew it. It also charged that MSFC personnel failed to advise their superiors of that hazard because of a poor communication system. Instead, Andrew Dunar and Stephan Waring, two historians writing an as yet unpublished study, have argued convincingly that the accident had more to do with NASA's organizational patterns and technological decisions that made sense at the time but in retrospect turned out to be faulty, than with the communication issue dwelt upon by the Rogers Commission. Their detailed analysis of both documentary evidence and testimony showed that NASA personnel involved in the O-ring question were convinced by standard risk assessment procedures that the joints were safe. Most important, there was little engineering data to support a correlation between O-ring anomalies and low temperatures, contrary to what the Rogers Commission reported. MSFC knew and communicated to others that anomalies had occurred during previous cold weather launches but that the seals had always done their job. The catastrophic failure that occurred was a total shock to the MSFC staff, made all the more painful by a perception that the Commission used the center as a scapegoat to deflect blame away from political leaders in Washington.

Clearly, there is much to be learned from the Challenger accident about the nature of complex technological organizations, equipment, procedures and communication. The full history of the event has yet to be published but *Organizational Communication Imperatives* is a useful effort to help understand the accident and the issues surrounding it as well as much else. It is only one of several studies that will appear in coming years that analyze this episode from a variety of perspectives and draw lessons that--while perhaps flawed in some sense--are nonetheless useful for future decision-makers. ●

— Roger D. Launius
NASA Chief Historian,
NASA Headquarters, Washington, D.C.

ROCKETS RED GLARE

Keith J. Scala

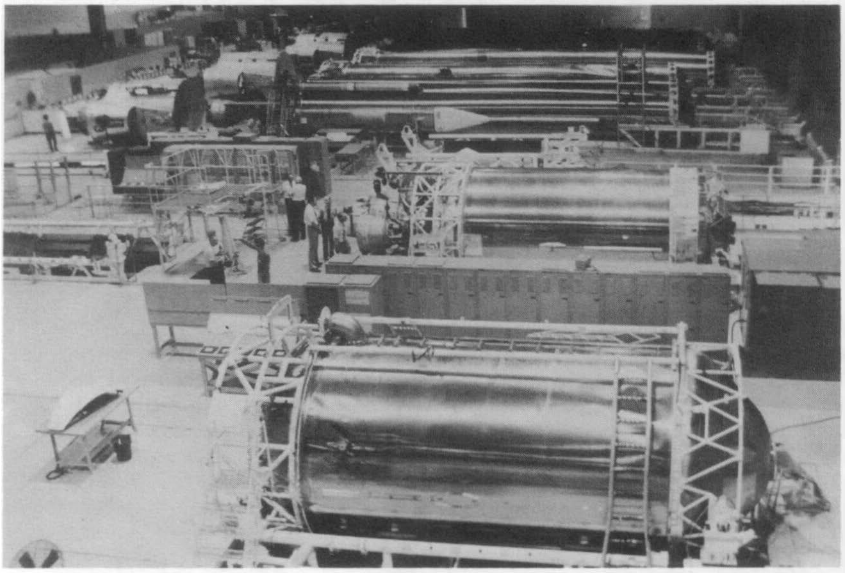
Launch vehicles and their role in the history of spaceflight

The Anonymous Atlas H

Note: this month's column was submitted by Joel W. Powell of Space Information Canada

When the first upgraded Whitecloud ocean surveillance satellites were introduced by the U.S. Navy in the early 1980's, a more powerful launch vehicle was required to replace the original Atlas E/F boosters used for the first four launches. Rather than choose a different launch vehicle or attempt to upgrade the Atlas E/F (which were refurbished ICBM vehicles), project managers decided to modify the SLV-3D first stage of Atlas-Centaur (without the upper stage) to serve as the replacement. The 20.1 meter long SLV-3D had more powerful engines and greater propellant tank capacity than Atlas E/F with the added advantage that it was almost exactly the same size as the older model. The two Whitecloud variants did not require a separate upper stage because they incorporated an on-board solid propellant kick stage, believed to be a Thiokol Star 37E motor.

Atlas H was fitted with uprated MA-5 engines from the Atlas G - Centaur that developed 31 kN more thrust than did SLV-3D. Positioned atop a new conical adapter section (replacing the cylindrical Centaur adapter on the SLV-3D) was the same payload fairing used for Whitecloud on Atlas E/F. To achieve compatibility with the Vandenberg AFB range facilities, the SLV-3D inertial guidance system was replaced with the Mod-3G radio-controlled system from Atlas E/F. The 27.4 meter (90 foot) long launch vehicle (including fairing) also required a number of modifications to ground support equipment at the SLC-3 East pad at Vandenberg. Atlas H was developed for the military by the Centaur program office at NASA's Lewis Research Center. This was an ironic turn of events for NASA which had procured many launch vehicle systems from the Air Force over the years. This philosophy of borrowing from civilian designs has been used twice by the military in recent years, first for the development of Delta II for Navstar GPS, and then with Atlas II (Centaur) for the DSCS III satcoms. Only five Atlas H vehicles were rolled off the General Dynamics assembly line and all five were launched successfully.



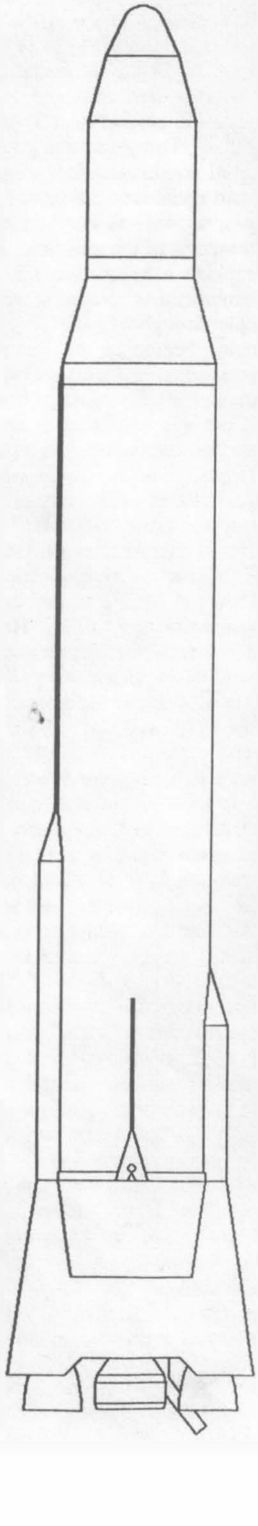


PHOTO CAPTIONS

Photo Opposite Page:

Rare view of Atlas H shortly before liftoff at Vandenberg AFB. Photo Courtesy Joel W.Powell, Space Information Canada.

Drawing At Right:

Atlas H launch vehicle. Drawing courtesy G.R. Richards.

Photo At Above Left:

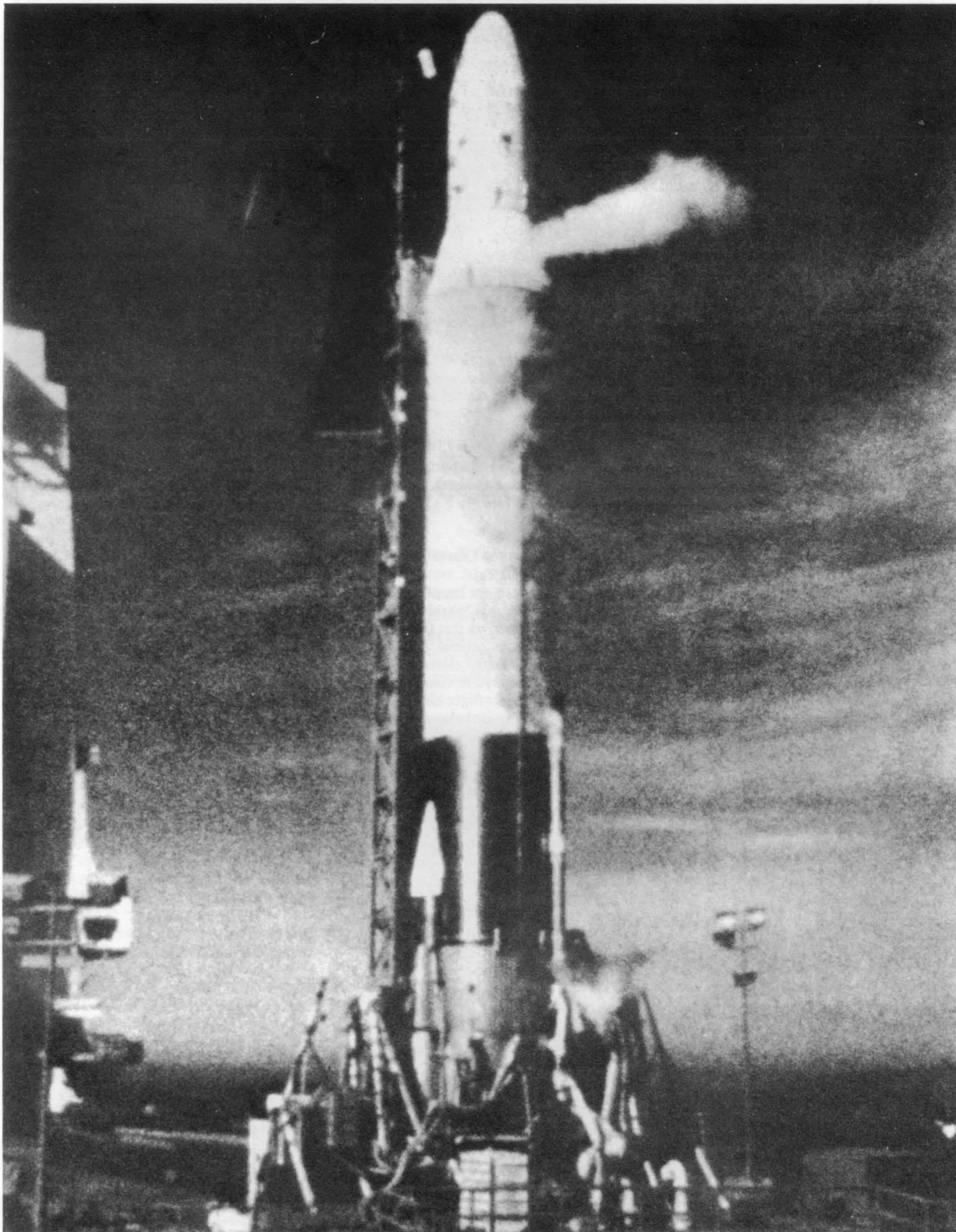
Two Atlas H boosters lie side-by-side at center (note numeral 3 and letter H on the booster section), and two Atlas G stages are visible in the background on the General Dynamics assembly line in 1983. Photo courtesy General Dynamics.

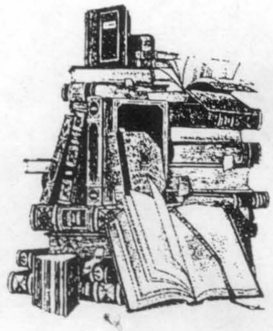
Launch Chronology

DATE	PAD	SERIAL NO.	PAYLOAD
February 9, 1983	SLC-3E	6001H	NOSS-5/LIPS-II
June 9, 1983	SLC-3E	6002H	NOSS-6
February 5, 1984	SLC-3E	6003H	NOSS-7
February 9, 1986	SLC-3E	6004H	NOSS-8
May 15, 1987	SLC-3E	6005H	NOSS-9/LIPS-III

NOSS - Naval Ocean Surveillance System
LIPS - Living Plume Shield subsatellite

References: J.W. Powell and G.R. Richards, *Journal of the British Interplanetary Society*, "Atlas E/F - An Unsung Workhorse," Volume 44, 229-240 (1991).





RESOURCES

by Glen E. Swanson

Air Force History Publications

The Center for Air Force History conducts research and writing projects to record and preserve the history of the United States Air Force. A recent catalog listing all Air Force History Publications is available for free from the Center. Among the titles listed in this catalog that may be of particular interest to spaceflight historians is the book *The Development of Ballistic Missiles in the United States Air Force, 1945-1960* by Jacob Neufeld, 1989, 409 pp, (this book is also available through the GPO stock no. 008-070-00641-3 for $23). For more information or to obtain a copy of this catalog call or write: **Center for Air Force History, 170 Luke Avenue, Suite 400, Bolling AFB, D.C. 20332-5113; PH: 202-767-0412.**

JPL Archives

The Jet Propulsion Laboratory (JPL), an operating division of the California Institute of Technology (Caltech), performs research, development and related activities for NASA. Most people know of them by their past spectacular achievements in the realm of unmanned planetary probes. Names like Pioneer, Viking, Voyager, Magellan, Galileo and yes, Mars Observer, are all associated with JPL. In April 1989, JPL established a public archives to document the history of these and other projects. In addition to its documentary files, the Archives has also developed an extensive oral history collection. Extensive photographs, motion picture film, videotape and CD-ROM materials are also available covering JPL's planetary missions from the 1940s to the present. Interested researchers may purchase copies of still photos and other materials. Researchers planning a visit should notify the Archives in advance. Reference service is available by the staff for locating records and answering questions related to JPL's projects and activities. The Archives is open for research from 7:30 AM to 4:45 PM M-F. For more information call or write: **Archives, MS 512-110, Jet propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109-8099; PH: 818-397-7674; FAX: 818-397-7121.**

NASA Headquarters Library

During a recent trip to the brand new NASA Headquarters building in Washington, D.C., I was shocked to discover that their main library is open to the general public. No prior permission, security clearance or special badging are required to visit this gem of a resource for the spaceflight historian. The spacious new facility includes an extensive journal, newsletter/newspaper and periodical section, document room, audio research room and a decent photo copier. Comfortable chairs and large tables make setting up camp a breeze. Next time you are in the DC area, make sure to stop in for a visit for it's worth the trip. By the way, they also have a nice little NASA exchange store and book store to pick up that last minute souvenir. Hours are **7:30 AM - 5:00 PM M-F.** Their address and phone are: **NASA Headquarters Library, 300 E. ST. SW. Room 1J20, Washington, DC 20546; PH: 202-358-0180.**

Russian Launchers Album in the Works

It seems like the capitalist bug is spreading quickly in the former Soviet Union. The newly established firm MTI Ltd., working under the auspices of the faculty of Special Machine Building (Moscow State Technical University) is trying to publish an album of "Russian Launchers." Several readers have forwarded copies of a letter and brochure from Vladimir Kachurin the Project Manager who is promoting the new book. The contents of both the letter and brochure are somewhat vague for it is not clear if the book is in print, will be in print or is just a good idea to get valuable western dollars. I am going to assume that the book is still in the works and that they are basically soliciting general interest in the project. The forthcoming book will include drawings and technical descriptions of all the main families of carrier rockets designed by Korolev's, Chelomei's and Yangel's Design Bureaus. A genealogical tree for every carrier-rocket family will be included along with an essay of its history and technical description. It will be 100 pages in length and sell for $25. Because of the difficulty in communicating with the CIS (sending any money is very risky), I would suggest that if readers are interested in the book, to write the firm expressing their support for the project but DO NOT SEND ANY MONEY. I would like to know more about the availability of the proposed book before recommending anyone to purchase it. Send your letters of support to: **MTI Ltd, Gospitalny per., 10, Moscow, 107005, Russia; PH: 095-263-6861; FAX: 095-267-9893.**

Space Memorabilia Auctions and Swap Meets Scheduled

Thought you spent enough over Christmas? Gregg Linebaugh is scheduling another Space Memorabilia Trade Show and Swap Meet for Saturday, February 5, 1994 at the Park View Inn, 9020 Baltimore Blvd., college Park, MD. For more information write or call Gregg at: **PO Box 604, Glenn Dale, MD 20769; PH: 301-249-3895.** Riding on its past successes, Superior Galleries will be holding another Space Memorabilia Auction in May 1994. For further information write or call: **Superior Galleries, 9478 W. Olympic Boulevard, Beverly Hills, CA 90212; PH: 310-203-9855; 1-800-421-0754; FAX 310-203-8037.**

Wanted: Film, Photos and Audio on the Space Program

Turner Productions is currently working on a four-hour documentary television series on the history of the space program. Tentatively entitled *Moon Shot* and based on the forthcoming book *Giant Steps: The Inside Story of the Race to the Moon* by Howard Benedict (see Book Reviews in this issue), the series will air sometime next year by TBS in commemoration of the 25th Anniversary of Apollo 11. Associate Producer Dan Levitt has asked me to forward his request to all readers for any images and audio on the Mercury through Apollo programs that they might be able to use in the making of this series. Specifically they are looking for home movies and interviews with astronauts, audio interviews, photographs, postcards and posters. He is especially looking for material that is unusual. If you have a collection or know of others, contact Dan by writing or calling: **Dan Levitt, Varied Directions International, 69 Elm Street, Camden, ME 04842; PH: 207-236-8506.**

NASA Clip Art Available

Finally someone has made available a quality collection of NASA clip art for the host of space-related magazines, newspapers and newsletters now on the market. The NASA Art collection is just one of 12 Federal Clip Art collections offered by One Mile Up, Inc. Big and small publishers alike will appreciate the extensive collection of space related illustrations offered for both the Macintosh and PC families of computers. Official contractor artists were used to compile hundreds of illustrations that make up the NASA Art collection. From Goddard to the Space Shuttle, all are Encapsulated PostScript files, many in full color, that have been created using many of the most popular computer illustration programs. In addition to the illustrations, the collection includes many NASA mission patches and a complete "NASA worm" alphabet. The collection is available on either 32 High Density diskettes or one CD ROM for $345. The collection is well worth the price because of the high quality and attention to detail that is apparent throughout many of the illustrations. For those interested in more than the NASA collection, One Mile Up also offers other subjects through its Federal Clip Art collection including Congressional Art, Air Combat, Naval Combat, Ground Combat, Naval, Army and Air Force Insignias and more! For further information write or call: **One Mile Up Inc., 7011 Evergreen Court, Annandale, VA 22003; PH: 1-800-258-5280.** Don't forget to tell them you learned about it through *QUEST*.

Cool Space Stuff for the Mac

The Exploration in Education (ExInEd) program of the Special Studies Office at the Space Telescope Science Institute has produced a series of HyperCard-based multimedia educational publications called Electronic PictureBooks, which are authored by space scientists, engineers and astronauts. Electronic PictureBooks run on Macintosh computers and each contains text, full-color images and navigational features to assist the reader. Titles that are currently available are: *Endeavour Views the Earth, Gems of Hubble, Images of Mars, Scientific Results from the Goddard High Resolution Spectrograph, Magellan Highlights of Venus, Volcanic Features of Hawaii and Other Worlds* and *The Impact Catastrophe That Ended the Mesozoic Era.* Prices range from $9.95 to $39.95 per title. The ExInEd program is also in the process of developing CD-ROMs (both Mac and IBM compatible), which will contain whole libraries of Electronic PictureBooks. For further information and to receive a full catalog write or call: **The Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco, CA 94112; PH: 415-337-2624.**

More Cool Space Stuff for the Mac (and PC): NASA Multimedia Space Educator's Handbook

In the Fall 1992 issue of *QUEST*, I ran an announcement for a free Hypercard Stack from NASA designed for space educators. Since that time, a new version of the program is now available that includes multimedia capability. The new program called the *Multimedia Space Educator's Handbook*, features a dozen Quicktime color/sound movies from NASA. The entire program uses 20 megabytes of storage space on a Macintosh and requires System 7. Additionally a Windows 3.1 version has been developed for those educators using PCs. The PC version uses a HyperCard-like program for Windows called ToolBook 1.5. A 386 PC or greater is recommended. About two-thirds of the information contained in the Mac version is resident in the PC version. Each of the new versions requires you to send 10 formatted high density 3.5" diskettes to **Jerry Woodfill, New Initiatives Office (IA12), NASA Johnson Space Center, Houston, TX 77058.** Please request which version of the program (Mac or PC) you want and tell them you heard of it through *QUEST*.

International Reference Guide to Space Launch Systems

The American Institute of Aeronautics and Astronautics has available the 1991 edition of this fabulous reference tool. First appearing in 1990, this wonderful guide quickly sold out and became a hot item among spaceflight historians and researchers alike. Compiled by Steven J. Isakowitz in collaboration with the AIAA Space Transportation Technical Committee, this authoritative work summarizes the proliferation of launch programs in China, Europe, India, Israel, Japan, the Soviet Union and the U.S. With over 295 information-packed pages with illustrations and figures, this is a must buy! ISBN 1-56347-002-0, paperback, AIAA members $25, Nonmembers $40. Order from **AIAA, The Aerospace Center, 370 L'Enfant Promenade, SW, Washington, DC 20024-2518; PH; 1-800-682-AIAA.**

Buyer Beware!

As Editor of *QUEST*, I feel an obligation to report when certain products, services or resources demonstrate a firm lack of honesty, quality, integrity or just plain fail to respond at all to purchases made by our readers. Over the past several months, readers have brought to my attention two such "resources" that, after further investigation, have proven to be not worthy of any further business. Please take note of the following two items: In the premiere issue of *QUEST* (then called *LIFT-OFF*) I published an announcement about a publication called *The Journal of Miniature Astronautics*. It has been over a year since the last issue of this publication has been published with no firm committal from the publisher that any more issues will be made available. Readers have purchased subscriptions to this magazine on the basis of my review and, sadly enough, they have not received a single issue. In addition, an outfit called Aerospace Ambassadors (also known as Aviation Space Education Foundation) has failed to live up to its agreements with its customers who have purchased books and tours to space facilities in Russia and China. Many have reported losses in the thousands of dollars in deposits for such tours. Recently, my office received a direct mail item from Aerospace Ambassadors promoting future tours. Because of their past track record, I would strongly urge caution in any future dealings with this organization.

LETTERS

For your information, I recently obtained a copy of the *Russian Space Directory* that you partially reviewed in your spring 1993 issue. Although brief histories are given of all the companies and organizations that are taken up, it is clear this book is intended in the first place for Western aerospace companies interested in making contacts with Russia, not for space historians. The introduction sheds some light on the historical development of the Soviet space industry, but even after going through this directory, the Russian space industry to me still largely remains a bureaucratic jungle of "design bureaus," "scientific production associations," "research institutes," "mechanical plants" which often are interrelated in an unclear way. For instance, in Samara (the former Kuybyshev, you have the "Central Specialized Design Bureau," "Photon Design Bureau" and "Progress plant," which specialize in designing, manufacturing and marketing Vostok-derived vehicles and engines of the Soyuz rocket. To complicate matters further, the "Progress plant" also turns out to have "a branch at Baikonur for construction of the Energia," while there is yet another Samara-based organization called "NPO Energia - Samara branch" which is said to be "heavily involved in the development of the Energia and Zenit, which are built at the nearby Progress Scientific Production Association." All these organizations are found under different entries. I can imagine a Western businessman will have to think twice before deciding which of these organizations he should contact. One other not concerning the directory: there is no separate entry for one of the CIS' main space plants, namely NPO Yuzhnoe in the Ukraine, even though the subtitle on the cover explicitly says the directory includes the facilities in the CIS republics. I've also seen numerous printing errors and I've had some difficulty finding certain organizations in the index. So all in all, my assessment of the directory is not too positive, although this of course is by far the most detailed publication on Russia's space industry.

— Bart Hendrickx
Belgium

Enclosed please find a check for renewal of my subscription to *QUEST*. I have yet to be disappointed in any article. I especially enjoy the coverage you give to Soviet/Russian space history. Perhaps in a future issue, you could cover the development of the Chinese space program. I'm a model builder of static spacecraft and booster models and your photographs and drawings have been extremely useful to me in the pursuit of my hobby. Thank you for such a high quality publication.

— Eric Benton
Richmond, CA

Already it's noticeable that the magazine is growing in strength with each edition as you succeed in capturing yet more readers and introducing new contributors. I've enjoyed many of the articles which have been published, but I think what's more important than this is the fact you are trying to create a forum in which students of space history can share information (New Resources, Notes From The History Office, etc.) and bounce ideas off each other. I am most encouraged by this trend and hope that it continues.

— Darren L. Burnham
Oxford, England

QUEST looks fine. Good luck!

— Arthur C. Clarke
Colombo, Sr Lanka

I've never read a better account of space history – and that includes the Air & Space Smithsonian stuff. *QUEST* is a gem of a magazine! The only thing bad about it is that it doesn't come every month. Those quarterly issues are really anticipated. Keep up the great work!

— R. Mike Mullane
Col., USAF (Ret.)
NASA Astronaut (Ret.)
STS 41D Discovery '84
STS 27 Atlantis '88
STS 36 Atlantis '90

Enclosed is a check to extend my subscription for another year. *QUEST*, in my opinion is the best source of factual reporting on the space program, past and present, and you are to be commended for your efforts in getting it into print.

I would also like to take this time to personally thank you for printing my ad. It has brought many offers of help and encouragement in my continued research on the MOL and X-20 programs and I don't think I could have contacted these sources without your help.

— Terry L. Smith
Fayetteville, AR

Enclosed is my check for $19.95 to continue my subscription to *QUEST*. I find the articles in the magazine fascinating. I have one complaint: both the Spring and Summer issues had articles in the Resources section of events I would have gone to but my issue arrived on the Monday after the events.

— Randal Cohen
Alexandria, VA

Sorry about that. We try to include dated items that have a generous lead time so that readers will not miss them. Unfortunately, since "QUEST" is a quarterly magazine, it is often a challenge to include some scheduled events. The last issue ran into post-press production problems which delayed its release by several weeks. Hopefully, this will not happen again. — *QUEST*

As a subscriber to many space-related periodicals, I am very impressed with *QUEST* magazine. You are doing an excellent job preserving the history of the space program. Also, your "Resources" section is invaluable. Keep up the good work!

— Thomas A. Neal
Orlando, FL

A Reader's Reply to Kennedy's Real Apollo Dream

I was very interested to read the letter from Phil Clark regarding his 'Kennedy hypothesis' about the true intent of the U.S. president when approving the Apollo maned moon landing goal. In the course of researching for my book "The History of Manned Spaceflight," I had access to classified documents, correspondence and audio tapes of Oval Office conversations in the White House concerning this most momentous of all decisions in NASA history. Because of this, I would like to provide some information that might throw more light on the issue.

The decision to go to the moon was not conceived by Kennedy and he was reluctant about selecting a space goal to restore American prestige in the face of Gagarin's flight of April 12, 1961, the Bay of Pigs fiasco and the worsening domestic situation concerning the budget and how best to get Americans back in work. There were many steps in getting the moon landing goal approved and in setting defined schedules over which Kennedy had no influence; he had little say in the selection of a moon landing goal or its timing and clearly was reluctant to present a space spectacular at all. The story is best explained through a series of bullet points:

1. January 9, 1961: Chaired by George Low, the Manned Lunar Landing Task Group submitted its first draft recommendations for post-Mercury flights of an Apollo A spacecraft beginning 1965, an Apollo B on circumlunar mission in 1966 and an Apollo moon landing attempt beginning July 4, 1967. The build-up plan then envisaged 36-48 Saturn launches each year from 1966. This formed the basis for all future studies on lunar landings.

2. January 10, 1961: Jerome B. Weisener submits a report on NASA for President-elect Kennedy faulting the agency for inadequate policies and inept technical judgement, clearing the way for a greater level of control from the White House.

3. March 22, 1961: NASA Administrator James Webb, Deputy Administrator Hugh Dryden, Associate Administrator Robert Seamans, President Kennedy, Vice President Johnson and Budget Bureau Director David Bell met to discuss the fiscal year 1962 budget request. Kennedy did not want to accelerate Apollo but wanted more Saturn launch vehicle development to match Soviet lift capability. Bell liked the injection of money to put people back to work and increase tax revenues.

4. March 28, 1961: Kennedy reviews Eisenhower's fiscal year 1962 budget proposals and increases NASA funding by only $126 million versus the $308 million NASA wanted. No acceleration in Apollo.

5. April 14, 1961: Two days after the Soviets put Gagarin into orbit, Kennedy was agitated, suffering with severe back pain and impatient with critics of the new administration's 'Boston Boys.' Meeting with Webb and Dryden in the evening he asked 'Is there any place we can catch them? Is there anything we can do? Can we leapfrog? There's nothing more important.' This was the touchstone for decision. A few days later he asked Johnson to find a solution. Johnson asked him to put the request in writing.

6. April 20, 1961: Kennedy sends Johnson a memo asking for a way to beat the Russians but, disillusioned with what he considered wasteful space projects, he turned to Weisener and said, 'It's your fault. If you had a scientific spectacular on this earth that would be more useful - say, desalting the ocean - or something just as dramatic, then we would do it.'

7. April 29, 1961: Johnson responded to Kennedy's memo, recommending a manned moon landing over a space station (too easily achieved by the Soviets with their heavy launchers) or a manned trip to Mars (technically ambitious and too expensive), and met with Senate leaders on May 3 to get their approval, then with House leaders next day for their OK. Having sewn up the deal, Johnson left for an Asian tour on May 9.

8. May 2, 1961: The Fleming Task Group for a Manned Lunar Landing Study is set up and in its June 16, 1961, report sets August 1967 for the landing. To achieve that, in the run-up to the first moon landing 12 Nova launched test flights were projected for the 150,000 lb Apollo on a direct descent mission.

9. May 5, 1961: Alan Shepard successfully makes the first suborbital Mercury flight, clearing the way for a moon announcement.

10. May 8, 1961: The day before Johnson left for Asia, the Vice President had NASA boss James Webb and Defence Secretary Robert MacNamara send Kennedy a memo saying that they projected a moon landing for 1967. Before getting on Air Force 2, Johnson made sure that the memo was hand-given to Kennedy at his desk and not left with an aide. Johnson left, knowing he had secured a coup: to put Kennedy's hand on approval for steering NASA, the Defense Department, the Senate and the House to a moon landing goal against the President's better judgement.

11. May 25, 1961: Kennedy announces the goal of landing men on the lunar surface 'before this decade is out,' so as to give some margin for delays beyond the projected landing date of 1967.

12. May 25, 1961: Lundin Committee set up in NASA, mandated to study moon landing plans in the period 1967-70.

13. July 10, 1962: Lunar Orbit Rendezvous mode selected, retaining 'before this decade is out' commitment.

14. December 10, 1962: Webb writes to Kennedy on the matter of LOR selection and explains that 'the decision...had to be made at this time in order to...aim at a landing attempt in late 1967.'

The reason the LOR mode was selected in July 1962 was to maintain a Fall 1967 landing. And the reason that was important was to beat the October 1967 deadline for the 50th anniversary of the Russian Revolution. There was no doubt in anyone's mind that, if the Soviets were serious about racing to the moon, they would do it for that event. The year 1967 was seen in 1961/62 as a vital target for scheduling the moon landing, the earliest feasible date by which the hardware and operational phases could converge.

Kennedy became increasingly concerned about the space race and through 1963 worked to encourage a joint endeavour with the Russians, an approach that was encouraged when Johnson became President after Kennedy's assassination in November that year. As to the dual advantage of having the great event come within the incumbent's tenure, that was a nicety that added zest post-facto. It was certainly not the primary reason. Kennedy wanted what he considered more important monuments to his vision than bootprints on the moon. In fact he increasingly tried to undo the mandate.

The fear that Soviet cosmonauts would get to the moon first prevailed. When Korolov died in 1967 the heat was off. Intelligence reports said the Russians had lost heart for a moon mission. But NASA never really believed that. In the weeks before Apollo 8 flew around the moon in December 1968 I remember well a large sheet of paper stuck on the wall at NASA on which dates were placed, counting down the days to the next lunar launch window for a manned Zond.

As to the allocation of launchers for Apollo flights, by late 1966 when hardware was flowing along, NASA expected to use Saturn 1B's through AS-208 and Saturn V's through AS-509 for the earth orbit and lunar tests including first landing. AS-208 through AS-229 would support Apollo Applications Program earth-orbit flights between 1968 and 1973, while AS-509 through AS-517 would support expanded lunar exploration between 1969 and 1973.

After the January 1967 fire, everything changed, flights got shuffled, more missions were flown on Saturn 1Bs, but there was nothing pre-meditated about where the cut-off point for launcher flights was concerned. I well remember the argument in Headquarters to the effect that Saturn IB flights in support of moon landing hardware tests was a useless waste of resources when a bigger launch vehicle (Saturn V) could do a more cost effective job.

I hope this adds something for further debate but I can say that as far as the conversations between NASA, the Department of Defense and politicians in the White House were concerned, Kennedy did not attach any significance at all to the timing, other than to want it as a signal to the 'free world' that the US was on the march. In that regard it was an outstanding success and gave to America the one thing that made Kennedy approve Johnson's recommendation: a race without weapons that the world could follow openly. But he had really hoped for some other goal with more down-to-earth benefits.

—David Baker
Cambridge, England

YourSpace Reader Classifieds

YourSpace Reader Classifieds is available as a free service to all subscribers for purposes of publishing announcements, wants, trades or disposals of space-related items. *QUEST* also encourages advertising subscriber interests in order to get in contact with others of same interests. Please limit your ad to approximately 50 words (including name and address) and only one ad per person per issue. All ads are reviewed for suitability for publication but *QUEST* assumes no responsibility for statements made or the quality of items appearing in the classifieds. Type or print clearly your ad and send it to: *QUEST Magazine*, Reader Classifieds, P.O. Box 9331, Grand Rapids, MI 49509-0331.

STS Mission Profiles: Get complete space shuttle mission coverage with STS Mission Profiles. STS is a pre-flight publication giving the latest information on every shuttle mission. Each 40 page issue complete with color photos and drawings is mailed approximately 1 week prior to launch allowing you to have your own personal "press kit" for each flight. Order now and receive a special expanded color issue covering STS-52 and STS-47 FREE with each 1-year paid subscription. As a subscriber to QUEST you will receive a special discount rate of $30.50/ 1 year (8 issues), or send for a trial issue for $4.75. Write: STS Mission Profiles, P.O. Box 751387, Memphis, TN 38175-1387.

In Search Of: Early issues of *American Modeler*, *Young Men* and *Air Trails* magazines; Model rocket catalogs, kits, newsletters for sale or trade. Write: Bob Kreutz, 506 Hunters Road, Bricktown, NJ, 08724-4614 or phone: (908) 892-9148 (Fri-Sun or Weekends).

History of Space Collection: This is a 20" x 26" framed collection of postal covers and patches telling the history of spaceflight. Collection includes 8 special event postal covers and 6 colorful embroidered patches all set within a mat black aluminum frame. Each event cover is hand mounted with clear acetate corner protectors and is postmarked in a different historical space location. Beneath each patch and cover is a narrative description of major space events. $89 plus $10 for shipping and handling (inside US). For more information or to obtain a photo of this collection call or write: Moments In Space, 2691 Rebeiro Avenue, Santa Clara, CA 95051. Phone: 1-800-735-4821.

Military Model Rocket Kits! The Launch Pad's all-new 1994 Catalog now includes eleven large-scale kits, including: EXOCET MM.40, ALARM, HAWK MIM-23A, KORMORAN AS.34, ASRAAM and more! Several use clustered "D" power! Eight all-new Plan-Paks (30 Plan-Paks in all!) and recovery accessories are also available. Dealer inquiries are welcome. Club discounts available. Catalog $2.50. The Launch Pad, 8470-F Misty Blue Ct., Springfield, VA 22153.

Wanted: Space paintings & sculpture 1950s to 1980s, Moon Landings, Rocket lift-offs, etc. Looking for good, non-professional pieces. Also, watch for my new book *Collecting Man's Race Into Space* published by Schiffer Publishing. Available in bookstores worldwide. Write: Stuart Schneider, P.O. Box 64, Teaneck, NJ 07666.

Countdown Magazine: Enjoy the complete picture of every Shuttle flight and each major space advancement in *Countdown* magazine. *Countdown* puts you aboard with full mission previews & reviews. *Countdown* is published monthly, allowing us to provide you with the latest in color photographs and colorful accounts of ongoing space missions. Money-back guarantee: if you are not fully satisfied with your first issue, cancel and pay nothing. Limited-time offer for new subscribers: $24.95 for 12 monthly issues, 40% off the cover price. Write: *Countdown*, P.O. Box 216, Athens, OH 45701.

Wanted: I am looking for original issue Apollo, Skylab, ASTP and early Shuttle flight patches. Lyon Brothers and AB Emblem. Will buy or trade. Write: Andrew Parris, 16202 El Camino Real, #801, Houston, TX 77062.

Space Available: The Space Business Newsletter. Covers aerospace developments for the individual investor. Write for a free sample issue to: Space Available, 654 Guemes Island Road, Guemes Island, WA 98221-9507 or call 1-800-455-SPAC.

For Sale: *Space Frontiers* back issues published from 1985-1989. Volume 1 (issues 1-6) and Volume 2 (issues 1-6) xerox copies only. Volume 3 (issues 1-6) and Volume 4 (issues 1-5) original printings. $2.50 per issue postpaid. Send SASE for detailed listing of all issues. Write: Ted Talay, 169 Carnegie Drive, Newport News, VA 23606.

For Sale: Out of print and difficult to locate books about the space program and related subjects. Write or call for free catalog: Knollwood Books, P.O. Box 197, Oregon, WI 53575-0197; PH: (608) 835-8861.

Wanted: Amateur spaceflight historian looking for contractor desktop models, 8 x 10 color/B&W photos & program histories of all U.S. IRBM, ICBM, expendable satellite/probe launch vehicles 1957-present. Send list & prices to: Arthur W. LeBrun, 17412 Burdie Lane, Orange, CA, 92669.

Information Wanted: I seek photos, drawings and other information on the Lockheed X-17 research rocket of the mid 1950s. Write: John S. DeMar, 4753 Freestone Road, Liverpool, NY 13090.

Books, Autographs, Memorabilia: After years of collecting I must dispose of everything due to illness. I have foreign & domestic books that are out of print by NASA, astronauts and cosmonauts. In addition I have models, actual artifacts, signed materials, toys, mission charts, globes and much more. For further details simply send two first class stamps to: Robert Shaw, 150 W. 26th St. #801, New York, NY 10001-6813.

Russian Space Items For Sale: First man in space 30th anniversary medal issued by Baikonur Cosmodrome and minted from metal of flown spacecraft. Fragments of Soyuz T-11. Large Gagarin and Energia/Buran pins. Vostock and MIR pocket calendars, Russian space videotape. Write for free catalog: Cosmodrome/Spaceport Enterprises, 24 Sheridan Street, Lawrence, MA 01841.

Space Data Base System: The ultimate space data base systems. For IBM only. No other software required. Space 2000 covers all countries from 1926 through NASA plans in 2012. CATSAT includes all US Space Command Cataloged items. Book versions also available. Write or call: SAR, Inc., P.O. Box 49446, Colorado Springs, CO 80949; PH: 719-260-0500.

Wanted: Decals in relation to payload carried on shuttles put out by private contractors. Send xerox and your price to: Ray DuBeau, 658 Babcock, Elmhurst, IL 60126-1868.

Space Trading Cards: Have a few complete sets of Series #2 & #3 of the SPACE SHOTS SERIES for $19 per set. Have tons of dupes for same and some from Series #1. Your list for mine. Please send a SASE to: Dennis L. Rodgick, 601 Bayberry Lane, Imperial, PA 15126.

For Sale: 60 different issues of Astronomy magazine (including first issue). Send SASE for list and prices to: Joseph L. Riccitelli, Jr., 74 Maple Street, East Haven, CT 06512-1137.

Astronaut Autographs For Sale: Genuine signatures of U.S. astronauts. Mercury-Shuttle. Write for free catalogue: Adam Harwood, 1759 Kickingbird Road, Edmond, OK 73034.

For Sale: Fine Russian Scale Model SA-3 Goa surface to air missile (Soviet Military rocket 5B24/Defence System C-125) in 1/12 scale. Built by M. Kuznetsov, the last Soviet Scale Altitude champion. One-of-a-kind world-class craftmanship, $350. Write: Alexander B. Mitiuriev, Rt. 4, Box 460, Forest, VA 24551.

Space Memorabilia Wanted: Especially Apollo 11 related items. Please send list to: Mr. Brown, P.O. Box 296, Salt Lake City, UT 84110; or FAX list to 801-364-2646.

Model Rockets: Plastic model kits and out of production Estes model rocket kits. Send SASE for list. Write: Richard Rondeau, 3825 Potter, Eugene, OR 97405.