Saguaro Astronomy Club

Metro Phoenix, Arizona

SACNEWS

July 1992 — Issue #186

The Great Moon Race: In the Beginning... Part 2

by Andrew J. LePage

Quick Calendar

SAC Meeting
7:30, Friday, July 17

Star Party
Buckeye Hills Recreation Area
Saturday, July 25

Continued from last month...

Photographing the Unknown

Less than one month later, the Soviets launched the most advanced Moon probe to date. On October 4, 1959, LUNA 3 — also known as the Automatic Interplanetary Station (AIS) — was launched towards the Moon. This probe was much different from the previous LUNA explorers. Its design was a cylinder capped by two hemispheres with a total length of about 4.3 feet (1.3 meters) and a diameter of about 3.90 feet (1.19 meters). The 613.3-pound (278.5-kilogram) probe was covered with banks of solar cells to recharge chemical storage batteries which provided electrical power, the first Soviet spacecraft ever to do so. The spacecraft was spin stabilized in part for thermal control. Additional thermal control was provided by rectangular thermal shutters between the banks of solar cells as well as fans inside LUNA 3 that circulated the gas inside, which was pressurized to 0.23 Earth atmospheres. These measures kept the interior temperature between 77 and 86 degrees Fahrenheit (25 and 30 degrees Celsius).

In addition to instruments to detect micrometeoroids and cosmic rays, LUNA 3 carried the first photo-television imaging system which was to be used to photograph the hemisphere of the Moon previously unseen from Earth. This system consisted of a 200mm, $f/5.6$ wide-angle lens as well as a 500mm $f/9.5$ lens for more detailed photographs. At least 29 exposures of a special radiation resistant 35 mm isochrome film were carried. Once exposed, the film was automatically developed onboard the spacecraft, after which it was scanned by a light beam with a maximum resolution of one thousand lines per image. The images were then transmitted to Earth at one of two speeds: A slow speed for the initial transmission far from Earth and a higher speed for when the probe was closer.

In order for LUNA 3 to be placed into a precise orbit that would take it past the Moon at the prescribed distance, the escape stage was equipped with a radio guidance system that allowed ground controllers to shut down the engine at just the right moment. The Block E escape stage also carried 344.6 pounds (156.5 kilograms) of additional instruments and other equipment. After passing only 4,300 miles (6,900 kilometers) above the lunar south polar region, LUNA 3 was swung upwards towards a vantage point where it could view seventy percent of the Moon's far side.

the [LUNA 3] images did reveal many new features on the far side and showed that ... it was nearly devoid of large maria.

On October 7 at 3:30 GMT, with LUNA 3 only 40,500 miles (65,200 kilometers) from the Moon, attitude control jets were fired to stop the spin of the probe and align its camera with the Moon. For the next forty minutes, LUNA 3 took the first photographs of the lunar far side. Once the photographs were taken, the spacecraft was spun up again and continued in a new orbit (as a result of lunar perturbations) around Earth with an apogee of 300,000 miles (480,000 kilometers) and a perigee of 29,500 miles

(47,500 kilometers), an inclination of eighty degrees, and a period of about fifteen days. This new orbit allowed LUNA 3 to appear high in the Soviet sky to facilitate transmission of these historic photographs.

The first transmission of the images took place at low speed while the probe was still quite distant from Earth. Although the quality was poor due to the transmission distance and the far from ideal lighting of the lunar surface, the images did reveal many new features on the far side and showed that, unlike the familiar hemisphere which always faces Earth, it was nearly devoid of large maria ("seas"), the vast beds of hardened lava. A second transmission of these photographs at closer range apparently never occurred as planned due to a spacecraft failure. Still, the Soviets secured yet another important space first. Possible attempts to fly an improved version of LUNA 3 failed on April 12 and 18 in 1960. These were to be the last of the first generation Soviet missions to the Moon.

Final Gamble

After the fiasco with ARPA's first five lunar probe attempts, NASA decided to build and launch its own set of PIONEER-class missions in this first round of lunar exploration. They were the most advanced American spacecraft to date. This new PIONEER was a sphere 39 inches (0.99 meters) in diameter that weighed in at 387 pounds (176 kilograms). Attached to the exterior were four paddles covered with 1,100 solar cells that would be deployed after separation from its launch vehicle. At each end of the probe was a small rocket engine; one to be used in bursts of up to four seconds for course corrections and the other to brake the probe into lunar orbit when it was only 5,000 miles (8,000 kilometers) from the Moon. The hydrazine propellant for these engines was kept in a 26-inch (66-centimeter) diameter sphere inside the probe. The hydrazine would spontaneously decompose inside the throat of the engines after it had passed over a bed of aluminum oxide catalyst.

Thermal control was provided by fifty four-blade blue and white butterfly fans. These fans were controlled by metal coils. As they heated and expanded, the butterfly fans would open, exposing more white and less blue to reflect heat. When cooled, the butterfly fans would close, exposing more blue to allow more heat to be absorbed. This more complex thermal control system was required due to the amount of instrumentation carried and the more demanding mission.

When the last ATLAS A was launched in March of 1958, a total of eight had been launched with only three successes.

Each probe carried a variety of instruments to measure the magnetic and radiation environment around the Moon. Instruments included two magnetometers, a high radiation counter, an ionization chamber, Geiger-Mueller counters, a low-energy radiation counter, a plasma probe, and a scintillation spectrometer to measure the energy of solar protons. In addition, a simple television scanner was carried to return images of the lunar surface from orbit.

The launch vehicle chosen for this lunar orbiter was the ATLAS-ABLE, which was specifically designed for high-speed missions such as this. The first stage consisted

Summary of Lunar Probe Launches, 1958–1960

Name	Launch Date	Country	Weight lbs (kg)	Launch Vehicle	Comments
Unannounced	May 1, 1958	USSR	790 (360)?	VOSTOK	Possible launch failure of lunar impact mission
Unannounced	Jun 25, 1958	USSR	790 (360)?	VOSTOK	Possible launch failure of lunar impact mission
PIONEER 0	Aug 17, 1958	US	83.8 (38.0)	THOR-ABLE	Failed lunar orbiter attempt
Unannounced	Sep 22, 1958	USSR	790 (360)?	VOSTOK	Possible launch failure of lunar impact mission
PIONEER 1	Oct 11, 1958	US	84.4 (38.3)	THOR-ABLE	Failed lunar orbiter attempt
PIONEER 2	Nov 8, 1958	US	87.3 (39.6)	THOR-ABLE	Failed lunar orbiter attempt
Unannounced	Nov 15, 1958	USSR	790 (360)?	VOSTOK	Possible launch failure of lunar impact mission
PIONEER 3	Dec 6, 1958	US	12.95 (5.88)	JUNO 2	Failed lunar flyby attempt
LUNA 1	Jan 2, 1959	USSR	795.6 (361.3)	VOSTOK	Failed lunar impact attempt; first lunar flyby
Unannounced	Jan 9, 1959	USSR	790 (360)?	VOSTOK	Possible launch failure of lunar impact mission
PIONEER 4	Mar 3, 1959	US	13.4 (6.09)	JUNO 2	Distant lunar flyby; first US probe in solar orbit
Unannounced	Jun 16, 1959	USSR	790 (360)?	VOSTOK	Possible launch failure of lunar probe
LUNA 2	Sep 12, 1959	USSR	859.2 (390.2)	VOSTOK	First lunar impact
LUNA 3	Oct 4, 1959	USSR	613.3 (278.5)	VOSTOK	First lunar photographic flyby of far side
ATLAS-ABLE 4	Nov 26, 1959	US	372 (169)	ATLAS-ABLE	*P-3* Failed lunar orbiter attempt
Unannounced	Apr 12, 1960	USSR	615 (280)?	VOSTOK	Possible launch failure of lunar photographic flyby
Unannounced	Apr 18, 1960	USSR	615 (280)?	VOSTOK	Possible launch failure of lunar photographic flyby
ATLAS-ABLE 5A	Sep 25, 1960	US	387 (176)	ATLAS-ABLE	*P-30* Failed lunar orbiter attempt
ATLAS-ABLE 5B	Dec 14, 1960	US	388 (176)	ATLAS-ABLE	*P-31* Failed lunar orbiter attempt

NOTES: Probe names given in *italics* are used if no official name exists.

Weights given are the launch weights of the probes and do not include any additional equipment that may have been carried by the escape stage.

of a modified Convair built ATLAS D ICBM. The ATLAS program began in February of 1954 when an ICBM was recognized to be feasible. Convair, because of its previous ICBM development work with the MX-774 test missile from 1946 to 1948, was chosen as the prime contractor for Weapon System 107A (later known as SM-65 ATLAS) in January of 1955. By June of that year, the project was given the highest national priority, a status later shared by the THOR IRBM.

Like the Soviet R-7, the ATLAS made use of parallel staging. At launch, two booster engines — along with a sustainer engine — ignited, drawing fuel from a common set of propellant tanks. The booster engines were later jettisoned, leaving the sustainer to continue with powered flight. The first model, the ATLAS A, was a research vehicle that made use of only the booster engines. Testing began with ATLAS 4A, which failed on June 11, 1957. Not until the third launch with ATLAS 12A on December 17 did the system finally work properly. When the last ATLAS A was launched in March of 1958, a total of eight had been launched with only three successes.

The first ATLAS B, which had a full complement of engines, was tested in July of 1958 and failed. The second flight, on August 2, did succeed however. The ATLAS finally flew at full range in November. On December 18, a stripped down ATLAS B was launched into Earth orbit carrying a recorded message from President Eisenhower as part of Project Score. By the end of the ATLAS B program on February 4, 1959, ten ATLAS B missiles had been launched with six successes.

... [the ATLAS-ABLE launch vehicle] had just enough power to hurl the new PIONEERs to the Moon.

The ATLAS C was used for additional testing and training of Strategic Air Command (SAC) missile crews. Eventually deployed in limited numbers, the ATLAS C was armed with a General Electric (GE) Mk 2 warhead and employed a radio guidance system which, while much more accurate than the inertial guidance systems of the day, prevented salvo launches. During its test program, which ran from December 23, 1958 to August 24 the following year, only three ATLAS C missiles met their objectives out of six attempts.

The ATLAS D (SM-65D), outfitted with a GE Mk 3 warhead and an improved inertial guidance system that relied on ground commands for periodic updates, was meant to be deployed operationally in semi-hard coffin installations. It was later used as the booster for launch vehicles. The first test launch in April of 1959 failed as well as the next three attempts. The first ATLAS D to meet it goals was launched on July 28. After another successful flight from the Pacific Missile Range in California on September 9, the ATLAS D was declared "operational", if not yet very reliable.

The upper stages of the ATLAS-ABLE were nearly identical to those used in the not so successful THOR-ABLE. Major differences appeared in the second stage, which included lengthening it by 2.1 feet (0.65 meters) and substituting an Aerojet AJ10-101 engine for the AJ10-42 used earlier. By the fall of 1959, this upper stage combination, along with its close relative, the VANGUARD, still had an abysmal success record: Two out of three USAF THOR-ABLE entry tests were flown successfully (although the payload was only recovered once). Out of the five flights of the THOR-ABLE Space Carrier, only the launch of the 142-pound (64-kilogram) EXPLORER 6 satellite into an elongated Earth orbit on August 7, 1959 was successful. The upper stages were responsible for three of the four launch failures. The upper stages of the VANGUARD continued their poor performance, racking up only two additional successes since the launch of VANGUARD 1. The upper stages were found responsible for six of the eight VANGUARD launch failures.

In total, the ABLE combination had flown successfully only six times out of sixteen opportunities. Combined with the record of the ATLAS, things were bound to go wrong. On paper, the ATLAS-ABLE launch vehicle was capable of placing 1,500 pounds (680 kilograms) of payload into a 300-mile (480-kilometer) Earth orbit, or place 100 pounds (45 kilograms) directly into a Clarke orbit, or 200 pounds (90 kilograms) into a direct ascent escape trajectory into interplanetary space. It had just enough power to hurl the new PIONEERs to the Moon.

This new series of PIONEER Moon probes suffered its first set back on September 10, 1959, when ATLAS-ABLE 1 caught fire and exploded on the launch pad during a static firing test, fortunately without the payload attached. Finally, on November 26, ATLAS-ABLE 4, with ATLAS 20D as the booster and a PIONEER orbiter designated P-3 as the payload, lifted off from Pad 14 on the Atlantic Missile Range. About 45 seconds into the flight, the fiberglass payload shroud ripped away, prematurely ending the mission.

Another attempt would not take place for over one year. On September 26, 1960, ATLAS-ABLE 5A, carrying a PIONEER orbiter payload designated P-30, lifted off from Pad 12. While the ATLAS 80D booster operated as intended, the second stage failed to develop full thrust and shut down early. The payload was destroyed upon entry seventeen minutes after launch. The last PIONEER orbiter, P-31, was launched on December 15 of that same year using ATLAS-ABLE 5B. Like so many ATLAS flights at that time, the ATLAS 91D booster exploded at an altitude of 40,000 feet (12,000 meters) after only 68 seconds of powered flight.

NASA's first probes to the Moon suffered the same fate as all but one of the original ARPA Moon missions: Ending up as either debris on the bottom of the Atlantic Ocean or as fine dust in the upper atmosphere. While the

Soviets appear to have suffered from their share of failures, their successes were spectacular. In this first round of the race to the Moon, the Soviets clearly won, not only in their eyes but in the eyes of the United States and the rest of the world. The stage was now set for the next round in the race to reach the Moon.

Bibliography

Barabashov, N. P., A. A. Mikhailov, and Yu. N. Lipsky, **An Atlas of the Moon's Farside**, 1961

Boehm, Josef, Hans J. Fichtner, and Otto A. Hoberg, "EXPLORER Satellites Launched by JUNO 1 and JUNO 2 Space Carrier Vehicles", **Astronautical Engineering and Science**, 1963

Brockman, M. H., H. R. Buchanan, R. L. Choate, and L. R. Malling, "Extraterrestrial Radio Tracking and Communication", **Proceedings of the I.R.E.**, April, 1960

Burrows, William E., **Exploring Space: Voyages in the Solar System and Beyond**, 1990

Clark, Phillip S., **The Soviet Manned Space Program**, 1988

Emme, Eugene M., **Aeronautics and Astronautics: An American Chronology of Science and Technology in the Exploration of Space 1915–1960**, 1961

Gatland, Kenneth, **The Illustrated Encyclopedia of Space Technology**, 1988

Gatland, Kenneth, **Robot Explorers**, 1972

Gunston, Bill, **The Illustrated Encyclopedia of the World's Rockets and Missiles**, 1979

Johnson, Nicholas, **Handbook of Soviet Lunar and Planetary Exploration**, 1979

Josias, Conrad S., "Radiation Instrumentation Electronics for the PIONEER III and IV Space Probes"; **Proceedings of the I.R.E.**, April, 1960

Lange, Oswald H., and Richard J. Stein, **Space Carrier Vehicles**, 1963

Ordway, Fredrick I. III, "A Chronology of Space Carrier Vehicles, 1957 through 1962", **Astronautical Engineering And Science**, 1963

Pickering, William H., "History of the JUNO Cluster System"; **Astronautical Engineering and Science**, 1963

Von Braun, Wernher, and Fredrick I. Ordway III, **History of Rocketry and Space Travel**, 1966

Wilson, Andrew, (**Jane's**) **Solar System Log**, 1987

Major Nasa Launches, Kennedy Space Center (KSC) Historical Report No. 1A, circa 1987

About the Author

Andrew J. LePage is a member of the Boston Group for the Study of the Soviet Space Program, Krasnaya Orbita. In addition to his interests in astronomical and space related topics, Andrew has been a serious observer of the Soviet space program for over one decade.

Comet Comments

by Don Machholz

Two comets remain visible in our circumpolar sky this summer. Comet Tanaka-Machholz has already displayed a couple of outbursts. Meanwhile, Comet Shoemaker-Levy is brightning steadily as it approaches its July 24 perihelion.

Comet Spacewatch (1992h): D. Rabinowitz of the Lunar and Planetary Lab at Kitt Peak discovered this comet with a CCD attached to a 1-meter telescope. Discovered at magnitude 19, the comet will brighten only slightly as it approaches its Sept. 1993 perihelion of 3.2 AU.

Comet Bradfield (1992i): William Bradfield of Australia discovered this, his sixteenth comet, on May 3 at magnitude 10, in the morning southern sky. The comet reached perihelion three weeks later at .59 AU. It then briefly appeared in the evening northern sky as it dimmed rapidly.

Don Machholz (916) 346-8963

Comet	**Shoemaker-Levy**			**($1991a_1$)**	
Date	RA-2000-Dec		Elong	Sky	Mag
06–22	03h07.0m	+72°28′	55°	M	8.0
06–27	04h45.6m	+77°27′	55°	M	7.6
07–02	07h50.6m	+77°55′	55°	E	7.2
07–07	10h06.1m	+70°50′	55°	E	6.9
07–12	11h04.7m	+59°49′	54°	M	6.7
07–17	11h32.7m	+47°34′	52°	M	6.6
07–22	11h47.9m	+35°38′	51°	M	6.6
07–27	11h56.9m	+24°58′	49°	M	6.8
08–01	12h02.5m	+15°53′	47°	M	7.0
08–06	12h06.1m	+08°21′	45°	M	7.3

Comet	**Tanaka-Machholz**			**(1992d)**	
Date	RA-2000-Dec		Elong	Sky	Mag
06–22	06h32.0m	+61°06′	38°	E	9.6
06–27	06h56.1m	+59°18′	37°	E	9.8
07–02	07h16.5m	+57°28′	35°	E	10.0
07–07	07h33.9m	+55°38′	34°	E	10.2
07–12	07h49.0m	+53°51′	32°	E	10.4
07–17	08h02.2m	+52°08′	31°	E	10.6
07–22	08h14.0m	+50°28′	30°	E	10.7
07–27	08h24.4m	+48°55′	30°	M	10.9
08–01	08h33.8m	+47°23′	30°	M	11.1
08–06	08h42.4m	+45°57′	30°	M	11.2

Directions to SAC Events

SAC General Meetings 7:30 PM at Grand Canyon University, Fleming Building, Room 105 — 1 mile west of Interstate 17 on Camelback Rd., north on 33rd Ave., second building on the right.

SAC Star Parties at Buckeye Hills Recreation Area — Interstate 10 west to Exit 112 (30 miles west of Interstate 17), then south for 10.5 miles, right at entrance to recreation area, one-half mile, on the right. No water and only pit toilets. Please arrive before sunset; allow one hour from central Phoenix.

SAC Deep Sky Subgroup Meeting at John & Tom McGrath's, 11239 N. 75th St., Scottsdale, 998–4661 — Scottsdale Rd. north, Cholla St. east to 75th St., southeast corner.

Bits and Pieces

Coming Events

Plan for Tucson Amateur Astronomy Association's (TAAA) All Arizona Star Party in October.

July's Speaker

Gerry Rattley will be our speaker for the July meeting. His subject is planetary nebulae. Gerry will provide lots of information on these beautiful and strange objects, both on observing them and their astrophysical characteristics. He requests that SAC members bring any drawings, personal photos or slides of planetary nebulae to the meeting. If anyone has sculptures or models of planetary nebulae, either scaled or unscaled, please bring those too. Let's fill the room with cosmic debris!

1992 SAC Meetings
July 17
August 14
September 11
October 9
November 6
December 12 Party

1992 SAC Star Parties
July 25
August 22
September 19
October 24
November 21
December 19

Deep Sky Meeting

The next Deep Sky meeting will take place on Thursday, July 23 at 7:30pm. Objects in the constellation Aquila are open for discussion.

Newsletter Deadline

Mail items at least two weeks before the end of the month. Items arriving too late for an issue will be included in the next newsletter.

SAC Officers

President	Paul Lind	863–3077
Vice President	Steve Coe	878–1873
Secretary	Susan Morse	934–7496
Treasurer	Bob Dahl	582–5526
Properties	Rich Walker	997–0711
SACNEWS Editor	Paul Dickson	841–7044

Minutes of the June Meeting

President Paul Lind opened the meeting at 7:35 PM with a welcome to all new members and visitors. Guests were introduced and included three enthusiasts from Australia — Paul Tierney, Marty Spencer and Nick Williams. Paul explained the general format of the meeting and pointed out the upcoming SAC events as listed on the board. He complimented Paul Dickson on the quality of the SAC Newsletter.

For the Treasurer's Report, Bob Dahl said that our membership stands at 105. Because of El Niño, our Arizona skies have been very disappointing recently. To help, the ancient Indians used special rituals to clear the skies while wearing SAC T-shirts and SAC caps. If all the rest of us would buy these shirts and caps, we too would have clear skies.

As Properties V. P., Rich Walker reminded the members about the club's library. All books may be checked out for a month and returned at the next meeting. Paul Lind mentioned that because his name appeared in a national magazine, he has received a lot of mail, including *The Eternal Universe*, which attempts to explain about cosmic music, reincarnation, and creation. A.J. presented two awards to Rich Walker — one for completing the Messier Catalogue and the other for completing the 110 Best NGC Objects. The Deep Sky group will meet at the McGrath house and Aquila (the Eagle) will be the featured constellation with its planetary nebula.

For the "show 'n tell" presentations, Tom Polakis had slides of star trails taken at the Texas conference; Rick Rotramel showed slides of the Riverside conference telescopes that were unusual or won awards; Paul Tierney from Australia showed slides taken from "Down Under;" and Chris Schur had slides of Jupiter taken with his CCD camera and image processed. Andrew Grunke from Wickenburg explained about his portable electronic spectrometer soon to be available for serious stargazers.

After the break, the main speaker, David Levy, a well-known comet hunter and writer of the *Sky and Telescope* column "StarTrails" gave a well-received presentation on Comet "Tales" — unusual comet stories.

—*Susan V. Morse, SAC Secretary*

Trip to Kitt Peak:

Bus or Carpool?

From Steve Coe

Several members have pointed out to me that it would be much cheaper to set up a carpool to Kitt Peak for a tour. Right now, what I have is a very tentative date of Sept. 5. We would be leaving around 9 AM, picnic on Kitt Peak, tour would cost approximately $25 per member and the bus holds about 40. I have not put any deposits down as yet.

What needs to be decided is: do we want a bus and driver or carpool to Tucson using member's vehicles? As I see it there are advantages and disadvantages to both approaches. A carpool is cheaper and provides flexibility for individuals to leave the group and do whatever they would like as far as food or other side trips. The bus tour would allow us to chat, sleep or whatever along the way without the worry of who will drive, but this is not very flexible.

I need to hold a short discussion, followed by a decision of what the club would like to do at the July meeting. So think it over and let me have your input.