Saguaro Astronomy Club

Metro Phoenix, Arizona

SACNEWS

June 1992 — Issue #185

Quick Calendar

SAC Meeting
7:30, Friday, June 12

Star Party
Buckeye Hills Recreation Area
Saturday, June 27

The Great Moon Race: In the Beginning...

by Andrew J. LePage

Introduction

With each passing day it seems more and more likely that we will be returning to Earth's Moon. The Soviet Union (now the Commonwealth of Independent States) has been considering a lunar mapping mission for over one decade. The United States has made a public commitment to return to the Moon, starting with a mission to map and inventory lunar resources. Already the GALILEO spacecraft, during its first flyby of Earth in late 1990, made important observations of our only natural satellite. GALILEO will make more lunar examinations on its last flyby of our planet this December before finally heading to the Jovian system.

The Japanese are also seriously considering probes to the Moon: So far they have sent a pair of simple probes into lunar orbit as part of an engineering test program. Plans for dropping landers on the lunar surface later in this decade are already under way.

We finally seem to be at the threshold of the next round of lunar exploration. This is the time to look back at the first round, which started before most readers of

The myth of American technical superiority was crumbling fast with each Soviet satellite launch.

this article can remember — in fact, it started a few years before even I was born! The world then was a much different place than the one we live in today. We were in the middle of the Cold War and at the very beginning of the Space Age, an age which was ushered in by the Soviet Union with their launch of SPUTNIK 1 in 1957. The myth of American technical superiority was crumbling fast with each Soviet satellite launch.

The early Space Age was a time when the space programs of both the Soviet Union and the United States were run, for all intents and purposes, by the military. Indeed, only military missiles and their derivatives were capable of placing payloads into Earth orbit or beyond. As a result, the Soviet success in space was viewed as a military threat and, more importantly to American politicians, a global public relations threat.

It was also a time of total chaos in the American space program. The space program was run by dozens of military and civilian agencies, groups, and committees of various sizes, all struggling for their piece of the New Frontier. What little guidance which was provided by the Eisenhower Administration and Congress was often conflicting and reflected the keen inter-service and inter-agency rivalries that had developed over the previous decade. Against this backdrop, all involved agreed that the Americans needed some spectacular space firsts quickly. Meanwhile, in the Soviet Union, it was realized that the Soviets needed to stay ahead as proof of the superiority of socialism.

The Military Lunar Missions

The battle lines in the United States were drawn on March 27, 1958. President Dwight David Eisenhower (1890–1969) approved a Department of Defense (DoD) plan that directed its newly created Advanced Research Projects Agency (ARPA) to fund two military proposals to reach the Moon as part of America's contribution to the International Geophysical Year (IGY). ARPA felt that a successful military lunar mission would add credibility to the military presence in space. It would also help prevent any civilian space agency that might be formed from taking an important share of the space program from them. In addition, the long-distance guidance and tracking experience gained in the project would be useful for future programs. Three of the launches would be performed by the United States Air Force (USAF) and two by the United States Army.

The USAF was first up to bat with the more ambitious of the two proposals. Only months after the launch of the first Earth satellites, the USAF wanted to send a probe that would orbit the Moon. Under contract by the USAF, Space Technology Laboratories (STL) built an 84-pound (38-kilogram) spin-stabilized probe carrying 39 pounds (18 kilograms) of scientific instruments. The orbiter was made of fiberglass and consisted of a wide belt joining two flattened cones. At the apex of one cone was a ring of eight vernier solid rockets which were to be used to adjust the trajectory of the probe. At the other end was a single Thiokol Falcon solid rocket motor that would be fired once the probe approached the Moon so that it could enter lunar orbit. Removable black and white stripes applied to the probe's exterior surface were used for passive thermal control. Depending on the anticipated thermal environment, which depended on the trajectory, these strips could be added or removed before launch to achieve the proper thermal balance.

The wide belt contained the control systems, batteries, radio, and scientific instruments. These instruments included a spin-coil magnetometer to measure magnetic fields, an ionization chamber and proportional counter to measure radiation, sensors to monitor internal temperatures, a special microphone 1.3 inches (3.3 centimeters) in diameter to detect the impacts of micrometeoroids, and a simple camera. The camera weighed only 14 ounces (400 grams) and consisted of a small parabolic mirror that would focus infrared radiation received from the Moon onto a special cell. A picture would be built up one line at a time as the probe spun. In case the probe should accidentally impact the Moon, the spacecraft was decontaminated to minimize the chances that organisms from Earth would corrupt any future biological lunar investigations.

The launch vehicle that would send this probe on its way was the THOR-ABLE Space Carrier. The THOR-ABLE was originally designed for high-speed entry tests of USAF inter-continental ballistic missile (ICBM) warheads. This two-stage version of the THOR-ABLE was first used on April 23, 1958, but its payload fell short of the recovery area. A second attempt on July 9 was considered successful. The first stage was a USAF THOR intermediate-range ballistic missile (IRBM) with a range of 1,600 miles (2,600 kilometers) and was built by Douglas Aircraft. When THOR was authorized in November of 1955, it was immediately given the highest national priority. Designed and built in record time, the first SM-75 THOR was delivered to the USAF in October of 1956, and the first flight test — a failure — took place on January 25, 1957. After three more failures, it was successfully tested on September 20. By the following June, THOR had completed its test program and was ready to be made operational.

In the THOR-ABLE configuration, THOR's nuclear warhead was replaced with an adapter skirt upon which the upper stages would sit. The second stage was a Douglas modified unit originally used as the second stage on the Navy's VANGUARD satellite launcher. In the ABLE configuration, this stage was shortened by 11.6 feet (3.5 meters) and the original Aerojet General AJ10-37 liquid propellant rocket engine replaced by the slightly more powerful and efficient AJ10-42 engine. The third stage was the same X-248 Altair solid motor built by Allegany Ballistic Laboratory used in later versions of the VANGUARD.

The powered flight profile of the THOR-ABLE Space Carrier starts with the ignition of the THOR booster. Ten seconds into the flight, the launch vehicle begins a slow gravity turn to place it in the proper injection angle. This gravity turn would stop 140 seconds into powered flight. At an elapsed time of 159.5 seconds, the THOR booster shuts down at an altitude of 59.3 miles (95.4 kilometers) and an inertial velocity of 10,859 miles per hour (4,855 meters per second). Next, the second stage ignites to bring the altitude and velocity to 194.3 miles (312.6 kilometers) and 16,033 mph (7,167 mps), respectively, 269.3 seconds into the flight. At 306.3 seconds elapsed time, the third stage burns out. The altitude is 257.9 miles (415.0 kilometers) and the final speed is 24,011 mph (10,734 mps).

The first lunar launch, in the glare of the world press, proceeded as planned until 77 seconds into the flight, when the turbo-pump seized causing the booster to explode.

The upper stages, although successfully used in the second THOR-ABLE entry tests, had a poor record. By June of 1958, problems in the second stage of the VANGUARD were responsible for three of VANGUARD's five failures. At the time, the upper stages of the VANGUARD operated correctly only once, to place the VANGUARD 1 satellite into Earth orbit on March 17, 1958. Theoretically, if the THOR-ABLE Space Carrier worked properly, this launch vehicle could place 350 pounds (160 kilograms) of payload into a 300-mile (480-kilometer) high orbit or 85 pounds (39 kilograms) into a direct ascent escape trajectory.

The first lunar launch, in the glare of the world press, was attempted on August 17, 1958 using the THOR-ABLE 1 launch vehicle. At 7:14 A.M. local time, the rocket lifted off Pad 17A on the Atlantic Missile Range

(AMR) in Florida. Everything proceeded as planned until 77 seconds into the flight, when the turbo-pump in the first stage engine seized, causing the THOR 127 booster to explode. It was a depressing start for the program and an omen of things to come.

NASA Gets into the Game

The August 17 launch attempt would prove to be the one and only purely military Moon shot. During 1958 the United States Congress created a civilian space agency called the National Aeronautics and Space Administration (NASA). When it officially came into existence on October 1, 1958, President Eisenhower transferred control of all scientific space projects, including the ARPA Moon missions, to NASA. NASA would direct the last four Moon missions while the USAF and the Army would continue their involvement as "executive agents." NASA designated this series of probes PIONEER.

Another THOR-ABLE was quickly assembled and prepared for what would be NASA's first space probe launch. At 3:42 A.M. on October 11, PIONEER 1 was successfully launched — or so it seemed at first. After the probe separated from the third stage, the velocity was found to be 340 mph (152 meters per second) short of its target, due to the premature shutdown of the carrier rocket's second stage. Attempts to increase the probe's velocity using the eight vernier rocket motors did not help. PIONEER 1 reached a peak altitude of 70,700 miles (114,000 kilometers) before it arced back towards Earth and burned up over the South Pacific Ocean 43 hours, 17 minutes, and 30 seconds after launch.

While PIONEER 1 failed its primary mission, it did return some data indicating that the Van Allen radiation belts discovered earlier that year by EXPLORER 1 extended to an altitude of 5,000 to 7,000 miles (8,000 to 11,000 kilometers) at Earth's equator and then tapered off at an altitude of 9,320 miles (15,000 kilometers). In addition, eleven micrometeoroid impacts were detected. Still, PIONEER's failure to reach the Moon was yet another big blow.

One lunar month later, PIONEER 2 and its THOR-ABLE launch vehicle was ready for launch. The guidance system of this THOR-ABLE was modified to incorporate a Doppler command system to minimize the velocity errors that occurred previously. On November 7, the last USAF lunar attempt lifted off. The first two stages operated as planned, but this time the third stage failed to ignite. PIONEER 2 reached a peak altitude of 963 miles (1,550 kilometers) before it plunged back to a fiery entry 42.4 minutes after launch. During its brief journey, PIONEER 2 detected a flurry of micrometeoroid impacts reaching a rate as high as sixteen hits per minute. Later analysis cast doubt on this data, since it was found that thermal variations can cause spurious signals with the sort of detector carried by the PIONEERs.

While the USAF PIONEER probes never accomplished their primary mission, they did provide important engineering information and data on the then little understood near-Earth environment. These missions demonstrated that a dynamically stable, spinning spacecraft could be designed, built, and operated. The thermal control scheme also operated as intended. This project also provided experience in tracking and controlling distant spacecraft, skills which would be put to good use in the future.

Next up were the Army PIONEERs. This pair of probes were modest compared to the USAF probes, as they would only attempt a simple lunar flyby. The project had its origins in an early 1956 Army Ballistic Missile Agency (ABMA) and Jet Propulsion Laboratory (JPL) proposal to use a modified JUPITER IRBM to launch two deep probes during the IGY. Once funded by ARPA, the Army contracted JPL to build two small fiberglass probes weighing about 13 pounds (5.9 kilograms) each. They would be 20 inches (51 centimeters) long, ending in a 9-inch (23-centimeter) wide cone with a 3-inch (8-centimeter) spike antenna. The probe was gold plated and striped with paint for passive thermal control. The electrically conductive gold plating on the cone also served as an unsymmetrical dipole antenna element in conjunction with the spike antenna.

A 75% success record was excellent in these early days of the Space Age.

At the base of the probes was a despin mechanism which consisted of two 60-inch (1.5-meter) long weighted wires. As the wires unwound, the payload's spin would decrease from 415 to 11 revolutions per minute. Located inside of the probe was a 1.1-pound (500-gram) transmitter with an effective power of 180 milliwatts. Three telemetry channels were used to carry engineering and science data. The power supply for the transmitter and instruments consisted of eighteen mercury cells.

Two Geiger-Mueller tubes and the required electronics were used to obtain data on the radiation environment between Earth, the Moon, and hopefully beyond. A photoelectric triggering device was also carried as an engineering test for future systems. This device was incapable of producing images and had to be closer than 20,000 miles (32,000 kilometers) to the Moon in order to operate.

The launch vehicle to be used was the ABMA's JUNO 2, developed by the team lead by German rocket pioneer Wernher von Braun (1912–1977). The JUNO 2 consisted of a modified JUPITER IRBM topped with a modified version of the solid rocket cluster used as the upper stage of the JUNO 1 launch vehicle. The SM-78 JUPITER originated in a joint Army-Navy proposal in 1955 to build an IRBM with a range of 1,600 miles (2,600 kilometers). By November of 1956, as the result of a Department of Defense policy change that forbade the Army from deploying missiles with a range in excess of 200 miles (320 kilometers), it was decided that the USAF would deploy the missile after it was developed by the ABMA.

Flight testing began on March 1, 1957. In November of 1957, the prime contractor, Chrysler, began delivery of the JUPITER at the rate of four units per month. By July of 1958, 38 JUPITERs had been launched with a record of 29 successes and 7 partial successes. In August, deliveries of operational JUPITERs to the USAF began.

As the first stage of the JUNO 2 launch vehicle, the propellant tanks of the JUPITER were lengthened by 3.0 feet (0.92 meters) to increase the burn time by twenty seconds. Mounted on top of the first stage under an aerodynamic shroud was the instrument compartment and a JPL developed, three-stage solid rocket cluster. Modifications of this cluster from the version used on the JUNO 1 included increased thrust of the third and fourth stages and changing the titanium casing of the fourth stage to stainless steel.

During its unintended ballistic flight, PIONEER 3 was able to confirmed the extent of Earth's previously known radiation belt, as well as discover a second belt.

After the first stage shut down, it would separate using small lateral thrusters. The shroud would then be jettisoned. The instrument compartment contained a spin table to spin up the upper stages and payload for stability. It would also keep the upper stages oriented during the coast phase using four pairs of compressed air thrusters. After a predetermined period, the second stage — consisting of a ring of eleven modified SERGEANT rockets — would fire. Nine seconds later, the third stage cluster of three SERGEANTs would ignite, followed nine seconds later by the fourth stage consisting of a single modified SERGEANT rocket.

The upper stage cluster of the JUNO 2, when used with the JUPITER C (an ABMA developed rocket for high speed entry tests of a scale JUPITER IRBM warhead) and JUNO 1 launch vehicle (essentially a JUPITER C with a fourth stage attached), was quite reliable if somewhat inaccurate, due to the inconsistent performance of early solid rocket motors. All three JUPITER C flights were successful and only two of the three JUNO 1 failures were due to an upper stage malfunction. It operated successfully three times, orbiting EXPLORERs 1, 3, and 4. A 75-percent success record was excellent in these early days of the Space Age.

Theoretically, the JUNO 2 could place 95 pounds (43 kilograms) of payload in a 300-mile (480-kilometer) high Earth orbit, send a 500-pound (230-kilogram) payload vertically to an altitude of 1,800 miles (2,900 kilometers) or 30 pounds (14 kilograms) to 11,000 miles (17,700 kilometers). Most important to PIONEER, the JUNO 2 was capable of sending 15 pounds (7 kilograms) of useful payload on a direct ascent escape trajectory.

The first NASA/Army/JPL Moon probe, PIONEER 3, lifted off from Pad 5 at the Atlantic Missile Range at 12:45 AM on December 6, 1958. The JUPITER AM-11 booster cut-off 3.7 seconds early and with the flight path one degree lower than planned. After the upper stages fired successfully, PIONEER 3 was traveling at 23,606 mph (10,550 meters per second), well under the 24,240 mph (10,834 meters per second) required to reach the Moon. It was also discovered that the despin mechanism failed to operate as intended.

As a result, PIONEER 3 reached a peak altitude of only 63,580 miles (102,300 kilometers) before it returned to its destruction over French Equatorial Africa 38 hours and six minutes after launch. During its unintended ballistic flight, PIONEER 3 was able to make measurements that confirmed the extent of Earth's previously known radiation belt, as well as discover a second belt extending 10,000 miles (16,000 kilometers) above Earth, before fading out at a distance of 40,000 miles (64,000 kilometers). While an important discovery, it still did not make up for the fact that yet another American spacecraft failed to reach the Moon. Another PIONEER and JUNO 2 were prepared in hopes that the last of the original ARPA funded missions would be the first to the Moon. But it was not meant to be.

First Again

The United States was not the only country that wished to reach the Moon first. The Soviet Union was also working actively to be the first. On September 26, 1954, the Soviet Union announced that a rocket for interplanetary missions had been designed and the flight principles worked out. That fall, the Interdepartmental Commission on Interplanetary Communications was formed to study various space related projects. On April 26, 1955, the Soviets announced that they were studying plans to explore the Moon. By the summer of 1957, it was clear to the West that the Soviets had developed the first ICBM. The point was driven home with the launch of SPUTNIK 1 on October 4 of that year using their new ICBM.

After the launch of SPUTNIK 3 on May 15, 1958, the Soviets publicly appeared to be very quiet. Still, Western intelligence agencies had detected unsuccessful launches of some sort of rocket launched from Soviet Central Asia on May 1, June 25, September 22, and November 15 of 1958. All were perfectly timed to reach the Moon but none of them did.

Finally, on January 2, 1959, the Soviet Union announced the launch LUNA 1 or MECHTA (Dream, in Russian). The Soviets' first acknowledged Moon probe consisted of two polished aluminum-magnesium alloy hemispheres four feet (1.2 meters) across, bolted together at their equator. The interior, which held the transmitters, batteries, instruments, and other electronics, was pressurized to 1.3 Earth atmospheres. Combined with patterned surfaces and thermal louvers, this helped maintain the interior at a temperature of about 68 degrees Fahrenheit (20 degrees Celsius). The probe was neither spin-stabilized nor had an attitude control system. It relied on the tumbling brought about at separation from its escape stage to even out solar heating. On the exterior were four rod antennae for communication and the sensors for the instruments.

The instruments carried by this probe included a boom mounted magnetometer, an ammonium phosphate piezo-electric micrometeoroid detector covering about an area of two square feet (0.2 square meters), and radiation detectors. This roughly spherical 795.6 pound (361.3 kilogram) probe was far larger than anything the United States could launch. The escape stage that followed LUNA 1 after its ejection also carried a tracking and telemetry transmitter, instruments to study cosmic rays, and 2.2 pounds (1 kilogram) of sodium. The sodium was released 70,000 miles (113,000 kilometers) from Earth to produce a luminous cloud to locate the spacecraft as well as study Earth's magnetic field.

The rocket used to launch LUNA 1 into its direct ascent trajectory to the Moon was a modified version of the Soviet's first ICBM, the R-7. With a liftoff thrust in excess of 1.1 million pounds (500 metric tons), it was almost three times more powerful than its American equivalent, the ATLAS. Not until the first test flights of the SATURN 1 two years later would the United States have anything to compare to this truly huge rocket.

Development of the R-7, also known in the West as the SS-6 or by its NATO (North Atlantic Treaty Organization) codename, SAPWOOD, began in the early 1950s under the direction of Sergi Korolev (1906–1966). Unlike the Americans, who had an effective fleet of long-range bombers to deliver nuclear weapons, the Soviets decided to develop an ICBM to counter this threat. Since the first generation Soviet nuclear weapons were much larger than their American counterparts, the Soviets were forced to build a very large missile to lift their nuclear bombs over intercontinental distances.

The missile Korolev designed made use of parallel staging: Four boosters and the core would ignite simultaneously four seconds before liftoff. This was done since little was known at the time about the dynamics of igniting rocket engines at altitude. When the propellant in the boosters was depleted two minutes into the flight they were jettisoned, leaving the core to continue until its propellant also was gone. In its role as an ICBM, the R-7 had a range of about 6,000 miles (10,000 kilometers). It made its first test flight on August 3, 1957, and its first full range flight on August 27.

It was recognized early on that the R-7 would also make an excellent launch vehicle. The R-7 launched the first artificial satellite, SPUTNIK 1, on October 4, 1957, to the surprise of the West. Following three more orbital launch attempts, of which two were successful, the limits of the basic R-7 design had been reached. Modified so that a small Block E stage could be mounted on top of it, this new launch vehicle, later modified to become the VOSTOK launch booster, was able to increase the payload that the basic R-7 could carry to Earth orbit from about 1.5 tons (1.35 metric tons) to an incredible five tons (4.5 metric tons). It also allowed the launching of a little less than 0.5 ton (0.45 metric ton) on escape trajectories.

Although LUNA 1 was intended to hit the Moon, it gave the Soviets two more space firsts: The first lunar flyby and the first artificial planet.

Although originally intended to hit the Moon, LUNA 1 passed within 3,700 miles (6,000 kilometers) of the lunar surface about 34 hours after launch. LUNA 1 continued to transmit for another 28 hours to a distance of 371,000 miles (597,000 kilometers) before heading off into a solar orbit with a perihelion of 91.0 million miles (146.4 million kilometers), an aphelion of 122.6 million miles (197.2 million kilometers), and a period of 443 days. Another probable launch failure of a Soviet LUNA spacecraft occurred on January 9. Despite this, the Soviets had two more space firsts to add to their growing list: The first lunar flyby and the first artificial planet in the solar system. The United States had lost again.

Success...Sort of

With their hopes to be first to the Moon dashed, the last Moon probe originally funded by ARPA, PIONEER 4, was launched on March 3, 1959. PIONEER 4 was almost identical to PIONEER 3 except for some lead shielding added to one of its Geiger-Mueller radiation counters. This time, the second stage fired for one second longer than planned which, combined with aiming errors, resulted in the small JPL built probe not only escaping Earth's gravity but also missing the Moon by 37,300 miles (60,000 kilometers) at a speed of 4,300 mph (1,900 meters per second).

While PIONEER 4 passed too far from the Moon for its optical trigger device to operate, it did return useful data on the radiation environment until its batteries ran down 82 hours after launch at a distance of 407,000 miles (655,000 kilometers). Had the transmitter continued to operate, it was felt that communications could have been maintained to a distance of more than 700,000 miles (1.1 million kilometers). While PIONEER 4 was not the first to the Moon, at least it gave the Americans a long distance communications record and their first heliocentric satellite.

After another probable launch failure on June 16, 1959, the Soviets successfully launched their second officially acknowledged Moon probe, LUNA 2, on September 12. It was essentially identical to LUNA 1 except for an improved magnetometer, an upgraded micrometeoroid detector to improve the counting rate, and a modified antenna housing. As with LUNA 1, its escape stage released a cloud of sodium vapor at a distance of 97,000 miles (156,000 kilometers) which expanded to 400 miles (650 kilometers) in diameter during its outward trip.

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.

Unlike its predecessor, LUNA 2 and its escape stage successfully hit the Moon at a speed of 7,400 mph (3,300 meters per second) on September 13 at 21:02.14 Greenwich Mean Time (GMT) at thirty degrees north latitude on the lunar equator, at the edge of Mare Imbrium near the crater Archimedes. There were reports of sightings of the dust cloud kicked up by the impact, but the lack of similar sightings by impacts of larger spacecraft in later years cast doubts on their authenticity.

Measurements made by LUNA 2 indicated that there was no discernible lunar magnetic field down to an altitude of 34 miles (55 kilometers) and that the Moon had no radiation belts similar to Earth's. About 6,000 miles (10,000 kilometers) above the lunar surface, a region of ionized gas was detected. To leave no doubt to future generations as to who made it to the Moon first, LUNA 2 carried two small spheres, one 3.5 inches (9 centimeters) and the other 6 inches (15 centimeters) in diameter, made up of small pendants engraved with the Soviet Coat of Arms designed to scatter over the lunar surface upon impact. After the mission, Soviet authorities assured the West that LUNA 2 and its escape stage had been sterilized to prevent any Earth organisms from reaching the Moon.

To be continued next month...

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.

SAC Officers

President	Paul Lind	863–3077
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Minutes of the May Meeting

The meeting opened at 7:45 when president Paul Lind welcomed and introduced new members and visitors. He explained about the general format of the meetings and reminded all members about the upcoming SAC events that where listed on the board. All members receive the newsletter, which is published at the beginning of the month, and he wanted to thank the members who contributed to the May newsletter. It is a real teamwork effort.

Paul did mention that for the upcoming Grand Canyon Star Party on May 30 — June 7, please contact Dean Ketelson at 293–2855 for details. From the April 13 star party at Encanto School, Paul received many thank-you letters from the third grade students, complete with hand-drawn graphics. Patty Tate had brought the letters and a cheesecake for the SAC members who volunteered their time for the students.

On the table was a sample letter to Senator John McCain supporting the Cassini mission from NASA. Paul urged all members to write protesting the cancellation of upcoming space exploration programs. For the Riverside Telescope Makers' Conference, please contact Gene Lucas for information. Gene also talked about the Thunderbird Star Party for May 9, sponsored by the Glendale Parks Dept. There will be no fee. SAC has done this every year for 14 years.

A.J. Crayon told everyone about the Deep Sky meeting at the McGrath house, where they will discuss Canes Venatici. He gave the background of Messier and his catalogue. He also mentioned that our club is one of the most active astronomy clubs in the country. Of all the observation awards, our club members have earned 10% of the total. In addition to the Herschel 400 award, Paul reminded everyone about the best 110 Messier objects. Bob Dahl gave the treasurer's report and reported that 20 members are needed to get the discount for Deep Sky Journal. Membership stands at 103. The French are into high fashion and wearing our SAC T-shirts and caps is the "in" thing there, so our members can join this high fashion statement and purchase their shirts and caps from Bob. As a sign of appreciation from the club, Susan Moorse presented a set of towels to Steve Coe for his forthcoming wedding.

For Show-N-Tell, Tom Polakis gave a report on the Texas conference and Steve Coe showed some slides using Fuji 400 film. Following the break, the main speaker, Brian Skiff gave a presentation on tonight's sky and tomorrow's weather. His data of 9 years suggest that other stars have sunspot cycles like our own sun. —*Susan V. Morse, SAC Secretary*

Comet Comments

by Don Machholz

Two comets will be visible in out circumpolar sky early this summer.

Periodic Comet Singer Brewster (1992e): J. Scotti recovered this comet from Kitt Peak on Apr. 1 at magnitude 20. It has a 6.4 year orbital period but will remain faint.

Periodic Comet Shoemaker-Levy 8 (1992f): The team of Shoemaker and Levy discovered this comet from Palomar at magnitude 17 on Apr. 5. Its orbital period is 7.6 years but it will not get much brighter.

Periodic Comet Mueller 4 (1992g): As part of the Second Palomar Sky Survey, Jean Mueller picked up this object on APr. 9 at magnitude 17. It has a 9.1 year orbital period and will stay faint.

Comet Bradfield (1992i): William Bradfield of Australia discovered this comet on May 3 at magnitude 10, in the morning southern sky. It was moving rapidly eastward. I have no other word on it at this time.

Don Machholz (916) 346-8963

Comet	**Shoemaker-Levy**		**(1991a$_1$)**		
Date	RA-2000-Dec		Elong	Sky	Mag
05–23	01h17.3m	$+48°41'$	43°	M	10.4
05–28	01h24.2m	$+51°22'$	45°	M	10.0
06–02	01h32.5m	$+54°28'$	48°	M	9.7
06–07	01h43.3m	$+58°04'$	50°	M	9.3
06–12	01h58.5m	$+62°14'$	52°	M	8.9
06–17	02h22.6m	$+67°05'$	54°	M	8.4
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°	M	7.2
07–07	10h06.1m	$+70°50'$	55°	M	6.9

Comet	**Tanaka-Machholz**		**(1992d)**		
Date	RA-2000-Dec		Elong	Sky	Mag
05–23	02h29.3m	$+63°59'$	46°	M	8.6
05–28	03h17.4m	$+65°18'$	45°	M	8.8
06–02	04h05.1m	$+65°40'$	44°	M	8.9
06–07	04h49.7m	$+65°16'$	43°	M	9.1
06–12	05h29.2m	$+64°15'$	41°	E	9.8
06–17	06h03.1m	$+62°50'$	40°	E	10.0
06–22	06h31.6m	$+61°11'$	38°	E	10.2
06–27	06h55.7m	$+59°24'$	37°	E	10.3
07–02	07h16.1m	$+57°34'$	35°	E	10.5
07–07	07h33.6m	$+55°45'$	34°	E	10.7

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.

Bits and Pieces

June's Speaker

David Levy will be our speaker for the June meeting. His subject is "The Art of Finding Comets."

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

1992 SAC Star Parties
June 27
July 25
August 22
September 19
October 24
November 21
December 19

June Newsletter Deadline

Be sure to mail items to be included in the newsletter by June 22. Items sent later will not be included, but will be included in the next newsletter.

Deep Sky Meeting

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

Such-A-Deal

SUCH-A-DEAL is a place to advertise equipment, supplies, and services related to amateur astronomy. This is a free service for SAC members and friends. SAC is not responsible for the quality of advertised items or services.

Telescope—"Last Try!" 10″ $f/4.5$ Newtonian on 'LiL' Big Foot mount, on/off axis guider, RA, Dec drives with wire remote, 12mm, 20mm plössl eyepieces, 3x barlow, color filters. $1000/obo or trade for computer or trade for smaller scope and cash or trade for exercise equipment or trade for projection TV. David 772–9304.