Saguaro Astronomy Club

Metro Phoenix, Arizona

SACNEWS

November 1992 — Issue #190

The Great Moon Race: The Commitment

by Andrew J. LePage

Part 2

More Missions

Before the ink on the RANGER authorization was even dry, NASA had plans for even more ambitious lunar missions. In May of 1960, JPL's SURVEYOR project was authorized. As originally envisaged, SURVEYOR would consist of a single basic spacecraft which could be outfitted for two different missions. SURVEYOR A would be designed to land on the lunar surface. It would weigh about 2,500 pounds (1,100 kilograms) when launched and carry as much as 345 pounds (157 kilograms) of instrumentation. These instruments would include four television cameras: One would be used for approach photography and another would be used to monitor a semi-automated drill designed to penetrate up to sixty inches (1.5 meters) below the lunar surface. Various instruments would then be used to analyze samples from this hole. Other instruments would include a seismometer and magnetometer, along with sensors to measure lunar gravity, radiation, atmosphere, and surface mechanical properties.

The development of a hydrogen fueled rocket proved to be very difficult.

The lander would make use of a simple triangular frame upon which the various instruments and thermally controlled electronic compartments would be mounted. It would stand eleven feet (3.5 meters) from its three landing legs to the top of its mast mounted solar panel and high-gain antenna. After landing at a speed of six miles per hour (three meters per second) with the use of a solid rocket motor, it would weigh about 750 pounds (340 kilograms). The mission would last for a minimum of thirty days and hopefully as long as ninety days. The first flight was expected in 1963.

The second variant considered was SURVEYOR B. This spacecraft would use the same basic structure as the lander but instead would be placed into a sixty-mile (one hundred-kilometer) high lunar orbit to perform television reconnaissance of the Moon's surface as well as perform other measurements of the lunar environment for a period of six months. On January 19, 1961, Hughes Aircraft received the contract to build SURVEYOR.

The launch vehicle for this new lunar spacecraft was to be the ATLAS-CENTAUR then under development by NASA. The CENTAUR was to make use of liquid hydrogen and liquid oxygen as propellants; the first rocket to do so. This combination provided about thirty to forty percent more thrust pound for pound than most propellants then in use. CENTAUR development started officially on August 28, 1958, when the USAF received authorization from ARPA to develop a high-energy upper stage for use with the USAF's ATLAS D and the ABMA's JUNO

Quick Calendar

SAC Meeting
Elections / Swap Meet
7:30, Friday, November 6

Public Star Party
Reach 11
Saturday, November 7

Deep Sky Meeting
Thursday, November 12

Star Party
Buckeye Hills Recreation Area
Saturday, November 21

SAC Party
7:30, Saturday, December 12

V (later to become NASA's SATURN I). By October of that year, Convair had received the contract to develop and build CENTAUR.

Because of the political climate of the time, the development program was transferred to NASA in July of 1959 with the USAF relegated to an advisory role. The ATLAS booster to be used with the CENTAUR was to be a modified version of the ATLAS D ICBM. The forward propellant tank was modified to accept the wider and heavier upper stage and a new MA-5 engine assembly providing ten percent more liftoff thrust than when the baseline ATLAS D MA-2 was used.

The development of a hydrogen fueled rocket proved to be very difficult. One technical problem followed another, delaying the launch of the first test article. Finally, on May 8, 1961, the first ATLAS-CENTAUR was launched. After forty-four seconds of flight, CENTAUR's insulation panels started ripping off the ascending launch vehicle. Structural failure ensued and the hydrogen fueled CENTAUR exploded 54.7 seconds into the flight. The failure was studied and the stage was redesigned. More redesign work added additional weight to this highly innovative upper stage and the expected performance dropped. As time wore on, it became clear that CENTAUR would not be available as soon as engineers and space planners would like.

The timing could not have been worse. Within days of the failure of ATLAS-CENTAUR 1, President John F. Kennedy (1917-1963) threw down the gauntlet and committed the United States to a manned lunar landing by the end of the decade. The RANGER and SURVEYOR program objectives were redirected to support this new effort. In the coming months the U.S. Congress appropriated the needed funds.

In response to President Kennedy's challenge, JPL proposed another RANGER variant on June 30, 1961. On August 29, this third RANGER variant, Block III, was approved. Using the same bus as the first two versions, the payload to be carried this time was not a hard lander but a 375-pound (170-kilogram) package of six high-resolution television cameras. Additional instruments to measure the flux of cosmic dust, radiation, and magnetic fields would also be carried. The mission of the 800-pound (360-kilogram) Block III was to take a series of 1,600 images starting at an altitude of 800 miles (1,300 kilometers) and continue down until impact with an expected maximum resolution of only eight inches (twenty centimeters). Four Block III flights were planned beginning in 1963, using the same ATLAS-AGENA B used in the Block I and II RANGER flights.

Even more advanced missions were being studied at the time. PROSPECTOR was an automated mobile lunar laboratory that would explore large areas of the Moon, possibly in conjunction with the manned APOLLO missions. It could also serve as a "space truck" for astronauts. Because of its anticipated size, a SATURN I (which at the time was to include a modified CENTAUR third stage designated S-V) or even larger launch vehicle would be required to get it off the ground. In the meantime, NASA had to get the first RANGER into space.

The First RANGER Flights

By the summer of 1961, the first RANGER, payload P-32, and its ATLAS-AGENA B launch vehicle were ready. The first launch attempt was scrubbed a few minutes before launch due to a power failure on the ground. Over the following weeks, eight more countdowns were called off due to faults on the ground, in the launch vehicle, or in the RANGER itself. Finally, on August 26, RANGER 1 lifted off into a perfect 108 by 174-mile (174 by 280-kilometer) parking orbit.

After coasting for thirteen minutes, the AGENA B escape stage was to reignite for ninety seconds and propel RANGER 1 into deep space. A faulty pressure switch circuit in the AGENA's engine starting system prevented a valve from opening. The engine fired only briefly to change the orbit to 105.3 by 312.5 miles (169.4 by 502.8 kilometers). Stranded in low Earth orbit, RANGER 1 separated from its escape stage, obediently unfolded it solar panels and aligned itself with the Sun.

Although not meant to operate in low orbit with its ninety-minute day-night cycle, RANGER 1 did operate as intended. Every time it went into Earth's shadow, nitrogen jets would fire and the disoriented RANGER would mindlessly start searching for its lost celestial reference. Once back in the sunlight forty-five minutes later, RANGER would reacquire the Sun. While it was operating as well as it could under the circumstances, RANGER depleted its supply of attitude control gas the day after launch and started tumbling uncontrollably.

After 111 orbits, RANGER 1 succumbed to atmospheric drag, fell out of orbit, and burned up over the Gulf of Mexico on August 30. During its brief life, RANGER 1 did verify that a three-axis spacecraft could be controlled as expected. It was also able to collect a limited amount of data on radiation and cosmic rays but was too close to Earth for its magnetometer to operate.

On November 18, RANGER 2 was launched and entered its parking orbit. Again the AGENA B failed to restart properly and RANGER 2 was stuck in a quickly decaying 94.9 by 145.7-mile (152.7 by 234.4- kilometer) orbit. No tests were attempted this time and the wayward deep space probe burned up in the atmosphere only six hours after launch. This time the problem was traced to a roll gyro whose malfunction had gone undetected at launch. With no way to sense a rolling motion, the AGENA B started spinning, forcing its propellants to the outside edges of its tanks instead of to the bottom where the feed lines to the engine were located. When the command to reignite was given, only a brief firing resulted, due to residual propellant in the turbopumps. More bugs had to be worked out of the ATLAS-AGENA B.

While the two RANGER Block I spacecraft never made it beyond their parking orbits, they did provide enough engineering information to prove the basic design.

In September of 1961, it became clear that the ATLAS-CENTAUR would not be available in time to launch the 1,100-pound (500-kilogram) MARINER A towards Venus the following August. NASA switched to the MARINER R, which was nothing more than a stripped down, modified RANGER Block I spacecraft weighing 448 pounds (204 kilograms) and carrying a minimal science instrument payload of about twenty pounds (nine kilograms).

The first American Venus probe attempt, MARINER 1, launched on July 22, 1962, ended up taking a swim in the Atlantic Ocean due to yet another ATLAS-AGENA B malfunction. MARINER 2 was successfully launched on August 27 and operated until twenty days after its December 14 encounter with Venus, the first successful flyby of another planet. Closer to home, the RANGER Block II spacecraft would not fare quite as well.

The first Block II RANGER, P-34, lifted off on January 26, 1962 after a four-day delay to fix a ruptured intertank insulation bulkhead in the ATLAS D booster. As the ATLAS-AGENA B ascended towards its parking orbit, a component in its guidance system failed, disabling the radio command system. Relying on its internal autopilot system, the ATLAS placed the AGENA B escape stage and RANGER 3 into a parking orbit slightly off course. After a short coast, the AGENA B came to life again and boosted RANGER 3 into an escape trajectory. Because of an incorrect constant in the AGENA guidance program, RANGER 3 was thrown even further off course. Early tracking indicated that RANGER 3 was operating properly but would miss the Moon by 20,000 miles (32,000 kilometers), far too wide a miss for RANGER's small course correction engine to negate.

Since an impact was out of the question, it was decided to exercise the various functions of the new Block II spacecraft and perform some flyby photography. The first test was to perform a mid-course correction that would also bring RANGER 3 closer to the Moon. The course correction was performed as instructed with an accuracy one quarter of one percent of speed and two and one half degrees of direction. Unfortunately, the instructions sent to the RANGER were faulty. An undetected sign inversion in the instructions sent to the spacecraft resulted in the maneuver taking place in the wrong direction. Instead of pushing RANGER closer to the Moon, it moved the probe further away, resulting in a flyby distance of 22,860 miles (36,785 kilometers).

Forty hours after the course "correction" and some 31,000 miles (50,000 kilometers) from the Moon, RANGER 3 was instructed to turn towards the Moon and begin imaging this time with instructions carrying the proper sign. Telemetry showed that everything was going according to plan, but the spacecraft's high-gain antenna failed to properly realign with Earth and the RANGER's computer and sequencer failed. The camera on board did turn on and start transmitting images but because of the misaligned antenna, only noisy images containing the vidicon camera's reticle marks were received. Unable to properly transmit its images and accept further commands from Earth, RANGER 3 continued past the Moon and into solar orbit. The cause of the last minute malfunction was never found. The only scientific data returned by the wayward lunar probe were some background radiation readings from the gamma ray spectrometer.

On April 23, 1962, the second Block II spacecraft, RANGER 4, was launched — after some delays — in the middle of its allotted launch window. For the first time in the series, the ATLAS-AGENA B operated flawlessly, injecting RANGER 4 into a collision course with the Moon. Unfortunately, during the first tracking pass of the receding probe, it was discovered that RANGER's master clock had stopped and the computer was not responding to ground commands. Unable to perform any functions, RANGER 4 continued on to the Moon and was tracked using the hard lander's transmitter.

After sixty-four hours, the now lifeless probe

Public Star Party at Reach 11

Saturday, November 7
Sunset to 10 PM

Observe the Night Sky

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Telescopes by Saguaro Astronomy Club
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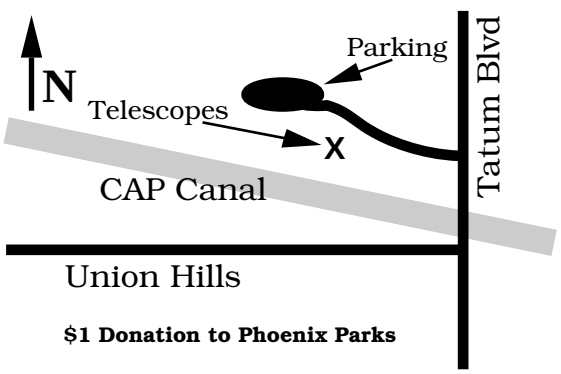

$1 Donation to Phoenix Parks

skimmed the limb of the Moon and crashed on its far side at 15.5 degrees south latitude and 130.5 degrees west longitude in a crater later named Paschen. RANGER 4 became the first U.S. probe to land on the Moon, but not quite in the manner that its designers had planned.

All hopes rode with the last Block II flight of RANGER 5. After an analysis of the previous failures, several improvements were made to the spacecraft. A hydraulic backup timer activated by the separation of the AGENA escape stage was included to operate automatic functions and a ground commanded backup timer in the command encoder was included to allow direct ground control. Both changes would help avoid a repeat of the previous two failures.

With less than fifty minutes remaining in the countdown, RANGER's transponder failed due to an errant flake of solder shorting out a cavity. With a functioning replacement, RANGER 5 finally lifted off from Pad 12 at the Atlantic Missile Ranger on October 18, 1962. As it accelerated towards orbit, a portion of the ATLAS D guidance system failed — the same component failure that started a chain of events which led to the loss of RANGER's cousin, MARINER 1, just three months earlier. Fortunately, the infamous hyphen excluded from the guidance program of the ATLAS 145D that carried MARINER 1 was included in RANGER's booster's program; RANGER 5 was successfully placed on a trajectory towards the Moon.

Unlike SURVEYOR, the PROSPECTOR automated lunar rover continued to gain weight...

RANGER's close brush with failure at launch was all for naught. Some seventy-five minutes after launch, as RANGER 5 was obediently settling into its cruise attitude, a short circuit developed in the solar panels. Although the panels' isolation diodes protected the power supply from immediate failure, RANGER had no means of powering itself except with the small backup battery. Within hours, RANGER 5 died from lack of power. The probe was tracked for eleven days with the lander's transmitter as RANGER 5 passed only 450 miles (724 kilometers) over the Moon's trailing edge and on into orbit around the Sun.

With the loss of the last Block II RANGER, the entire program was deemed to be an utter failure. Not a single scientific objective was met and all three spacecraft had suffered major malfunctions. A board of inquiry composed of officials from NASA, the USAF, and industry was formed to investigate the failures and recommend changes in the spacecraft design and JPL management of the project. The launch of the Block III RANGERs, the first of which, payload P-53, was nearing final mechanical assembly, was postponed from the original 1963 launch date pending the outcome of the investigation.

The Race Begins Again

RANGER was not the only program experiencing problems. SURVEYOR was having its own set of growing pains. In the first half of 1962, balloon-borne drop tests of retrorocket equipped models started over Holloman Air Force Base in New Mexico. The first test failed and subsequent tests had mixed results. Still, the tests did supply enough information to help fine tune SURVEYOR's landing sequence.

SURVEYOR's launch vehicle, the ATLAS-CENTAUR, was having more than its share of difficulties. Throughout 1962, design changes were made to the vehicle to correct various defects found during its first failed launch attempt as well as during ground testing. In October the entire development program was transferred from the Marshall Space Flight Center to the Lewis Research Center due to the ever-increasing work on the SATURN rocket development at Marshall. Another test of the ATLAS-CENTAUR was not expected until the middle of 1963.

Because of the CENTAUR design changes, SURVEYOR had to shed some weight. The new design called for a 2,100-pound (950-kilogram) lander carrying only 114 pounds (52 kilograms) of instruments. Advanced design work continued and several new options were added to the lander's design, including the use of a Martin-Marietta SNAP-11 nuclear generator to supply SURVEYOR A with 18.6 watts of power for ninety days. This generator would supply minimal power during the long lunar night when SURVEYOR's solar panels would be useless.

By the end of 1962, plans called for seven SURVEYOR A landing missions starting in late 1964 and five SURVEYOR B orbiters with the first launch expected in 1965. Options for five or more additional landers were being considered.

Unlike SURVEYOR, the PROSPECTOR automated lunar rover continued to gain weight and would likely need the services of one of the Advanced SATURN launch vehicles — like the SATURN V — to get it to the Moon. The weight gain was due to the expanding scope of PROSPECTOR's mission as well as the increasing complexity. By late 1962, four types of missions had been assigned to PROSPECTOR. One included low altitude reconnaissance of various lunar sites with the use of a hovering spacecraft. The second called for landing a rover capable of exploring up to fifty miles (eighty kilometers) from the landing point. Another type of mission contemplated for PROSPECTOR was as a soil sample return probe. The last mission envisaged used PROSPECTOR as an unmanned cargo ship to support manned lunar exploration. In these overly enthusiastic and naive early days of NASA, the first launch of PROSPECTOR was expected in 1966.

The Soviets were far from idle as the United States launched one Moon probe after another. The Soviets, like their American counterparts, knew the value of using parking orbits and building even more powerful launch vehicles to reach distant targets. Because of this, yet another

launcher based on the R-7 ICBM was developed. Later called the MOLNIYA after the communication satellites which made extensive use of its services, the new rocket replaced the small Block E escape stage used on the first LUNA missions with a pair of much larger stages.

The Block I stage, which would boost an escape stage and payload into a low parking orbit, replaced the small R-7 engine of the Block E stage with the five times more powerful RD-461. The stage was lengthened by over nineteen feet (six meters) to accommodate three times as much propellant. The 7.4-ton (6.7 metric ton) Block L escape stage, after a coasting period, would then ignite and boost as much as 2,600 pounds (1,200 kilograms) towards Venus or Mars and over 3,500 pounds (1,600 kilograms) towards the Moon. This was as much as seventy percent more payload than what the American ATLAS-CENTAUR was expected to lift once operational.

As with the American ATLAS-AGENA, the Soviets' MOLNIYA had its share of problems. In no less than ten launch attempts to Venus and Mars between 1960 and 1962, the MOLNIYA functioned properly only twice to send the ill-fated VENERA 1 and MARS 1 to their intended targets. When the Soviets started sending their second wave of spacecraft to the Moon in 1963, they encountered similar problems.

The first suspected launch of the new LUNA probes on January 4, 1963 ended in failure when its escape stage failed to ignite on command and stranded its payload in a 104 by 122-mile (167 by 196-kilometer) parking orbit that decayed the following day. A second attempt on February 2 never even made it that far. What was left of the rocket and payload fell into the Pacific Ocean near Midway Island shortly after launch.

Finally, on April 2, the Soviets announced the launch of LUNA 4. Some sort of failure occurred during a complicated maneuver enroute to the Moon. As a result, the 3,135-pound (1,422-kilogram) Moon probe flew by its target at an altitude of 5,300 miles (8,500 kilometers) and continued into an extended 55,800 by 434,000-mile (89,800 by 698,000-kilometer) Earth orbit which was eventually perturbed into a solar orbit.

The mission of LUNA 4 was never announced to the West. However, subsequent LUNA probes were definitely meant to land on the Moon. Only a small amount of data on solar and cosmic rays from LUNA 4 were published. The Soviets took a ten-month hiatus to modify their new lunar spacecraft and troubleshoot the unreliable Block L escape stage. In the meantime, it became increasingly clear that the American SURVEYOR would have some competition in the race to land on the Moon.

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Summary of Lunar Probe Launches, 1961–1963

Name	Launch Date	Country	Weight lbs (kg)	Launch Vehicle	Comments
RANGER 1	Aug 23, 1961	US	675 (307)	ATLAS-AGENA B	Failed deep space engineering test flight
RANGER 2	Nov 18, 1961	US	675 (307)	ATLAS-AGENA B	Failed deep space engineering test flight
RANGER 3	Jan 26, 1962	US	727 (330)	ATLAS-AGENA B	Failed lunar hard landing attempt
RANGER 4	Apr 23, 1962	US	729 (331)	ATLAS-AGENA B	Failed lunar hard landing attempt
RANGER 5	Oct 18, 1962	US	754 (342)	ATLAS-AGENA B	Failed lunar hard landing attempt
Unannounced	Jan 4, 1963	USSR	3130 (1420)?	MOLNIYA	Failed lunar hard landing attempt
Unannounced	Feb 2, 1963	USSR	3130 (1420)?	MOLNIYA	Failed lunar hard landing attempt
LUNA 4	Apr 2, 1963	USSR	3135 (1422)	MOLNIYA	Failed lunar hard landing 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.

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Seventh Semiannual Report to Congress (NASA), January 1 to June 30, 1962

Eighth Semiannual Report to Congress (NASA), July 1 to December 31, 1962

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 (now C.I.S.) space program for over one decade.

MARINER 1 Footnote:

The following is taken from the sci.space newsgroup's monthly posting of "Frequently Asked Questions" (or FAQ). Each posting contains a list of answers to questions that are most often asked.

MARINER 1, the first U.S. attempt to send a spacecraft to Venus, failed minutes after launch in 1962. The guidance instructions from the ground stopped reaching the rocket due to a problem with its antenna, so the onboard computer took control. However, there turned out to be a bug in the guidance software, and the rocket promptly went off course, so the Range Safety Officer destroyed it. Although the bug is sometimes claimed to have been an incorrect FORTRAN DO statement, it was actually a transcription error in which the bar (indicating smoothing) was omitted from the expression "R-dot-bar sub n" (nth smoothed value of derivative of radius). This error led the software to treat normal minor variations of velocity as if they were serious, leading to incorrect compensation.

November's Meeting

We are still looking for a speaker, but the elections and the swap meet are planned for this meeting.

Comet Comments

by Don Machholz

(916) 346-8963 September 8, 1992

A very significant comet recovery took place recently with the sighting of Periodic Comet Swift-Tuttle.

Comet Brewington (1992p): We now know that this comet is periodic, taking 8.65 years for each orbit. It had apparently outburst before discovery, it has now dimmed again to mag. 16.

Comet Helin-Lawrence (1992q): Eleanor Helin and Kenneth Lawrence discovered this comet on films taken with the 0.46m Schmidt at Mt. Palomar on Aug. 29. The orbit indicates it will be closest the sun next March at 2.1 AU. It may brighten by then to magnitude 13.

Periodic Comet Tuttle (1992r): G. Tancredi and M. Lindgren recovered this comet on CCD images taken from La Palma. With an orbital period of 13 years, it is still 20 months from perihelion, when it may be visible in amateurs' scopes.

Periodic Comet Ciffreo (1992s): J. Scotti recovered this comet from Kitt Peak on Sept. 24. With an orbital period of 7 years it will stay fainter than mag. 13.

Periodic Comet Swift-Tuttle (1992t): Japanese amateur T. Kiuchi recovered this comet with 25x150 binoculars on Sept. 26. It brightened rapidly from magnitude 11.5 at recovery to 9.5 one day later.

This is the same comet seen in 1737 by Kegler, and by many others in 1862. It reaches perihelion on Dec. 12 as it moves southward in our evening sky. It may get brighter than indicated below, but a large coma size and a diffuse appearance may make the comet a difficult object in binoculars. N. Hemisphere observers will lose sight of it by Christmas.

Periodic Comet Swift-Tuttle is responsible for the Perseid meteor shower each year. The intensity next year is expected to peak on Aug 12.0 UT, when it is daylight in the U.S. but early morning in Europe.

Periodic Comet Swift-Tuttle (1992t)					
Date	RA-2000	Dec	Elong	Sky	Mag
10–15	14h10.5m	$+57^\circ17'$	67°	E	8.1
10–20	14h56.2m	$+54^\circ44'$	67°	E	7.8
10–25	15h40.7m	$+50^\circ56'$	67°	E	7.5
10–30	16h21.6m	$+45^\circ52'$	65°	E	7.2
11–04	16h57.8m	$+39^\circ44'$	64°	E	7.0
11–09	17h29.1m	$+32^\circ55'$	62°	E	6.8
11–14	17h55.8m	$+25^\circ49'$	58°	E	6.7
11–19	18h18.5m	$+18^\circ50'$	54°	E	6.6
11–24	18h38.0m	$+12^\circ16'$	51°	E	6.6
11–29	18h54.9m	$+06^\circ16'$	47°	E	6.6
12–04	19h09.7m	$+00^\circ51'$	43°	E	6.6
12–09	19h22.8m	$-03^\circ59'$	38°	E	6.7

Bits and Pieces

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

Magazines & Discounts

Club members may subscribe to astronomical magazines at reduced rates through the club Treasurer. See the Member Services Form on the back page of this newsletter. Furthermore, club members are encouraged to align their subscriptions with the Jan.–Dec. calendar year. This eases the burden both on the Treasurer and the Publisher by permitting a single Group Renewal to be placed in the autumn for the upcoming calendar year.

Those members who experience problems with their subscriptions to *Astronomy* magazine may call Kalmbach Publishing Customer Service at (800) 446–5489.

Those members who experience problems with their subscriptions to *Sky & Telescope* magazine may call Sky Publishing at (800) 253–0245.

Besides the club discount on *Sky & Telescope* magazine, Sky Publishing offers club members a 10% discount on all other Sky publications. This means books, star atlases, observing aids, Spotlight prints, videos, globes, computer software, and more.

Club members who subscribe to *Sky & Telescope* through the Club Discount Plan may order Sky publications directly, at the above toll-free number, without going through the club Treasurer. Simply mention the Club Discount Plan and give the Saguaro Astronomy Club name to receive the discount. Sky Publishing will check their records to verify that you are eligible to receive the discount.

Deep Sky Meeting

The Deep Sky Group is made up of people that like to observe celestial bodies out past the far reaches of our Solar System. These bodies include stars, nebula and galaxies. If you are interested in sharing your observations, or knowing what they look like in telescopes — then by all means come join us at the next meeting. We will discuss Deep Sky objects in Aries the Ram, Triangulum the triangle, and Perseus son of Zeus and slayer of Medusa. The meeting will be held at John McGrath's house and the directions will be found elsewhere in the Newsletter.

You don't need to RSVP, we don't extend special invitations to anyone — ourselves included. If you are interested show up, we'd love to have you.

The Deep Sky meeting will take place on Thursday, November 12 at 7:30pm.

E-Mail Roster

Here is the latest list of e-mail address of SAC members. The Compuserve addresses are given in the Internet format: `nnnnn.nnn@compuserve.com` are really in the format `nnnnn,nnn` within Compuserve. BIX and GEnie addresses aren't currently addressable from the outside world (the Internet), but their addresses are given as `@bix` and `@genie` to specify which host. All other hosts are directly accessible from the Internet.

Steve Coe	`74040.2071@compuserve.com`
A J Crayon	`a.crayon@az05.bull.com`
Paul Dickson	`p.dickson@az05.bull.com`
	`pdickson@bix`
Paul Lind	`plind@sedona.intel.com`
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	`mwillmoth@bix`
	`m.willmoth@genie`

Minutes of the October Meeting

President Paul Lind opened the meeting at 7:35 PM with a welcome to all new members and visitors, but there were none. He outlined the scheduled events listed on the board. The Treasurer's Report was given by Bob Dahl with membership now at 120. He now has name tags available for those who ordered them and said that there were still some seats available for the bus trip to Kitt Peak. This was the last chance for members to pay for their magazine subscriptions and money must be turned in before next Wednesday.

Steve Coe gave further information about the bus trip; everyone should be there by departure time of 9:00 AM. A. J. Crayon mentioned that there will be no Deep Sky meeting this month, but members can prepare for next month by studying the constellations *Aries*, *Triangulum*, and *Perseus*. The Messier Marathon will be held in March of next year at Arizona City and other clubs will be invited. He then presented an award for observing to Paul Lind.

Rich Walker asked for any more slides for the "family tray," then reminded members about the books from the library available for checkout. Paul Lind then opened the floor up for nominations for the elections. The nominations for the elections. The nominations present are as follows: President — Bob Dahl, Rick Nadolny, and Pierre Schwaar; Vice-President — Tom Polakis; Treasurer — Steve Strazdus; Secretary – Susan Morse, A.J. Crayon; Properties — Rich Walker. There was a move to close the nominations, but the by-laws state that nominations may

be submitted until the election. Elections are held next month at the meeting on November 6th.

Steve Coe show some slides of the Andromeda Galaxy and Phil Dahl gave a small talk about the three types of Astrophotography, using the 1. Unguided method, 2. Piggyback method (Camera on the telescope) and 3. Barn Door technique. After the break, members showed some of their worst and some of their best slides.

—*Susan V. Morse, SAC Secretary*

A Successful Trip to Kitt Peak and the U. of A. Mirror Lab

by Steve Coe

All 42 SAC members who had signed up for the bus trip to Tucson where on time and the bus left at 9:00 AM. The very well-appointed coach had a video tape player and "Raiders of the Lost Ark" was the movie on the way to the Mirror Lab on the Univ. of Arizona campus. Dean Ketelsen was on hand to start the tour at 11:00 and we saw the giant 6.5 meter mirror which will replace the six mirrors of the MMT. This big piece of glass has a very steep curve, but the casting came out free of bubbles and in excellant shape. Next, we went to the polishing section, where work is progressing on two 3.5 meter mirrors, one for the Air Force and one to go Kitt Peak in the WIN telescope.

The group boarded the bus and were on our way to the Peak. An episode of "Nova" about the Voyager mission was on the tape player as we climbed up the steep road which leads to a mountain encrusted with telescope domes. After a picnic with a magnificent view of the NRAO radio telescope slewing from object to object, we made our way to the Visitors Center. Lots of T-shirts, hats, posters and other goodies where purchased and stored on the bus. Dean started the tour with a trip to the McMath solar telescope, where we able to view a nice sunspot group through the monitor on the telescope. A short walk led us to a refractor equipped with an H-alpha filter. This instrument provided some excellant views of solar prominences and flares at the edge of the sun.

Next was a talk from the engineer working on the WIN telescope. Then, on to the 4-meter. Dean was able to get us onto the observing floor and the evening's observer was slewing the scope and setting up for the night's work as we watched. She was planning to do spectroscopy on stars in the globular M-15.

The trip back down the mountain was set off by a beautiful sunset to the west and a giant full moonrise to the east. If that was not enough, two vintage Star Trek episodes played on video. We stopped at Eloy for a meal and then returned to Tempe, happy and tired. Thanks a lot to all who attended, especially Bob Dahl for handling the monetary aspects, Tom Polakis for finding a spot to park the cars conveniently, to our driver Al for doing a great job getting us there and back safely, and obviously Dean Ketelsen for a excellant and memorable tour.

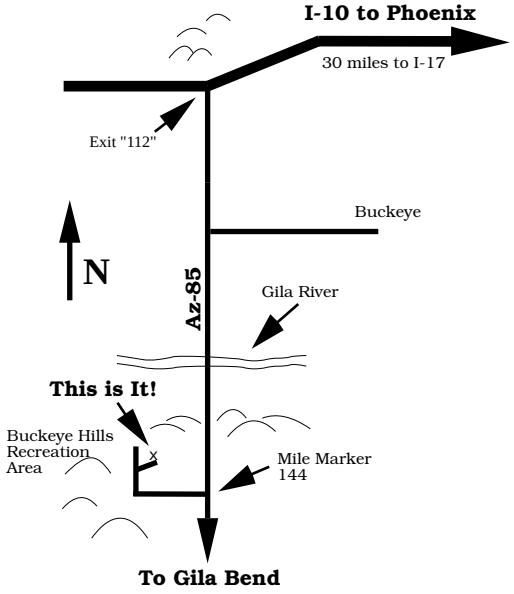
1992 SAC Meetings
Nov. 6
Dec. 12 Party
— **1993** —
Jan. 8
Feb. 5
Mar. 5

1992 SAC Star Parties		
Date	Sunset	Moonrise
Nov. 21	5:24pm	5:22am
Dec. 19	5:25pm	4:15am
— **1993** —		
Jan. 16	5:46pm	3:11am
Feb. 13	6:12pm	2:05am
Mar. 20	6:41pm	5:24am

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.