Saguaro Astronomy Club

Metro Phoenix, Arizona

SACNEWS

October 1992 — Issue #189

Dear Abby: I've Got This Problem!

By Hesitant Cluber

There's this club that I am a member of; it's abbreviation is CAS (that's not its read abbreviation.) Well, you see, I really enjoy this group. We're into scientific stuff. We have great meetings with interesting speakers and various other activities that give me something to do almost every week. For me, sometimes the best part is the discussions I have with fellow members before or after meetings. My problem is that I have never volunteered to help; you know, I've never been an officer nor helped with organizing events or with the newsletter or even gotten up to tell other members about some of the interesting things that I have done. I guess I'm both shy and a little afraid of the responsibility. What do you suggest? *Signed, Hesitant Cluber, Phx., Az.*

Dear Hesitant,

I assume your group is a gathering of individuals with a common interest. The first thing you need to remember is that these kinds of clubs, while they can be sophisticated, are informal. They kind of happen just from the common interest among the members. Actually, in such a group most members prefer a rather relaxed atmosphere; nobody expects perfect organization. It's recreation not occupation.

All this means that volunteers are just that — volunteers. Although natural leaders come along once in a while, most clubs operate quite nicely when average members pitch in to get the job done. By "average" I mean that most of the things that need to be done in a club can be handled relatively easily by anyone.

You've got the most difficult part under control; you already have the interest in the "scientific stuff" that got you to join in the first place, don't you?

I'm willing to bet that the kinds of things that your club needs volunteers for are really just extensions of the kinds of things you do every day. I haven't been to your meetings, but I bet someone collects dues and pays bills; you can balance your checkbook can't you? I bet someone keeps track of meeting dates and arranges for the meeting place? That same person probably calls all the volunteers together once in a while for an "official" meeting; when is the last time you got together with your buddies for coffee? It's the same kind of thing.

I'll bet someone else bring a slide projector to every meeting and sets it up; that's a snap. I'll bet someone else takes minutes; read a copy of the last minutes and ask yourself if you can do that.

If you are shy the best way to get over it is to just raise your hand and volunteer. If that is too difficult, call the person responsible and tell him or her that you want to volunteer.

The responsibility that you are hesitant about shouldn't be a problem. If this club has been around a while, I am sure that there are plenty of past officers who you can turn to for advice and help. After all, they are now "experts."

And here is one more tip that might help: Maybe you and a buddy can volunteer together for one job — split up the duties of bring that slide projector to the meetings or take turns writing the minutes. *Abbey*

Quick Calendar

SAC Meeting
7:30, Friday, October 9
Piggybacking Month, Exposed Members

Kitt Peak Tour
Saturday, October 10

All-Arizona Star Party
Fri. & Sat., October 23, 24

SAC Meeting
7:30, Friday, November 6

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

The Great Moon Race: The Commitment

by Andrew J. LePage

Introduction

As the 1950s were drawing to a close, the general perception was that the American space program was lagging further behind the Soviets. While the Soviets had their share of failures, these were generally unknown outside the small group privy to the needed intelligence information. All the public knew was that the Soviets had made three spectacular lunar missions, while only one of America's PIONEER Moon probes managed to break the gravitational bonds of Earth to make it anywhere near its target.

During 1959, while the Soviets managed one space first after another, the newly formed National Aeronautics and Space Administration (NASA) was busy consolidating its new empire and began formulating plans to meet the formidable Soviet challenge. In late December of 1959, the Jet Propulsion Laboratory (JPL) was directed to make plans for five lunar missions to take place in 1961 and 1962. Throughout 1959, JPL and the Army Ballistic Missile Agency (ABMA) were already studying follow-on lunar missions that would make use of a three-stage ATLAS-VEGA launch vehicle specifically designed for lunar and planetary missions. With the cancellation of JPL's home-grown ATLAS-VEGA on December 11, 1959, these missions would have to make use of the soon to be available ATLAS-AGENA B being developed by the United States Air Force (USAF).

> **This type of trajectory [direct ascent] greatly magnified any velocity or aiming errors.**

Two of the major problems with the launch vehicles used to date for the American lunar missions were the small payloads that could be carried and the inaccuracy of these rockets. The THOR-ABLE, JUNO II, and ATLAS-ABLE were far from ideal for lunar missions. Their upper stages were undersized for their booster stages and were essentially existing rockets that were quickly kludged together for the task. In addition they could only use direct ascent trajectories to inject their payloads, which resulted in large gravity losses as these rockets climbed more or less straight out of Earth's gravity well. This type of trajectory greatly magnified any velocity or aiming errors.

Ideally the upper stage and its payload would first be placed into a temporary parking orbit around Earth. Once the precise orbit had been determined, the upper stage would ignite at exactly the right moment to insure accuracy. With the upper stage firing approximately in line with the horizon, gravity losses are minimized. The ATLAS-AGENA B was designed to do precisely that.

Development of the AGENA upper stage began in 1956 under a USAF contract with the Lockheed Missiles and Space Company. This stage was specifically designed to be used with a modified THOR or ATLAS D. The AGENA B was a greatly modified version of the original AGENA A. It was over eight feet (2.5 meters) longer to accommodate a larger propellant supply and replaced the A model's Bell Aerospace Hustler 8048 engine with a slightly more powerful 8081, which also possessed an in-orbit restart capability.

The THOR-AGENA was used to launch the experimental DISCOVERER military satellite series into polar orbits. Flights with the THOR-AGENA A had started on February 28, 1959 and flew successfully ten times out of fifteen attempts before it was replaced by the improved THOR-AGENA B, whose first flight took place on October 26, 1960. The AGENA B demonstrated its all-important restart capability for the first time with a one-second burn on the flight of DISCOVERER 21, launched on February 18, 1961.

The ATLAS-AGENA was originally designed to place large payloads, such as the MIDAS experimental early warning satellite and the SAMOS reconnaissance satellite, into medium altitude Earth orbits. The ATLAS-AGENA A flew only four times between February of 1960 and January of 1961 with limited success. The first flight of the improved ATLAS-AGENA B took place on July 12, 1961 with the successful launch of MIDAS 3. The ATLAS D was modified for this task by stiffening its forward bulkheads to handle the heavier payload and replacing its MA-2 propulsion system with the uprated MA-3 system being used on the improved ATLAS E/F silo based ICBM then under development. This change resulted in an eight percent increase in liftoff thrust over the basic ATLAS D ICBM. By the summer of 1961, the AGENA had operated successfully twenty-one times out of twenty-nine opportunities; a very respectable record in these early years of space rocketry.

RANGER is Born

By the end of January in 1960, JPL's new lunar project, RANGER, had taken form. The five flights would use two spacecraft designated Block I and Block II. The first two flights would make use of the Block I spacecraft. They were meant to be engineering test flights which would place RANGER into an extended Earth orbit with a perigee of 37,500 miles (60,300 kilometers) and an apogee of 685,000 miles (1.1 million kilometers). These 675-pound (307-kilogram) three-axis stabilized spacecraft would be the forerunner of not only the RANGER Moon probes but also the MARINER A and B spacecraft designed to explore the planets Venus and Mars, respectively.

Test flights of this spacecraft were deemed necessary to test the interface between the probe and launch vehicle, as well as determine whether all the "bugs" had been worked out of controlling a three-axis stabilized spacecraft. Three-axis stabilized spacecraft provide a more stable platform for certain instruments, such as cameras, than do spin-stabilized probes like ARPA's and NASA's previous PIONEER Moon probes. Typically, one axis is pointed towards the Sun to provide illumination for the spacecraft's power producing solar panels. With the RANGER probes, the other celestial reference used was Earth itself.

At RANGER's base was a 430-pound (195-kilogram) hexagon shaped magnesium frame bus five feet (1.52 meters) across that contained the spacecraft's central computer and sequencer which controlled the spacecraft,

A total of ten scientific instruments would be carried

a 125-pound (57-kilogram) silver-zinc battery providing nine kilowatt-hours of backup electrical energy (enough for about two days), a one-quarter-watt and a three-watt radio transmitter, and the attitude control system. Attitude reference was provided by six Sun sensors, two Earth sensors, and three gyros.

Extending from the sides of the bus were a pair of solar panels containing 8,680 solar cells to provide 155 to 210 watts of power for the spacecraft. Also extending from the base was a hinged dish-shaped high-gain communications antenna four feet (1.22 meters) across, which would be pointed at Earth with the aid of a light sensor. The spacecraft maintained its attitude with the use of ten nitrogen gas jets supplied by 2.4 pounds (1.1 kilograms) of compressed nitrogen held in three tanks.

On top of the bus was an open aluminum truss structure topped with a low-gain antenna to aid in communications with Earth when the probe's high-gain antenna could not be used. When deployed in space, the Block I spacecraft was about thirteen feet (four meters) tall and seventeen feet (5.2 meters) across its extended solar panels. A total of ten scientific instruments would be carried to study solar and cosmic radiation, cosmic dust, magnetic and electric fields, and perform engineering tests concerning mechanical friction and solar cell performance. These experiments were mounted at various points on the bus and open truss structure. Some of these devices carried independent battery power supplies.

The Block II spacecraft would actually travel to the Moon starting in early 1962. The basic bus was similar to the one used on the Block I probe, but the open truss structure above it was replaced with a new payload:

…the entire spacecraft was sterilized first by baking components for 24 hours at 257 degrees…

A 330-pound (150-kilogram) package consisting of a small hard lander with a 5,080-pound (2,300-kilogram) thrust retrorocket. The Ford Aeronutronic-built hard lander was a 25-inch (64-centimeter) diameter sphere weighing 94 pounds (43 kilograms). The exterior was composed of balsa wood to help absorb the force of impact.

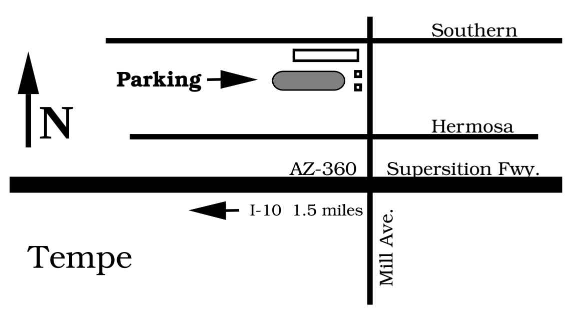
Inside was a smaller twelve-inch (31-centimeter), 56-pound (25-kilogram) sphere that was free to rotate on

Bus Trip to Kitt Peak

The trip is set for Oct 10 and the bus **leaves** at 9:00 AM headed for Kitt Peak. Dean Kettlesen, President of the Tucson Amateur Astronomy Association will lead the tour. The bus will leave the mountain around 4:00 PM and go to the Mirror Lab at U. of A. Dean works at the Lab and will conduct a one hour tour of the Mirror Lab facility. We then return to Phoenix around 9:00 PM. There will be short stops on the way down and back.

Please be sure to bring a light jacket or sweater as the top of the mountain will be much cooler. Also bring a picnic lunch to eat on the mountain, money for souvenirs, and comfortable walking shoes.

SAC members are invited to "get on the bus" to Kitt Peak for $20 per person. Only 8 seat remain available as of 9/19. If you haven't decided whether to go, decide soon. Send your check, payable to SAC, to our Treasurer, Bob Dahl, or bring it to the August meeting. Please don't send it to Steve Coe, he is only setting up the tour, Bob has agreed to handle the money. Thanks, Bob.



a cushion of freon inside the balsa shell. The primary instrument carried inside this capsule was a seismometer sensitive enough to detect the impact of a five-pound (2.3-kilogram) meteorite on the opposite side of the Moon. The sensitive components of the seismometer were protected from the impact forces by a cushion of heptane. Also included in the capsule was a fifty-milliwatt transmitter, six silver-cadmium batteries, and a temperature sensitive voltage oscillator. The lander was designed to survive an impact of 150 miles per hour (67 meters per second).

The hard lander's interior temperature was controlled by a capsule containing 3.7 pounds (1.7 kilograms) of water. During the hot lunar day, the interior would heat up to 86 degrees Fahrenheit (30 degrees Celsius) when the water would start to boil under the ambient conditions. The temperature would rise no further until all the water would boil away, a process that could take as little as a single lunar day (fourteen Earth days) or as long as three lunar days, depending on conditions. During the cold lunar night, this heated water — along with the heat generated by the lander's internal electronics — would keep the interior above the freezing point.

The 730-pound (332-kilogram), 10.25-foot (3.1-meter) tall Block II RANGER had additional modifications from its predecessor. First, the battery was reduced in size to 25 pounds (11 kilograms), which provided one kilowatt hour of reserve power. Another modification included the use of a 36-pound (16-kilogram) hydrazine-fueled course correction engine, providing 50 pounds (23 kilograms) of thrust to fine tune its aim as it approached the Moon. This engine could be fired for a maximum of 68 seconds, giving a total velocity change of one hundred miles per hour (44 meters per second). Since any torques imparted during this engine's operation could not be compensated with the small attitude control jets, this engine was fitted with steering vanes at the exit nozzle.

The Block II RANGER also carried an entirely new set of instruments, including a radar altimeter to provide ranging information as well as data on the lunar surface's radar characteristics, a gamma ray spectrometer mounted on a six-foot (1.8-meter) boom to determine surface composition, and a Radio Corporation of America (RCA) built television camera with a JPL designed 40-inch (102-millimeter) focal length lens. The camera was expected to return over 150 images comprised of two hundred scan lines, each starting at an altitude of 2,400 miles (3,860 kilometers). The instrument would continue transmitting down to fifteen miles (24 kilometers), where objects as small as ten feet (three meters) across could be resolved.

In order to minimize the chances of Earth organisms reaching the Moon, the entire spacecraft was sterilized first by baking components for 24 hours at 257 degrees Fahrenheit (125 degrees Celsius), then cleaning all the parts with alcohol before they were assembled. Finally, the spacecraft was saturated in its AGENA B nose faring with ethylene oxide gas for 24 hours.

The Flight Plan

There were many variables involved with choosing a proper launch window. First, the length of the trip to the Moon was set to about 66 hours to maximize the payload while insuring that the spacecraft would be near the meridian as viewed from the Goldstone tracking antenna (the most sensitive in the network) when RANGER impacted on the Moon. RANGER also had to approach the Moon almost vertically at a precise speed because of the fixed velocity increment of the lander's retrorocket. Because of the imaging requirements and the position of celestial references, the landing could only take place on the Moon's visible face during a four or five-day period centered on the Moon's last quarter phase. Finally, the requirement that the hard lander's antenna have Earth in view meant that it could not be placed more than forty-five degrees from the center of the Moon's visible side. All of these constraints limited impact sites to near the lunar equator in the eastern part of Oceanus Procellarum.

A typical mission sequence for the Block II RANGER started with the modified ATLAS D placing the AGENA B and RANGER into a parking orbit after a short burn from the AGENA B. After a certain time delay fixed before launch, the AGENA B would reignite to place the spacecraft on a path to the Moon. Once its job was completed, the AGENA B separated from the probe and fired small retrorockets to distance itself from the craft. About five minutes after separation and forty-eight minutes after launch, RANGER then unfolded its solar panels and high-gain antenna to began its search for its first attitude reference, the Sun. Once acquired, RANGER switched from its nonrechargeable battery to its solar panels for power. It then began a slow roll until its antenna locked on to Earth, its final reference point, about four hours after launch.

Fifteen hours after launch, RANGER would be commanded to make a single mid-course correction, if needed, at a distance of 91,000 miles (146,000 kilometers) to insure a lunar impact. During this time, internal gyroscopes were used as an attitude reference. After the burn, the fragile gamma ray spectrometer boom was deployed. As RANGER approached the Moon, it began its terminal descent maneuver. The spacecraft switched to its internal battery and turned 180 degrees so that its back end was aligned with the Moon.

Before the ink on the RANGER authorization was even dry, NASA had plans for even more ambitious lunar missions.

After the high-gain antenna was once again pointed at Earth, the probe would begin to acquire television images about thirty-two minutes before impact at an altitude of 2,400 miles (3,900 kilometers). Images would be taken every thirteen seconds down to an altitude of 37 miles (59 kilometers). Transmission of this last image would have been completed as the probe reached an altitude of only 15 miles (24 kilometers).

Only 8.1 seconds before the bus crashed into the lunar surface at a speed of 6,500 miles per hour (2,900 meters per second), the radar altimeter generated a fusing signal at an altitude of 13.3 miles (21.4 kilometers). At that moment, bolt cutters would free the hard lander and retrorocket from the bus. A three nozzle spin motor fires and lifts the package 2.5 feet (0.8 meters) above the bus and imparts a three hundred revolutions per minute (rpm) spin. The retrorocket then fires, slowing the capsule to a virtual stop at a height of only 1,100 feet (335 meters) above the lunar surface. Explosive bolts cut the clamp holding the lander to its retrorocket and the two are separated by springs. The hard lander free falls to the surface with an impact speed of one hundred miles per hour (45 meters per second), give or take twenty miles per hour (nine meters per second).

Protected from the force of impact by its balsa wood shell, the lander rolls to a stop. The free floating capsule inside the shell was made to be bottom heavy so that it would settle into a horizontal position. This allowed its antenna to point towards Earth. After twenty minutes, plugs are blown out, allowing the one-half pint (225 milliliters) of heptane protecting the seismometer and the freon to evaporate into the lunar vacuum, thus fixing the capsule in place and allowing the seismometer to operate correctly. The package would then transmit its findings on lunar seismic activity for the next sixty to ninety days. If it worked, the United States would have the first high resolution pictures of the Moon as well as the first hard landing on its surface.

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

Comet Comments

by Don Machholz

(916) 346-8963 September 8, 1992

One new comet has been discovered and a faint returning comet has been recovered recently. Meanwhile, new information about an old comet has given us another example of a transitional object.

The "old comet" that I'm referring to is Comet Wilson-Harrington. It was discovered in Nov. 1949 at magnitude 16, and recorded only on photographic plates taken between Nov. 19 and 25 of that year. The orbit was not well-determined, and it's been thought that the comet had not been seen since.

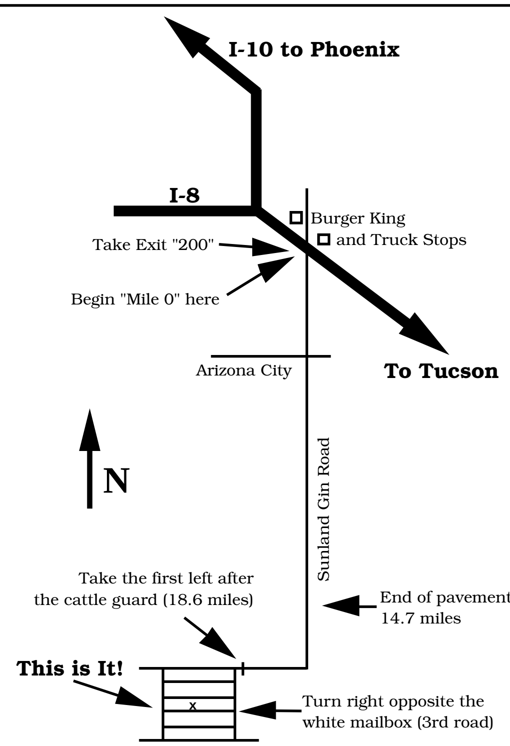
Examination of the plates now have determined that this comet was also observed in the years 1979–80, 1988–89, and 1992. However, in these latter observations the comet appears star-like, and it even was, in 1979, labeled as an asteroid. Apparently, this object is a "largely inactive comet that undergoes occasional outburst." We now

All-Arizona Star Party

The All-Arizona Star Party is at EVAC's Deep Sky site. It's a two night event October 23, 24. Friday night's session starts at sundown. Saturday's session will begin with a Potluck followed by the observing session.

Remember the bug repellent! For last minute on-site weather conditions, call Ted Hankins on his cellular phone: 1–602–540–0395. Ted will be on-site at least an hour before sunset both days.

For further information contact Dick Simmon at (602) 949–1110.



know that Periodic Comet Wilson-Harrington has an orbital period of 4.3 years, second only to Comet Encke's 3.3-year period.

This is not the first time that an asteroid-looking object has shown itself to be a comet. But improved observing and hunting technology have uncovered and increasing number of such "transitional" objects. This causes some concern for those who classify newly-found solar system objects, because the old method of calling an object either an asteroid or a comet doesn't always work. One suggestion is to add a third category ("active asteroid"?) for those objects which appear to linger between the two. Another suggestion is to classify and label all new objects the same, whether they show cometary activity or not.

Periodic Comet Daniel (1992o): T. Seki of Japan recovered this comet at magnitude 18 on June 29. It may brighten to magnitude 15 over the next few months. The orbital period is 7.1 years.

Comet Brewington (1992p): Howard Brewington of Cloudcroft, New Mexico visually discovered this comet on Aug. 28. He was using his 16-inch reflector at 55x. This find came 99 search hours since his previous find in December 1991.

At discovery the comet was in the northern morning sky, shining at magnitude 11. An early orbit indicates that it was closest to the sun at a distant 1.70 AU on June 20. It is now slowly pulling away from the sun as the distance to the earth remains nearly constant.

Comet	**Brewington**				**(1992p)**
Date	RA-2000-Dec		Elong	Sky	Mag
09–25	08h21.3m	+35°21′	64°	M	11.1
09–30	08h31.5m	+35°00′	67°	M	11.2
10–05	08h41.0m	+34°40′	69°	M	11.2
10–10	08h49.8m	+34°20′	72°	M	11.3
10–15	08h59.9m	+34°00′	75°	M	11.3
10–20	09h05.4m	+33°43′	79°	M	11.4
10–25	09h12.1m	+33°27′	82°	M	11.5
10–30	09h18.1m	+33°14′	86°	M	11.5
11–04	09h23.4m	+33°02′	89°	M	11.6
11–09	09h27.9m	+32°54′	93°	M	11.7

Bits and Pieces

Minutes of the August Meeting

President Paul Lind opened the meeting at 7:35 PM with a welcome to all new members and visitors. He reminded everyone about the upcoming events listed on the board. He explained the general format of the SAC meetings with the business first and the Show 'n Tell presentations second, with the main speaker following the break. Elections are coming in November and we will need a new President, Vice-President and Treasurer.

Bob Dahl gave the Treasurer's Report with membership now at 117. He explained about the magazine subscriptions available through SAC at a reduced rate and took a count of those who would like to buy a copy of the 1993 Observer's Handbook. A.J. Crayon talked about the Deep Sky Group meeting on Sept. 17 at the McGrath House. This month's constellation will be Cetus. Again this month, there are no awards to be presented, so A.J. took a count of those interested in a Messier Marathon night where observation of all 110 objects sequentially to those interested.

Other business — Leon Knott proposed a mirror grinding class for those wanting to make their own telescopes. Steve Coe urged the members to become involved in the Club by running for the vacant offices in the next election. He reported on the success of the "To Heck With the Monsoon Start Party" and gave some information about the Kitt Peak trip on Oct. 10. Jeff Hester asked for volunteers to help staff the upcoming American Astronomical Society meeting in January (week of Jan. 4) at the Point South Mountain. Rich Walker had three volumes from the SAC library available for members to borrow. Tom Polakis talked about the 1994 eclipse and proposed group travel with the Texas clubs.

After the break, Jeff Hester from ASU gave a presentation on the Hubble Space Telescope and the efforts to correct the defective mirror alignment.

—*Susan V. Morse, SAC Secretary*

1992 SAC Meetings
Oct. 9
Nov. 6
Dec. 12 Party
— **1993** —
Jan. 8
Feb. 5
Mar. 5

1992 SAC Star Parties		
Date	Sunset	Moonrise
Oct. 23, 24	5:45pm	6:32am
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. 13	6:35pm	12:53am

Coming Events

The Kitt Peak tour is October 10, see details in this newsletter.

October is Piggybacking Month: Members to Expose Themselves

Phil Dahl will be the main speaker for the meeting this month and the topic of the entire meeting will be "Piggyback Astrophotography." **Lots** of our members have slung their camera onto the scope and taken some photos of the heavens. With that in mind, the members portion of the meeting will be dedicated to displaying astrophotos. So, if you have some piggyback pictures that are yearning for exposure, here is what I propose: each member who wishes to show off some pictures should show up with their 5 **best** and 1 **worst** (or funniest) astrophoto. Drop those slides into the tray, or set up your prints on a board and be ready answer about how you did your best work. You should also be ready to field questions concerning your worst or funniest or most bizarre photo as well.

E-Mail Roster

Here is a list of e-mail address of SAC members. The Compuserve addresses are given as `nnnnn.nnn@compuserve.com` are really in the format `nnnnn,nnn` within Compuserve. BIX addresses aren't currently addressable from the outside world, but their addresses are given with `@bix` to specify which host.

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
Pete Manly	petemanly@bix
Tom Polakis	70413.1543@compuserve.com
Paul Maxson	maxson@maricopa.edu
Chris Schur	72070.2612@compuserve.com
Brian Skiff	bas@lowell.edu
Dan Ward	72040.3357@compuserve.com

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.

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.

Planning will continue for the Messier Marathon for March 20 at the Arizona City site.

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.

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.

For Sale:—2″ Star Diagonal, new, never used. $75 Helen Lines 493–1976.