Saguaro Astronomy Club

Metro Phoenix, Arizona

SACNEWS

December 1992 — Issue #191

Telescopes, Optical Quality and Today's Amateur

M. Leon Knott

In 1913, famed observer Edward Emerson Barnard, discoverer of Jupiter's fifth moon and many of dark nebulae, comets and other objects, made a dedicated search for the Horsehead Nebula (B33) using the Yerkes 40 inch refracting telescope.* After the search, Bernard was unable to announce a definite sighting of this heavily photographed, but seldom seen object.

Today, the Horsehead Nebula is routinely observed in instruments as small as 10 inches in diameter and is no longer considered a test of visual acuity and observing ability among amateurs. Some of the reasons for this astounding success are narrow bandpass filters (although B33 is often seen without filters), better quality optical instruments and amateurs who may be considered to have bettered the observational four-minute mile.

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This upsurge in observing ability has generated a desire among amateurs for telescopes with optical quality far surpassing those of a few years ago. These observers, well aware that superior optical performance is possible, find themselves increasingly disenchanted with the quality of current commercial offerings. To many, it seems as if an inordinate amount of effort is expended in providing questionable bells, whistles and marketing strategies, while optical quality takes a back seat. The reason for this is very simple.

* Burnham's Celestial Handbook, Vol. 2, page 1341

Quick Calendar

SAC Party
7:30, Saturday, December 12

Star Party
Buckeye Hills Recreation Area
Saturday, December 19

SAC Meeting
7:30, Friday, January 8

1993 SAC Officers

President	Bob Dahl
Vice President	Tom Polakis
Treasurer	Carol Lee
Secretary	Susan Morse
Properties	Rich Walker

The manufacture of machined or cast parts for tubes, mounts, drives and so on is very straightforward. However, the making of telescope mirrors (and lenses to a lesser degree) does not lend itself to mass production. It is certainly possible to grind, fine grind and polish mirrors by machine. On the other hand, having personally tested hundreds of commercial mirrors, I do not believe a machine or high production system can be made to provide a proper mix of the three primary essentials for a superior performing optical surface.

For the kind of performance demanded by today's advanced observer, the telescope's mirror must meet the following criteria. Firstly, the mirror's edge **must** be right. Turned edges, either up or down, are anathema to good performance. Unfortunately, most of the commercial offerings suffer from this malady to one degree or another... Secondly, a telescope mirror's surface **must** be smooth overall. Any roughness, such as "dog biscuit" or visible ring zones will result in a very substantial degradation in image quality, especially when observing objects requiring high resolution or magnification. Unfortunately, this condition is even more common than turned edges. In real life however, a smooth 1/4th wave mirror will easily outperform a rough 1/8th wave mirror. Finally, the mirror should depart from theoretical perfection by as little as possible. We speak of this as the mirror's wavefront error. This simply means that the surface of a 1/10th wave mirror departs from a perfect paraboloid at no point, by a quantity greater than 1/10th of a wavelength of light (a wavelength of light is simply a convenient unit of measurement for this kind of super-tiny quantity and is about 21.6 millionths of an inch. . . or about 1/200th the thickness of this sheet of paper). It is very important that one not sacrifice surface smoothness in the quest for a super-low wavefront error. A balance must be struck.

And here is the crux of the matter. This balance be achieved only by careful handwork. It is not economically feasible for commercial manufacturers to allow the time necessary for master opticians to produce fine work. The making of a poor but serviceable commercial mirror is indeed a science. The making of an exquisitely performing mirror is an art.

Happily, the amateur, with access to greater amounts of time, can easily produce mirrors that will outperform **any** commercial product. While the overall task of doing so seems overwhelmingly complex, the making of a mirror is merely a succession of several very simple jobs, easily managed by a 12 or 14 year old. Furthermore, new technologies and materials, inexpensively available, make the fabricating of a superb telescope mirror a very satisfying experience. As a corollary to the above, it is as easily possible to refigure existing but poorly performing mirrors.

It seems evident that commercial sources aren't likely to begin producing optics or optical instruments of substantially improved quality anytime soon. Armed with a very few, incredibly simple and inexpensive tools, the amateur can easily test and evaluate all kinds of optical systems, both in and out of the telescope. With these same tools he can build his own systems that will outperform the commercial offerings while at the same time giving him a large measure of satisfaction and pleasure.

While it might seem a big job, optimizing a [telescope] system can give immediate and very noticeable improvements in performance. . .

For those who don't wish to delve into the awesome pleasures of optical work (and it is extremely addicting) there remain a number of other ways to improve the performance of existing equipment. Owners of refractors and compound telescopes are generally restricted to purchasing accessories that make them more suited to a given kind of observing. On the other hand, most factory produced reflectors are anything but optimized, being set up on the basis of economic consideration rather than performance. In many cases, simple modifications can make such scopes perform like completely different instruments, giving significant increases in performance across the board. This "optimizing" process can be done in phases, allowing the instrument to remain in service, while undergoing a major upgrade in capability.

An optimized system is one in which the juxtaposition of primary and secondary or diagonal mirrors is such that a very small diagonal can be used. After poor collimation, a too-large diagonal is the number one culprit in poorly performing reflectors. While much is made of the obstruction of light caused by a large diagonal mirror, the major decrease in performance will be directly related to the larger diagonal's image degrading diffraction effects. The loss of light throughput, due to a larger diagonal is of little import, when place alongside the losses of resolution and contrast, the problems associated with dirty "flares" between double stars, scattered light and greater spider vane effect.

Of course, merely replacing a large diagonal with a smaller one isn't the end of the story. Remember, the telescope is an optical system and every component contributes to the overall performance. The proper size of the diagonal is tied to the tube diameter and focuser height as well as to the primary mirror's focal ratio. In order to determine the optimal diagonal size, we take the intercept distance (the distance from the center of the diagonal to the top of the racked-in focuser,) divide it by our primary mirror's focal ratio and add 1/10th of an inch to the answer (giving a 1/10th of an inch fully illuminated field, more than adequate for visual observing. . . photographic work will require a larger fully illuminated field and thus a larger diagonal.)

Doing a few examples will quickly show the benefits of a low-profile focuser and minimal tube diameter. Standard solid tubes, such as paper, aluminum, fiberglass or Bakelite must allow enough space around the primary to alleviate tube currents. Truss tube systems can be made much smaller without tube current difficulties. As an example, my truss tube $20''$ $f/4$ has an intercept distance of just 12 inches, meaning I can use a 3.1 inch diagonal and having a central obstruction of just 15 percent. A Coulter solid tube $13.1''$ $f/4.5$ scope will use the same 3.1 inch diagonal, giving an obstruction of nearly 24 percent. Optical experts claim that obstruction must be kept below 20 percent in order to eliminate image-degrading diffraction effects. Of the two examples, its easy to see which is optimized.

While it might seem a big job, optimizing a system can give immediate and very noticeable improvements in performance along several fronts. High resolution targets such as the moon and planets will exhibit a wealth of new detail, deep sky objects will be seen resting against a super-black background and double stars will split much more easily. Eyepiece aberrations will lessen greatly and scopes that had never before shown an Airy disk or diffraction rings may do so.

Modern observers, with their awesome abilities, deserve the very best in equipment. I find it interesting indeed that many of them have within themselves a potential for meeting that need and then some. Whether the improvements are of a mechanical, or optical nature, today's amateur has no excuse for putting up with telescopes that fail to match their observing needs.

Christian Huygens, discoverer of Saturn's rings and builder of huge aerial telescopes in the mid-1650's said, "I set myself to work with all the earnest and seriousness I could command to learn the art by which glasses are fashioned for these uses, and I did not regret having put my own hands to the task." Over the years, in seeing nearly 100 mirror-making students bring their optical surfaces to completion, I've yet to see one who would disagree with the sentiment expressed above.

Coping with Dew

by Charlie Manahan

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How many amateur astronomers have been out happily observing, only to find their celestial targets slowly fade into the background? The culprit is dew, usually covering the front optical element of their telescopes. What is dew? Where does it come from? Most importantly, what can we "dew" about it?

The most popular amateur telescope design is the Schmidt-Cassegrain, which is particularly susceptible to dewing on its exposed front corrector. However, any optical element exposed to the open air can (and usually will) dew, given sufficient time and a humid night.

Dew does not fall from the sky. It is the same phenomenon that causes the glass holding your iced drink to get wet. Any object that is colder than the condensation point (dew point) gets moisture on it. If the object is cold enough, the condensate is ice, otherwise liquid.

Why do Schmidt-Cassegrain corrector plates seem to be the first to fog? For any given set of atmospheric conditions, dew formation is a function of temperature. Schmidt-Cassegrain correctors are usually colder than other things around an observing site. Why? The temperature of different objects at an observing site can vary considerably, depending on the heat flow into and out of the objects.

All things in the Universe give heat to objects that are colder and accept heat from objects that are warmer. The temperature of any object that does not generate its own heat is solely dependent on the net heat flow to and from that object.

The corrector of an SC is no exception. The corrector is at a steady state temperature and heat flow achieved by radiating heat to the night sky and accepting heat from the terrestrial surroundings. Deep space is at the temperature of the microwave background, a frigid 2.73 degrees Kelvin (−454 degrees Fahrenheit). An unshielded corrector plate pointing at the zenith "sees" a hemisphere of extreme cold above it and only the telescope below it. Since the night sky is so much colder than the corrector, the corrector radiates heat to the sky. As long as the heat flow out of the corrector is greater than the heat flow into it from the air and surrounding objects, the corrector gets colder. The colder the corrector becomes, the more heat flows into it and the less heat flows out. The temperature continues to drop until the heat flow in matches the heat flow out.

If the steady state temperature of the corrector is lower than the dew point, the corrector gets covered with dew. Wiping it will not help; it will only redistribute the dew. The one act that will prevent dew formation is keeping the corrector plate temperature above the dew point.

There are two ways to keep your optics warm enough to prevent dew. One is to reduce the heat flow out by reducing the area of night sky that the corrector "sees." This is how dew shields work. By narrowing the circle of sky to which the corrector is exposed, the heat loss is reduced and the steady state temperature of the corrector increases. Dew shields have an additional benefit of increasing image contrast by reducing optical flare caused by stray light. The longer and deeper the dew shield, the better it works. This is why Newtonians have less trouble with dew than Schmidt-Cassegrains. Their mirrors are only exposed to a small portion of the sky.

With humid nights in such places as Georgia, dew shields are rarely sufficient to keep the dew away, although they slow dew formation. In addition, as the environment cools throughout the night, the ambient temperature can drop to or below the dew point, making dew shields useless. At this point, the only way to prevent dew is by artificially heating the corrector.

Hair dryers work, but dew clearing with a hair dryer requires a 120V power supply and is a repetitive chore. On a night with heavy dew formation the corrector may require a "blow dry" every ten minutes. Corrector plate heaters are a step up from hair dryers but can cause convection currents that generate bad "seeing" through the telescope. A combination dew shield and corrector plate heater with a temperature control that allows the heater to work at a temperature just barely warm enough to keep the corrector above the dew point is a better solution than either alone.

Amateurs can save money on dew shields without much effort. Commercial dew shields are expensive and usually too short. A rolled poster board tube painted with the polyester resin used for automotive fiberglass makes an acceptable dew shield. Untreated poster board sags out of shape as it gets wet with dew during the night. Painted aluminum flashing (easily joined with pop rivets) makes an inexpensive, durable dew shield.

For those who like to solder, resistors for heating are cheap. As a starting value for twenty-centimeter (eightinch) SCTs, twelve three ohm resistors in series (36 ohms total) should give plenty of heat to keep dew away when attached to an automotive battery (13.6V). This gives about four-tenths of one watt per resistor. Allow a safety margin of 5x on the power factor for resistors. Just be sure to mount them close to the corrector and give your construction the "smoke test" before you put it on your telescope. Do NOT plug this into a household outlet — it may cause an electrical fire!

The ideal solution maintains the optical element temperature slightly above the dew point, while minimizing temperature differences and air currents in the optical path.

About the Author —

Charlie Manahan is a familiar ASA member to fellow observers at Hard Labor Creek Observatory (HLCO) activities. Charlie pursues astrophotography and deep sky observing through his custom modified Celestron 11 telescope. His hardware attests to the value of a little "do it yourself" magic, which always seems to make things work better.

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.

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.

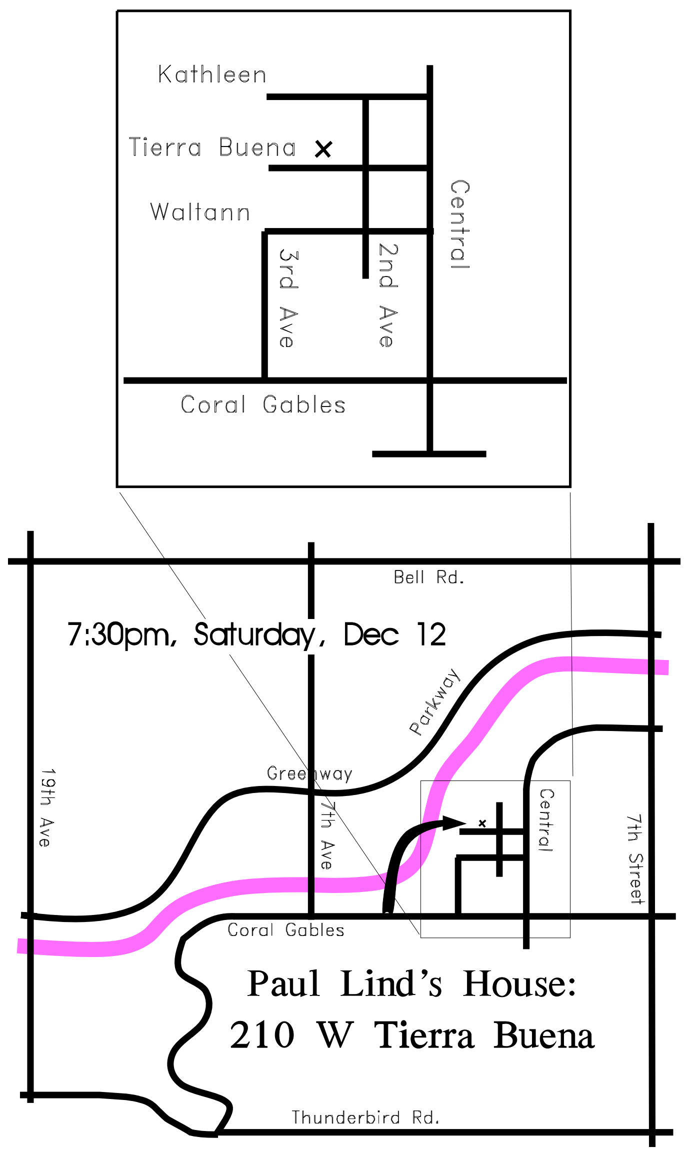
Those members who experience problems with their subscriptions to *Sky & Telescope* magazine may call Sky Publishing at (800) 253–0245.

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.

December's Party

The end of the year party is upon us. Below is a map:



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 Taurus and Auriga. 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, January 16 at 7:30pm.

Planning continues for the Messier Marathon for March 20 at or near EVAC's Arizona City site.

Minutes of the October Meeting

President Paul Lind opened the meeting at 7:40 PM with a welcome to all newcomers and visitors. Because of the election of officers, the meeting would be shortened. The Treasurer's report was given by Bob Dahl with our membership now standing at 120. Steve Coe announced that the December Christmas party would again be held at Paul Lind's house on December 12, 1992. The next public star party would be tomorrow at Reach 11 Park and all members are encouraged to bring their scopes for the expected crowd. The Kitt Peak trip was a success and more trips will be considered for the future.

Susan Morse presented a letter from a new member, Chris Waldrup, who attends college in North Carolina. Chris is coming to Arizona for the summer and would like help in finding a job. He is willing to work for room and board and if anyone knows of something, please contact Susan. A.J. Crayon announced that the next Deep Sky meeting would be on Nov. 12, at 7:30 PM at the McGrath house. The constellations—*Aries, Triangulum,* and *Perseus* will be featured at the meeting. He then presented the Herschel 400 award (#79) to Tom Polakis. He also mentioned that Ron Caciola (a former member present) had received #6 in the Herschel 400 awards.

Rich Walker as Properties Vice-President, told members about the great deals that could be had by buying some of the back issues of the library's magazines and older books. Any money raised will go to purchase newer material for the club's library.

Paul Lind then opened the elections by asking for any more nominations from the floor. Rick Nadolny has his name removed from the nominations for President. Carol Lee was nominated for Treasurer; then Steve Coe moved to close the nominations, and A.J. Crayon seconded the motion. The results of the elections were as follows: President—Bob Dahl, Vice-President—Tom Polakis, Treasurer—Carol Lee, Secretary—Susan Morse, and Properties Director—Rich Walker.

Following the elections, Steve Coe announced that there would be a Swap session during the break and after the break, Pierre Schwaar and Rich Walker would present their slides.

—Susan V. Morse, SAC Secretary

Comet Comments

by Don Machholz

(916) 346-8963 November 8, 1992

This is the last chance for Northern Hemisphere observers to see Periodic Comet Swift-Tuttle as it heads south and into our evening twilight. It is due to return in July 2126, if it is a couple of weeks late it will make a close passage to earth. A collision seems unlikely, because, first, we're talking about an object only 15 miles in diameter hitting the earth, and second, future technology could eliminate not just the possibility of a hit, but the comet itself. In any respect, the Perseid meteor shower in 2126 should be preety good.

Comet Vaisala 1 (1992u): Jim Scotti used the Spacewatch telescope at Kitt Peak to recover this comet at 22nd magnitude. It might reach 15th magnitude by next April.

Comet Gehrels 3 (1992v): On the same night as the previous recovery (Sept. 26), Jim Scotti also recovered this comet. It is expected to remain very faint.

Periodic Comet Slaughter-Burnham (1992w): S. Larson and C. Slaughter recovered this comet on Sept. 18 at magnitude 22. It will remain faint.

Periodic Comet Schaumasse (1992x): T. Seki recovered this comet on Sept. 25 at magnitude 20. It reaches perihelion early next March at 1.2 AU, and approaches to within 0.5 AU of earth this January.

Comet Shoemaker (1992y): Carolyn Shoemaker found this comet on plates taken by Eugene Shoemaker, David Levy and Henry Holt with the 18" Schmidt at Mt. Palomar. It was then at 15th magnitude. It is expected to brighten by a couple of magnitudes before reaching a perihelion of 2.3 AU next March.

Periodic Comet Swift-Tuttle (1992t)

Date	RA-2000	Dec	Elong	Sky	Mag
11–19	18h18.6m	$+18°45'$	55°	E	5.6
11–24	18h38.1m	$+12°11'$	51°	E	5.6
11–29	18h54.0m	$+06°11'$	47°	E	5.6
12–04	19h09.7m	$+00°46'$	43°	E	5.6
12–09	19h22.8m	$-04°04'$	38°	E	5.7
12–14	19h34.5m	$-08°14'$	34°	E	5.8
12–19	19h45.3m	$-12°06'$	30°	E	6.0
12–24	19h55.2m	$-15°34'$	26°	E	6.1
12–29	20h04.6m	$-18°43'$	22°	E	6.3
01–03	20h13.6m	$-21°36'$	18°	E	6.5

Periodic Comet Schaumasse (1992x)

Date	RA-2000	Dec	Elong	Sky	Mag
12–09	04h04.8m	$+15°37'$	164°	E	12.3
12–14	03h57.8m	$+16°40'$	158°	E	11.9
12–19	03h50.9m	$+17°50'$	152°	E	11.5
12–24	03h44.6m	$+19°11'$	146°	E	11.1
12–29	03h39.1m	$+20°38'$	140°	E	10.7
01–03	03h34.9m	$+22°12'$	134°	E	10.4

E-Mail Roster

Yet another updated list of e-mail addresses 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.

Bob Bryant	Bob_Bryant@poncho.phx.sectel.mot.com
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
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Tom McGrath	mcgrath@phyast.la.asu.edu
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Brian Skiff	bas@lowell.edu
Alex Vrenios	71024.3024@compuserve.com
Diane Vrenios	71024.3024@compuserve.com
Dan Ward	72040.3357@compuserve.com
Mike Willmoth	76170.1037@compuserve.com
	mwillmoth@bix
	m.willmoth@genie

AAS Volunteers' Orientation Meeting

The AAS meeting during the week of January 4, 1993 is quickly approaching. The meeting for volunteers to help with the AAS meeting is on **Friday, December 4, at 7:30PM**. Those of you who signed up should make every effort to attend this meeting and those who didn't signup but wish to help are also invited to attend. The meeting will take place on the first floor of the **Bateman Physical Science Building F-wing** and parking is available in **Parking Structure #2**.

Parking Structure #2 is on the northeast corner of McAllister and Tyler (which is one block southwest of University and Rural.) The Bateman Physical Science Building is the fourth building on the north side of Tyler Mall (west of the parking structure.)

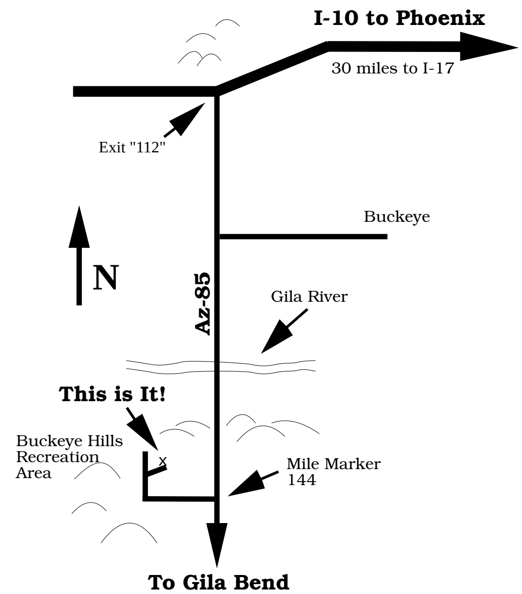
1992 SAC Meetings
Dec. 12 Party
— **1993** —
Jan. 8
Feb. 5
Mar. 5

1992 SAC Star Parties		
Date	Sunset	Moonrise
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.