Saguaro Astronomy Club

Metro Phoenix, Arizona

SACNEWS

March 1992 — Issue #182

Our Closest Neighbors in the Milky Way Subdivision

by Ingemar Furenlid and Tom Meylan

This article is from the September, 1989 (Volume 1, Number 2) issue of the Electronic Journal of the Astronomical Society of the Atlantic (EJASA) and is Copyright © 1989 by the Astronomical Society of the Atlantic (ASA). It is reprinted here with permission.

Our closest known stellar neighbors in the Milky Way Galaxy — excluding Earth's Sun — are the stars in the Alpha Centauri system. The two main components in this triple system are called Alpha Centauri A and Alpha Centauri B. The third component, which is actually the closest of the three, is called Proxima (for proximity) Centauri and is a faint M dwarf star of visual magnitude 11.05. The trinary star system is located approximately 4.3 light-years from Earth.

Alpha Centauri A is quite similar to the Sun and has been called a solar twin, which it is not, but more about that later. Co-author Ingemar Furenlid traveled to Chile a few years ago to use the excellent facilities of the European Southern Observatory (ESO) for a detailed study of the spectrum of this star. Flying down the length of South America along the Andes is a beautiful experience; the approach to Santiago de Chile is announced by the Aconcagua summit, a 7,800-meter (26,000-foot) landmark in the Andes, towering over the other peaks.

As an ESO observer I was met at the airport by an agent carrying a big sign with my name. He placed me in a cab and I was promptly taken to the "guest house". Next morning, I was off to a smaller airport for a memorable flight to La Serena up north and closer to the observatory. The flight, in a seven-seater twin, was done on the last day of one of the biggest storms in recorded history; it was the finest roller coaster I ever rode! The runway in La Serena was a big lake, and the pilot's comforting words during final approach were: "Let's give it a try, at least we won't burn." Hanging forwards in our seat belts through cascades of water, we experienced the plane coming to a full stop in only 45 meters (150 feet)! A big van took the ESO party 160 kilometers (100 miles) to the mountain, where we arrived in time for dinner prepared by the world famous (among astronomers) chef, Mr. Schuhmacher.

My purpose was to conduct a spectroscopic analysis of Alpha Centauri A, and to do this, I made observations with a special purpose telescope called the coude auxiliary telescope, located in a separate tower next to the 3.6-meter (11.9-foot) telescope building. A coude focus is located in a fixed place, independent of where the telescope is aimed. In this case, the coude room housing the echelle spectrometer, and the observing room are both in the 3.6-meter building. This is one of the finest spectrographs in the world and observing here was a delight. Surrounded by TV screens, counters, touch screens, and keyboards, I felt as if I were in a satellite. In a typical setup, the observer runs the spectrometer and the night assistant brings in the stars. This run was easy for the assistant, as most observations were of the same star. Most of the spectrum of Alpha Centauri A in the range of 3900 (blue) to 7600 (red) angstroms was observed in pieces 50 angstroms long in such a way that the resulting data had

Quick Calendar

SAC Meeting
7:30, Friday, March 20
Bring your Survey

Deep Sky Meeting
Thursday, March 26

Star Party
Buckeye Hills Recreation Area
Saturday, March 28

Deep Sky Group's
Sentinel Star Gaze
Saturday, April 4

Public Star Party
Reach 11
Saturday, April 11

unusually high resolution and precision. All went fine: The weather after the storm was excellent, and the last needed spectrum was recorded in the morning of the last night.

Afterwards, we were in a rush to get to bed after the long night. The night assistant, however, rushed too quickly, and on the way down from the telescope hit a snowbank and rolled his car upside down. He crawled out from under it and walked to his quarters to sleep, and some friends righted it the next day. During all these observations I was never near the telescope, but I did remember to walk over to the tower before the last night to see the beautiful alt-alt 1.5 meter (4.9-foot) reflector.

Back at Georgia State University the data were reduced in standard fashion and the process of analysis started. The spectra were obtained for a very careful chemical abundance analysis of the Alpha Centauri system. The chemical analysis of stars has come a long way from early qualitative determinations of composition made merely by identifying the spectral line signatures of elements as previously determined in the laboratory. Now it is possible to compare very high quality numerical data collected at the observatory to numerical results produced by sophisticated computer models of the atmospheres of the stars, and in this way one can make high precision quantitative determinations of the abundances of the stars.

Before spectra can be interpreted, the effects introduced by the electronic equipment must be removed from the raw data. A diode array called a Reticon records the light in the spectrometer, and collects charge on each pixel dependent on how much light was collected. Charge also collects on pixels even in the dark, and this needs to be measured and subtracted away from the data. Also, each pixel in the Reticon responds to light with different efficiency, and this problem must be treated as well.

For the most part, once these instrumental effects are taken care of, the spectrum is ready for analysis. One is left with a string of numbers which give the intensity of light recorded by each pixel. This string of data must be scaled to a standard level, called the continuum, which represents the amount of light that would be radiated by the star if atoms were not absorbing certain wavelengths of light in the star's atmosphere.

After that one needs to find the relationship between the wavelengths of light observed and the pixels on the chip. In other words, one wants to know which wavelength of light was shining on each pixel. This relationship is called the dispersion solution, and has a relatively simple mathematical form.

Once the spectrum is scaled and the dispersion solution has been found, the spectrum is ready to be measured. When the spectrum is plotted as a graph, with wavelength running horizontally and the intensity vertically, features called absorption lines — caused by specific chemical elements absorbing certain wavelengths of light — appear as dips in the plot. The strength of each absorption line is measured by finding the area that the dip covers.

The absorption lines are the key to chemical analysis. If two stars are exactly alike in temperature and size, then the star with a higher abundance of chemical elements like carbon, oxygen, or iron, will show stronger absorption lines. In photographs the lines will look darker, or when graphed, they will be deeper.

To measure compositions, we commonly use the Sun as a standard, because we know its composition better than that of any other star. Excellent spectra exist of the Sun from which measurements of the strengths of its absorption lines have been made. The strengths of these lines, together with known atomic constants for atoms found in the Sun's atmosphere, and sophisticated models of stellar atmospheres, allow us to measure the absolute composition of the Sun. Using the same model used to calculate the Sun's composition on a similar star, this gives the relative abundances directly, as a ratio of the strengths of absorption features. For stars which are dissimilar, a more complicated process is required, in which differences in the atmospheres of the stars must be accounted for.

When we take the final model calibrated by the Sun and apply it to the spectrum of Alpha Centauri A, we get the following results: Physically, we find the star to have a temperature of 5,700 degrees K (Kelvin), which is 90 degrees K cooler than the Sun. It appears that the surface gravity is roughly one-half to two-thirds the strength of the Sun's, indicating that it is also somewhat further along in its evolution than the Sun. This agrees well with the fact that Alpha Centauri A is about one-tenth more massive than the Sun, as found by studies of its orbit, which also means that it ages more rapidly than the Sun.

Chemically, we find that the atomic elements from carbon through zinc are enriched in Alpha Centauri A relative to the Sun by about 35 percent. This enriched composition is also supported by recent calculations of the interior structure of the star, which is strong evidence that the result is correct.

The difference in composition between Alpha Centauri A and the Sun also give us clues as to what caused the enrichment. The heaviest element which is enriched is zinc, and there are also large enrichments of sodium, aluminum, manganese, and copper. Furthermore, the enrichment in carbon, oxygen, and iron is somewhat smaller. These three findings are consistent with enrichment by a massive supernova explosion. We conclude that the material which formed the Alpha Centauri system was affected by one more supernova than the material which formed the Sun.

It is a long, arduous path to the observatory. From the observatory to the final result, the road is no less arduous. However, from our planet we have done some very high quality long-range sensor scanning, and determined to high precision the physical and chemical characteristics of a very distant body. The precision is in fact good enough to begin to piece together some of the "family"

history of our closest neighbors in the Milky Way Subdivision. Alpha Centauri A is sufficiently different from the Sun that we can say for sure it is not a twin!

The Observer's Column

by
Tom Polakis and Paul Lind

The great wall of clouds hanging over the California-Arizona border was not enough to discourage a large group of observers from attending SAC's Buckeye star party on January 25. As twilight descended, the wall receded back into California where it belonged.

One of the treats of this hobby is that there is always something new happening in the sky. One of these happenings was Comet Zonatta-Brewington hanging about 15° over the western horizon at the end of twilight. We began the evening by star-hopping from the Water Jar in Aquarius to the south until landing on the bright 7th magnitude smudge. The coma was very concentrated as viewed in Rick Rotramel's 16-inch and Pierre Schwaar and Tom Polakis debated over the structure of the tail whose length was about a half-degree. Only the photographs will show definitively if our suspected gas tail was real or not.

As the comet set, many of the scopes were swung to the south as the other happening, a supernova, that was "cookin" in a galaxy in the Fornax cluster. NGC 1380 was home to a 13th magnitude supernova that was obvious in 8-inch telescopes. We had to be careful, as a nearby member of this galaxy cluster, NGC 1399, has an "impostor supernova" that is really only a foreground star.

Sometimes a walk around the telescope field is much more enjoyable than observing with your own equipment. Many of the club's members are immersed in observing projects such as the "best of the NGC" and the "Herschel 400." A.J. Crayon is well along on this latter list and could be heard cursing about identifying an open cluster in Taurus. NGC 1750 is situated *inside* the border of the cluster NGC 1746. And to make matters worse, it is involved with a third cluster, NGC 1758. Delineating between the three clusters is nearly impossible task so A.J. had to be content to just describe the star field. Coincidently, Rich Walker was simultaneously observing this same object on his journey through the Herschel 400. He had even drawn the clusters but made no claims as to where one cluster stopped and the other began.

Steve Coe was hard at work photographing winter Milky Way star fields with his tracking platform. He would typically walk around the field and view through other's scopes casually taking occasionally glances at his stopwatch. At the end of each exposure, he would recenter a new field and take another walk. This astrophotography with the tracker is some difficult stuff.

A comparison of nebular filters was taking place at Rick Nadlony's telescope. Paul Lind was not to be bothered as he was working his way through the 110 best NGC objects with his 8-inch scope. While not taunting Bob Dahl about his lack of a clock drive on his 20-inch Dobsonian, Steve Strazdus was also working his way through the winter sky. His view of NGC 1275 in Perseus was quite sharp and the object stayed centered for fifteen minutes. While scanning a chart from the *Uranometria 2000.0* star atlas, Bob Dahl came across Hind's Variable Nebula. This is an extremely challenging reflection nebula around an 8th magnitude star in Taurus. It resembles a star viewed through dewed-over optics at best and was a challenge even with twenty inches of aperture. We went over to the other prominent variable nebula, Hubble's, which appeared like a comet with a tiny fan tail.

Jim Stevens was demonstrating a binocular viewer in the corner of the field. Somehow, the physiological effect of viewing with both eyes overcomes the effect reducing the light-gathering power of the scope in half and one is left with an awesome "three-dimensional" view! Jim plans to obtain a better beam splitter for even brighter bino-views with his 17-inch telescope. The towering 16-inch $f/9$ telescope built by Pierre Schwaar was tracking on the Eskimo Nebula in Gemini. This scope naturally provides high-magnification views very clearly when seeing holds up. Unfortunately, Pierre claims to have upset the seeing gods by building this telescope and hasn't seen subarcsecond seeing since last summer. Another of Pierre's creations, his tiny 6-inch $f/5$, was being used by Dick Jacobsen. This scope is the definition of a great beginner's telescope and is being sold commercially at Dick's shop in the Valley. It, too, showed the supernova in NGC 1380 earlier in the evening.

Frank Martin managed to make the star party even after his car's engine threw a rod near Buckeye. Talk about determination!

After moonrise, which occurred after midnight, a group made its usual post-star party visit to the all-night restaurant west of Phoenix. In warm comfort, we talked about the past night's observations, adding our own embellishments where necessary.

Directions to SAC Events

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

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

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

Bits and Pieces

Coming Events

Several Public Star parties are being planned for the Spring. Reach 11 on April 11, which is just north and west of Tatum and Union Hills, and Thunderbird Park on May 9th. The Sentinel Star Gaze is sponsored by SAC's Deep Sky Group. It will take place at Sentinel, Arizona (Interstate 8 west from Gila Bend, exit 87), south from there. Better directions will be included in next month's newsletter.

March's Speaker

The speaker for March will be Brian Skiff. His topic is "Spotted Stars and Tomorrow's Weather."

1992 SAC Meetings	1992 SAC Star Parties
March 20	March 28
April 17	April 25
May 15	May 23
June 12	June 27
July 17	July 25
August 14	August 22
September 11	September 19
October 9	October 24
November 6	November 21
December 12 Party	December 19

Deep Sky Meeting

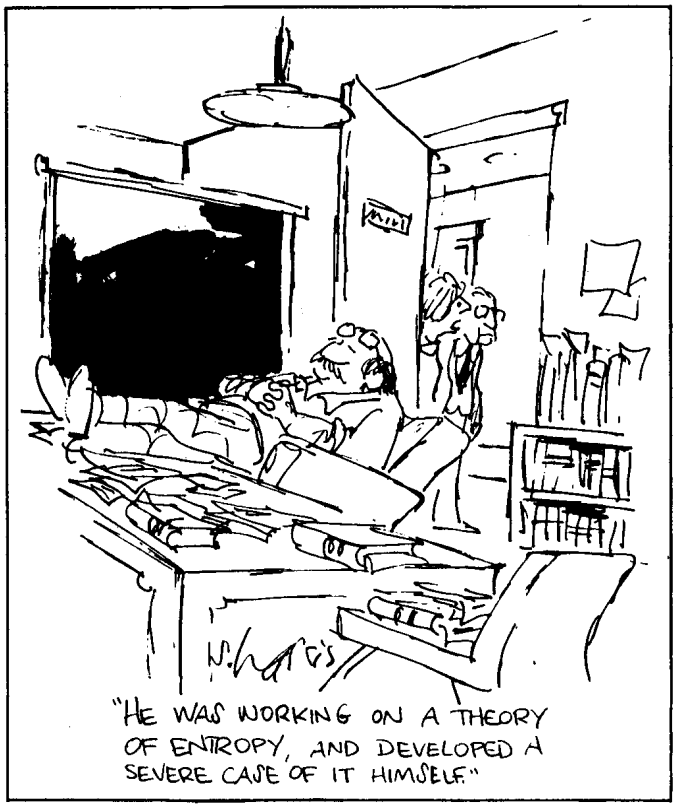
The next Deep Sky meeting will take place on Thursday, March 26 at 7:30pm. Objects in the constellation Pupis are open for discussion.

Minutes of the February Meeting

The meeting was called to order by Paul Lind at 7:40pm. New members and guest were introduced. There were several announcements concerning the future meetings and star parties. Paul said that he had been contacted by a Encanto School third grade teacher to arrange a star party for the children on April 8, 9 or 10.

Paul then talked about the growth of the membership from 85 to 115 over the past year and wanted new members to feel that the club is not run by a central clique. He encouraged all members to become active and if they need advice or help, to ask the other members. There has been some concern over the brevity of the newsletter and reminded everyone that the editor gathers the articles from members and to please submit any announcements or information for inclusion in the newsletter.

Under old business, Paul reported that at the Board meeting, the suggestion of a permanent post office box was discussed. However the Board decided that because of the periodic change of officers, it would make it difficult to have a centrally located box. One of the members felt that it was still a good idea and was willing to pick up the mail, so Paul decided that it would be on the agenda for the next Board meeting.



For new business, A.J. Crayon reported that the Deep Sky group meets every other month and the next meeting was set for March 26. Steve Coe is arranging a bus tour of Kitt Peak with the date set for the summer, with no firm date. Due to the number of new members and the duration since the last gathering, Steve is organizing a novice group meeting for the month opposite the Deep Sky group. Bob Dahl gave the Treasurer's report, and reminded members about their last chance to renew their memberships before being purged from the roster. He also suggested that SAC T-shirts would make excellent Valentine's Day gifts for only $5.

For show and tell, Tom Polakis, Chris Schur and Brian Vorndam shared their slides and photos of the recent annular eclipse of the sun.

Stan Student was the main speaker from Scottsdale, he gave a presentation of his back yard observatory MOMOON. Because of his background, he combined his interest in photography, astronomy and computers. He made his own dome and linked software from his computer to his telescope for display on his monitor. The observatory was spacious, unobtrusive, protective and inexpensive to build (not counting the computer or telescope.) The meeting adjourned at 9:40pm. —*Susan V. Morse, SAC Secretary*

April Newsletter Deadline

Be sure to mail items to be included in the newsletter by Mar 18. Items sent later will not be included, but will be included in the next newsletter.

Comet Comments

by Don Machholz

Two comets have been found recently. Meanwhile, Comet Shoemaker-Levy (1991d) remains in our morning sky, while Comet Mueller, IF it survives perihelion, will spring into our morning sky in late March.

Comet	**Shoemaker-Levy**				**(1991d)**
Date	RA-2000-Dec		Elong	Sky	Mag
02–23	19h30.2m	$+41^\circ 23'$	65°	M	11.2
02–28	19h42.3m	$+41^\circ 28'$	65°	M	11.3
03–04	19h53.6m	$+41^\circ 33'$	64°	M	11.3
03–09	20h04.2m	$+41^\circ 40'$	64°	M	11.4
03–14	20h14.0m	$+41^\circ 48'$	64°	M	11.4
03–19	20h23.2m	$+41^\circ 57'$	64°	M	11.5
03–24	20h31.6m	$+42^\circ 06'$	64°	M	11.5
03–29	20h39.3m	$+42^\circ 17'$	65°	M	11.6
04–03	20h46.3m	$+42^\circ 29'$	65°	M	11.6
04–08	20h52.6m	$+42^\circ 41'$	66°	M	11.7

Comet Helin-Alu (1992a): The first new comet of the year was discovered by E. Helin and J. Alu on Jan. 9 at at magnitude 16 with the 18″ Schmidt at Palomar. I will be closest to the sun in July at 3.0 AU and should not get much brighter.

Comet Bradfield (1992b): Bill Bradfield of Australia discovered this, his fifteenth comet, on Jan. 31. At that time it was magnitude ten, in the morning sky, and fifteen degrees south of the star Antares. The comet will be closest the sun at 0.5 AU in mid-March, but will not be easily visible to Northern Hemisphere observers.

Don Machholz (916) 346-8963

Comet	**Mueller**				**(1991h$_1$)**
Date	RA-2000-Dec		Elong	Sky	Mag
02–23	01h59.4m	$+05^\circ 47'$	56°	E	11.2
02–28	01h43.6m	$+00^\circ 38'$	46°	E	10.4
03–04	01h27.9m	$-03^\circ 52'$	37°	E	9.3
03–09	01h10.0m	$-07^\circ 48'$	28°	E	7.8
03–14	00h46.7m	$-10^\circ 54'$	19°	E	5.1
03–19	00h12.9m	$-11^\circ 32'$	12°	E	3.4
03–24	23h36.3m	$-05^\circ 23'$	12°	M	3.7
03–29	23h18.5m	$+04^\circ 54'$	18°	M	5.6
04–03	23h12.8m	$+15^\circ 04'$	26°	M	7.0
04–08	23h12.3m	$+24^\circ 27'$	33°	M	8.1

Universal Time and Date of Total Lunar Occultations for Phoenix (33.5° Lat., 112.15° Long.)

Date	Time[1]	Time[2]	Mag	Star	Information	PH	PA[1]	PA[2]	PS	Elong	MAL	MAZ	SAL	SAL	
04/06		04:10:13	5.0	ZC0472		DD		110	21	37	7	292	-28	301	
05/07		06:21:03	3.7	ZC1077	(ζ Gem)	DD		131	35	63	1	295	-38	342	
05/20	08:05:10	08:04:53	5.0	ZC2747	(ν_1 Sgr)	RD	223	219	72	230	25	143	-36	12	
07/12	04:22:19	04:20:45	3.4	ZC2500	(θ Oph)	DD	139	147	86	155	30	163	-18	314	
07/27		12:28:41	3.2	ZC0946	(η Gem)	RD		208	19	326	27	79	-2	65	†
08/10	04:28:59	03:55:23	5.0	ZC2747	(ν_1 Sgr)	DD	159	145	82	148	34	170	-24	311	‡
08/10	04:38:05		5.0	ZC2747	(ν_1 Sgr)	RD	170		82	148	34	172	-26	312	‡
08/22		09:07:11	4.3	ZC0709		RD		181	45	279	26	78	-39	31	
09/18	09:50:37	09:50:27	4.4	ZC0660	($\mathcal{U}$ Tau)	RD	226	239	60	251	59	101	-40	530	
10/02	03:05:05	03:05:13	4.3	ZC2513	(44 Oph)	DD	104	92	42	76	20	222	-40	53	
10/15	05:38:31	05:38:40	4.5	ZC0599		RD	252	265	76	223	33	83	-57	313	
10/17		13:08:56	3.2	ZC0946	(η Gem)	RD		334	59	254	73	232	-8	96	
10/18	07:50:47	07:51:01:	3.7	ZC1077	(ζ Gem)	RD	305	317	53	264	25	81	-65	23	

†Southern limit graze just north of Phoenix (total not visible from Phoenix)
‡Southern limit graze east of Phoenix (total visible from Phoenix)

NOTES:
Subtract 7 hours for correct Mountain Standard Time and Day.
Time[1] = Hrs:Min (Std Sta NM)
Time[2] = Hrs:Min (Std Sta LA)
PH = Phenomenon, i.e. RD = (R)eappearance on (D)ark Limb
PA[1] = Position Angle of star from north point of moon (90=East) (NM Std Sta)
PA[2] = Position Angle of star from north point of moon (90=East) (LA Std Sta)
PS = Percent Sunlit
Elong = Elongation of moon from sun (180 = full; 270 = 3rd Qtr)
MAL = Moon Altitude in degrees (90 = directly overhead)
MAZ = Moon Azimuth (90 = East)
SAL; SAZ = Sun Altitude; Azimuth
Blanks = Not Listed at Standard Station
Compiled by Brian K. Vorndam, for more info call him at 602–344–9841.

Gumby

The image to the right was taken from the first set of radar data collected in the normal operating mode. These fault-bounded troughs were imaged by Magellan on orbit 147 on September 15, 1990. The image is of part of the Lavinia Region of Venus at 60 degrees south latitude, 347 degrees east longitude. The image is 28 kilometers (17 miles) wide and 75 kilometers (46 miles) long. This region is at the intersection of two tectonic trends. An extensive set of east-west trending fractures extends to the west (left) and a second set extends down to the south-southeast (lower right). The lines of pits suggest some igneous or volcanic activity accompanying the faulting. The prominent trough trending diagonally across the image is 5 kilometers (3.1 miles) wide and is 100 to 200 meters (300 to 600 feet) deep.

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—10″ $f/4.5$ Newtonian reflector on 'Lil' Big Foot mount. Piccadilly on/off axis guider. RA and Dec drives with wire remote. 12mm and 20mm Plössl eyepieces, 3x barlow. Color Filters. $1,000 or trade for computer. David Owings, 772–9304.

Eyepieces—Brandon 40mm 2″ Efle, $170. Brandon 1.25″ 16mm $35. Meade 24.5mm Super wide angle eyepiece $110. Meade series 4000 2x barlow $50. Dwight L. Bogan, 482–9816 (home) 231–3906 (work).

Telescope—10″ $f/6.3$ S.C.T. with glass solar filter and extras. Upgrading to a larger scope and must sell. $1,500. Michael Janes, 945–5431.

Telescope—Complete Newtonian Reflector, 6″ $f/4$ (48″ focal length) rack-and-pinion focuser on strong equatorial mount with hand controls (clock drive can be added) with folding adjustable tripod legs. One eyepiece (18mm). $325 OBO 926–8114.

Telescope—Meade 826C 8″ $f/6$ Newtonian, Accutrak drive corrector, 8x50 finder, 25mm eyepiece. $550. Rich Walker 997–0711. **Eyepieces**–Televue 40mm Plössl $60, 32mm Plössl $60, Meade 24.5mm Super Wide Angle $85. Rich Walker 997–0711.

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