

East Valley Astronomy Club

February 1998

<http://www.goodnet.com/~rkerwin/evac/evac.html>

Scottsdale, Arizona

Comets and Disaster in the Bronze Age

Dr. Benny J Peiser

At some time around 2300 BC, give or take a century or two, a large number of the major civilisations of the world collapsed, simultaneously it seems. The Akkadian Empire in Mesopotamia, the Old Kingdom in Egypt, the Early Bronze Age civilisation in Israel, Anatolia and Greece, as well as the Indus Valley civilisation in India, the Hilmand civilisation in Afghanistan, and the Hongshan Culture in China - the first urban civilisations in the world - all fell into ruin at more or less the same time. Why?

A thousand years later, at around 1200 BC, many of the civilisations of the same regions again collapsed at about the same time. This time, disaster overtook the Mycenaens of Greece, the Hittites of Anatolia, the Egyptian New Kingdom, Late Bronze Age Israel, and the Shang Dynasty of China.

The reasons for these widespread and apparently simultaneous disasters - which coincided also with changes of cultures and societies elsewhere, such as in Britain - have long been a fascinating mystery. Traditional explanations include warfare, famine, and more recently 'system collapse', but the apparent absence of direct archaeological or written evidence for causes, as opposed to the effects, has led many archaeologists and historians into a resigned assumption that no definite explanation can possibly be found.

Some decades ago, the hunt for clues passed largely into the hands of natural scientists. Concentrating on the earlier set of Bronze Age collapses, researchers began to find a range of evidence that suggested that natural causes rather than human actions, may have been initially responsible. There began to be talk of climate change, volcanic activity, and earthquakes -

and some of this material has now found its way into standard historical accounts of the period.

Agreement, however, there has never been. Some researchers favoured one type of natural cause, others favoured another, and the problem remained that no single explanation appeared to account for all the evidence.

Over the past 15 years or so, however, a new type of 'natural disaster' has been much discussed and is beginning to be regarded, by many scholars, as the most probable single explanation for widespread and simultaneous cultural collapse, but not only in the Bronze Age but at another times as well. The new theory has been advanced largely by astronomers, and remains almost completely unknown amongst archaeologists (a few notable exceptions include the dendrochronologist Prof. Mike Baillie of Queen's University, Belfast, and Dr. Euan MacKie at Glasgow University). The new idea is that these massive cultural disasters were caused by the impact of comets or other types of cosmic debris on the Earth.

The hunt for natural causes for these human disasters began when the Frenchman Claude Schaeffer, one of

EVAC & Other Events: 1998

	Mtng	Local	DS	Other
Jan	14	17	24	
Feb	11	21	28	
Mar	11	21*	28*	21: EVAC Cookout* 28: Messier Marathon*
Apr	8	18	25*	4: Astronomy Day 19-26: Texas Star Party 25: Sentinel Star Gaze*
May	13	16	23	22-25: Riverside TMC
Jun	10	20	27	13-20: Grand Canyon SP 27-28: Universe '98
Jul	8	18	25	24-25: Stellafane
Aug	12	15	22	
Sep	9	12	19	11-13: Astrofest
Oct	14	10	17*	17: All-AZ Star Party*
Nov	11	14	21	
Dec	9	12	19	

the leading archaeologists of his time, published his book "Stratigraphie Comparee et Chronologie L'Asie Occidentale" in 1948. Schaeffer analysed and compared the destruction layers of more than 40 archaeological sites in the Near and Middle East, from Troy to Tepe Hissar on the Caspian Sea and from the Levant to Mesopotamia. He was the first scholar to detect that all had been totally destroyed several times in the Early, Middle and Late Bronze Age, apparently simultaneously. Since the damage was far too excessive and did not show signs of military or human involvement, he argued that repeated earthquakes might have been responsible for these events.

At the time he published, Schaeffer was not taken seriously by the world of archaeology. Since then, however, natural scientists have found widespread and unambiguous evidence for abrupt climate change, sudden sea level changes, catastrophic inundations, widespread seismic activity and evidence for massive volcanic activity at several periods since the last Ice Age, but particularly at around 2200 BC, give or take 200 years. Areas such as the Sahara, or around the Dead Sea, were once farmed but became deserts. Tree rings show disastrous growth conditions at c 2350 BC, while sediment cores from lakes and rivers in Europe and Africa show a catastrophic drop in water levels at this time. In Mesopotamia, vast areas of land appear to have been devastated, inundated, or totally burned.

Scholars who, following Schaeffer, favour earthquakes as the principal cause of civilisation collapse argue that the world can expect vast earthquakes every 1000 - 2000 years, leading to widespread abandonment of sites; while scholars who prefer climate change as the principal cause argue that severe droughts caused agriculture to fail and that societies inexorably fell apart as a result.

Yet what was the cause of these earthquakes, eruptions, tidal waves, fire-blasts and climate changes? By the late 1970s, British astronomers Victor Clube and Bill Napier of Oxford University had begun to investigate cometary impact as the ultimate cause. Then in 1980, the Nobel prizewinning Luis Alvarez and his colleagues published their famous paper in *Science* that argued that a cosmic impact had led to the extinction of the dinosaurs. He showed that large amounts of the element iridium present in geological layers dating from about 65 million BC had a cosmic origin.

Alvarez's paper had immense influence and stimulated further research by such British astronomers as Clube and Napier, Prof. Mark Bailey of the Armagh Observatory, Duncan Steel of Spaceguard Australia, and Britain's best known astronomer Sir Fred Hoyle. All now support the theory of cometary impact and

loosely form what is now known as the British School of Coherent Catastrophism.

These scholars envisage trains of cometary debris which repeatedly encounter the Earth. We know that tiny particles of cosmic material penetrate the atmosphere every day, but their impact is insignificant. Occasionally, however, cosmic debris measuring between one and several hundred metres in diameter strike the Earth and these can have catastrophic effects on our ecological system, through multimegaton explosions of fireballs which destroy natural and cultural features on the surface of the Earth by means of tidal-wave floods (if the debris lands in the sea), fire blasts and seismic damage.

Depending on their physical properties, asteroids or comets that punctuate the atmosphere can either strike the Earth's surface and leave an impact crater, such as the well-known Barringer Crater in Arizona caused by an asteroid made of iron some 50,000 years ago. At least ten impact craters around the world dating from after the last Ice Age, and no fewer than seven of these date from around the 3rd millennium BC - the date of the widespread Early Bronze Age collapses - although none occurred in the Near East.

Alternatively, comets and asteroids can explode in the air. A recent example - known as the Tunguska Event - occurred in 1908 over Siberia, when a bolide made of stone exploded about 5 km above ground and completely devastated an area of some 2,000 km through fireball blasts. The cosmic body, although thought to have measured only 60 m across, had an impact energy of about 40 megaton, three times as great as the Arizona example (about 15 megaton), and was equivalent to the explosion of about 2,000 Hiroshima-size nuclear bombs - even though there was no actual physical impact on the Earth. (The object that destroyed the dinosaurs, by contrast, is thought to have had a diameter of about 10 km.) A smaller cometary blast occurred over the Brazilian rainforest in 1930.

In addition to the physical impact of comets, the British astronomers point to occasional massive influx of cosmic dust high above the stratosphere which can cause a dramatic drop of global temperature, leading to the suspension of agriculture; and also the massive influx of cosmic chemicals (associated with dust) with, as yet, incalculable biochemical potentials but which may be harmful to DNA and can trigger evolutionary mutations.






Until recently, the astronomical mainstream was highly critical of Clube and Napier's giant comet hypothesis. However, the crash of comet Shoemaker-Levy 9 on Jupiter in 1994 has led to a change in attitudes. The comet, *-continued on page 5*

February/March 1998

All Times MST

O dark, dark, dark, amid the blaze of noon,
Irrecoverably dark, solar eclipse,
Without all hope of day!

-Milton

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
8 February	9	10 Tomorrow: Full Moon (near Regulus) 3:24 pm	11  EVAC Mtng 7:30 pm at SCC	12	13 SAC Mtng <i>Friday the 13th</i>	14 <i>Valentine's Day</i>
15 Moon near Spica	16 <i>President's Day</i> Sun enters Aquarius	17	18 N. Copernicus, b. 1473	19  Last Quarter 8:29 am	20 Venus at Greatest Brilliancy	21 EVAC Local Star Party
22 Mercury at Superior Conjunction	23 Jupiter at Conjunction Moon near Venus	24	25 Tomorrow: New Moon 10:20 am	26  Total Eclipse	27 Moon near Mars	28 EVAC Deep Sky Star Party
1 March Day 60/305 Julian Day: 2,450,873.5	2 Moon near Head of Cetus	3 G. Mercator, b. 1512	4 Moon occults Aldebaran (daylight)	5 PAS Mtng  First Quarter 1:43 am	6	7 J. Herschel, b. 1792
8	9	10 Mercury 1° NW of Mars	11 EVAC Mtng 7:30 pm at SCC	12  Penumbral Eclipse	13 SAC Mtng Yesterday: Full Moon 9:35 pm	14 A. Einstein, b. 1879

Caribbean Eclipse

M. Aaron McNeely, Editor

On February 26 lucky observers in the Caribbean will be able to witness one of nature's grandest spectacles, a **total eclipse of the Sun**. A total solar eclipse is visible only along a narrow path over the Earth's surface. Partial eclipses of lessening degree are visible at increasing distances from the path of totality. Phoenix lies just on the edge of the zone of visibility. To compensate, we will be able to view a **penumbral eclipse of the Moon** on March 12. The Moon will drift through the outer, lighter-shaded zone of Earth's shadow, the penumbra. Maximum immersion occurs at 9:20 pm. Penumbral eclipses are very interesting and pretty to observe, depending on the degree of the Moon's immersion in Earth's shadow. For this event 73.5 % of the Moon's visible disk will be obscured by the gray shading of the penumbra. For those familiar with the Moon's regular appearance, the penumbral shading should be very evident. Use binoculars or a low power eyepiece to view the entire lunar disk.

Evening & Morning Planets

February begins with three evening planets, **Jupiter, Mars, and Saturn**. Jupiter gradually sinks

February 1998							March 1998						
S	M	T	W	Th	F	S	S	M	T	W	Th	F	S
1	2	3	4	5	6	7	1	2	3	4	5	6	7
8	9	10	11	12	13	14	8	9	10	11	12	13	14
15	16	17	18	19	20	21	15	16	17	18	19	20	21
22	23	24	25	26	27	28	22	23	24	25	26	27	28
							29	30	31				

Lunar Almanac: 1998				
	FQ	Full	LQ	New
Jan	5	12	20	27
Feb	3	11	19	26
Mar	5	12	21	27
Apr	3	11	19	26
May	3	11	18	25
June	1	9	17	23
July	1	9	16	23
	31			
	Full	LQ	New	FQ
Aug	7	14	21	30
Sep	6	12	20	28
Oct	5	12	20	28
Nov	3	10	18	26
Dec	3	10	18	26

into the solar glare achieving conjunction on the 23rd. Mars keeps ahead of the Sun, it will achieve conjunction in May. Mercury enters the evening sky at superior conjunction on the 23rd. It will lie close to Mars on March 10th.

In the morning sky, Venus climbs higher above the horizon and achieves greatest brilliancy (mag. -4.6) on February 20th. Venus will also achieve its greatest altitude for this apparition at the end of February. The Moon lies near Venus on February 23rd.

Zodiacal Light

The evening zodiacal light is especially prominent in February and March. From a dark location, look in the west after sunset for a diffuse cone of light extending up from the horizon. This is the combined light of innumerable tiny particles suspended in the plane of the solar system. The glow appears to extend along the ecliptic or zodiac, hence the name.

Midnight Culminations

Date	Constellation	Star
13 Feb	Vela	
22 Feb	Sextans	
23 Feb	Leo Minor	
24 Feb	Antlia	
1 Mar	Chameleon	
1 Mar	Leo	Regulus
11 Mar	Ursa Major	
12 Mar	Crater	

Midnight culmination marks the time of the greatest visibility of an object or constellation, they are at "opposition" with respect to the Sun.

In Astronomical History

February 8-28

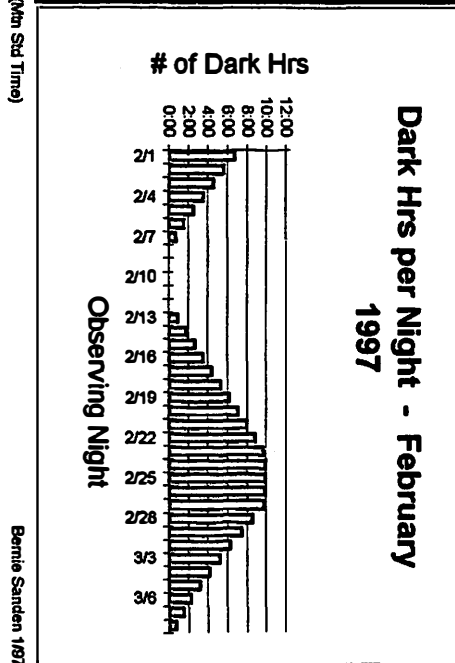
- Feb 15, 1564: Galileo born.
- Feb 17, 1600: Giordano Bruno burnt alive for espousing Copernican ideas.
- Feb 18, 1930: Clyde Tombaugh discovers Pluto.
- Feb 19, 1473: Nicholas Copernicus born.
- Feb 23, 1987: Appearance of Supernova 1987A, brightest in 383 years.

March 1-14

- Mar 4, 1835: Giovanni Schiaparelli, b.
- Mar 5, 1512: Gerardus Mercator, b.
- Mar 7, 1792: John Herschel, b.
- Mar 7, 1837: Henry Draper, b.
- Mar 13, 1781: William Herschel discovers Uranus.
- Mar 13, 1855: Percival Lowell, b.
- Mar 14, 1879: Albert Einstein, b.

Dark of the Moon Table -- February 1998

OBSERVING NIGHT	START OF DARK		END OF DARK		TOTAL DARK
	DATE	TIME	DATE	TIME	
SUN/MON	2/11	11:15 PM	2/2	5:59 AM	6:44
MON/TUES	2/3	12:20 AM	2/3	5:56 AM	5:38
TUES/WED	2/4	1:23 AM	2/4	5:56 AM	4:35
WED/THURS	2/5	2:25 AM	2/5	5:57 AM	3:32
THURS/FRI	2/6	3:24 AM	2/6	5:56 AM	2:32
FRI/SAT	2/7	4:20 AM	2/7	5:56 AM	1:38
SAT/SUN	2/8	5:12 AM	2/8	5:55 AM	0:43
SUN/MON	none	none	none	none	---
MON/TUES	none	none	none	none	---
TUES/WED	none	none	none	none	---
WED/THURS	2/12	7:34 PM	2/12	7:35 PM	0:01
THURS/FRI	2/13	7:35 PM	2/13	8:29 PM	0:54
FRI/SAT	2/14	7:36 PM	2/14	8:22 PM	1:46
SAT/SUN	2/15	7:36 PM	2/15	10:15 PM	2:39
SUN/MON	2/16	7:37 PM	2/16	11:08 PM	3:31
MON/TUES	2/17	7:38 PM	2/18	12:01 AM	4:23
TUES/WED	2/18	7:39 PM	2/19	12:55 AM	5:16
WED/THURS	2/19	7:39 PM	2/19	12:55 AM	5:16



Bernie Sanden 1987

NOTE: Applies to Phoenix area (4th Std Time)

EOT = End of Astronomical Twilight

MR = Moonrise

SOT = Start of Twilight

MS = Moonset

-continued from page 2 watched by the world's observatories, was seen to split into 200 pieces and slam into different parts of the planet over a period of several days. A similar impact on Earth would have been devastating.

According to current knowledge, Tunguska-like impacts occur every 100 years or so. It is, therefore, not farfetched to hypothesise that a super-Tunguska may occur every 2000, 3000 or 5000 years and would be capable of triggering ecological crises on a continental or even global scale. In the past, skeptics have demanded the evidence of a crater before they would accept an argument of cosmic impact, but it is now become understood that no crater is necessary for disastrous consequences to ensue. The difficulty this leaves scholarship, however, is that in a Tunguska Event no direct evidence is left behind. It may be impossible to prove that one ever took place in the distant past.

The extent to which past cometary impacts were responsible for civilisation collapse, cultural change, even the development of religion, must remain a hypothesis. But in view of the astronomical, geological and archaeological evidence, this 'giant comet' hypothesis should no longer be dismissed by archaeologists out of hand.

Dr. Benny J Peiser is a historian and anthropologist at Liverpool John Moores University, his article originally appeared in the December, 1997 issue of British Archaeology. For more information about neo-catastrophism investigate the following webpage—<http://www.knowledge.co.uk/xxx/cat/sis/cambconf.htm>

EVAC Meeting Highlights

Don Wrigley, Secretary
January 14, 1998

The meeting was called to order at 7:40 pm by President Sheri Cahn. Sixty members were in attendance, including six guests. Sheri introduced the club officers and board members and gave a rundown of the events planned for the spring schedule.

A motion was made to purchase a slide projector for the club. After some discussion we decided that one of the members will see what sort of a price we can get at Tempe Camera, and we will vote on the issue next month.

Our show and tell speaker was Bill Peters, who talked about the occultation of the asteroid Artemis. He showed a video of the occultation taken by Pierre Schwaar using a video enhancer, and showed a map of

the asteroid that was based on the timing observations of that occultation. For the benefit of those who might be interested in being involved in future occultation timings, Bill explained that there are essentially four things that are needed in order to participate: telescope; short wave radio or time cube to record GMT; tape recorder or cam-corder; asteroid occultation report form.

Bill brought some samples of the asteroid occultation report form and left them on the front table for those who were interested.

The main speaker was astrophotographer and fellow EVAC member Chris Schur. Chris' topic for the night was the Schmidt camera, and he highlighted the presentation with a demonstration of the workings of his 8-inch Schmidt camera and a slide presentation displaying its awesome capability to produce stunning wide field astrophotos.

Chris explained in his talk that regular lenses, such as those found on a refractor, cannot produce wide flat fields. Lenses faster than f/5 produce severe coma and chromatic aberration. Attempts were made to overcome this problem with two mirrors. One way was to use a parabolic main mirror with an ellipsoid secondary. The only problem was that no one could make it. In the 1930's Bernard Schmidt came up with an idea using both lenses and mirrors. His camera had a spherical mirror, a thin corrector plate in front and a curved film plate. The resulting camera had a 30° field of view. In the 1960's Tom Johnson (the founder of Celestron) wanted to mass produce this type of telescope, and found a way to mass produce the Schmidt corrector plate. The result was the Celestron 8-inch SCT, one of the most widely marketed amateur telescopes ever produced. Celestron also sold 5, 8, and 14-inch Schmidt cameras. However, only a handful of 14-inch cameras were made, as they were so sensitive to vibration that they would go out of focus in shipment. The film plate on the Schmidt camera must remain within a tolerance range of one thousandth of an inch in order to be in focus. This spacing is provided using bars made of either covar or envar, the only two substances which will resist thermal expansion throughout the full range of temperatures.

The difficulties inherent in using Schmidt cameras are more than compensated by the photographs Chris is able to produce with them. The remarkable photo of M-31, taken with the 8-inch Schmidt camera, showing 6° of galaxy and the warping of its spiral arms due to its companion galaxies in an 8 minute exposure, is a case in point. Other slides showing the Cygnus Superbubble, the Rosette Nebula with Bok globules, the California Nebula showing faint north and south extensions, the region of Orion's Belt showing the faint outer

extensions of the Orion Nebula, were equally remarkable and represent only a small sample of the magnificent presentation by Chris Schur.

February's Guest Speaker

Our guest speaker for the February 11th meeting is Ryan Wyatt, manager of the Dorrance Planetarium at the Arizona Science Center. Join Mr. Wyatt in an exciting exploration of the "Invisible Universe," the development of infrared astronomy.

EVAC Board Meeting Highlights January 8, 1998

President Sheri Cahn called the meeting to order at 6:55 pm. In attendance were Robert Kerwin, Kathy Doyle, Tom Polakis, Gary Zimthum, Bernie Sanden, Steve Bell, Dave Richardson, Joe Goss, Kathy Woodford, Enrico Alvarez, and Don Wrigley. There were 12 items on the agenda, the disposition of each is as follows:

1.) *Picnic & Cookout*: Kathy Woodford will contact Lost Dutchman Park and make arrangements. Dave Richardson and Steve Bell will help out on grill. Joe Goss and Kathy Woodford will get food. The cookout will be held at Lost Dutchman Park on March 21. (MSP)

2.) *Astronomy Day (April 4th)*: Sheri will contact Ryan Wyatt, director of the Arizona Science Center, about having a star party at the Center on Astronomy Day. She will contact Kim (the EVAC faculty advisor at SCC) about having our annual SCC Star Party on a weeknight when there would be a better chance of student attendance. (MSP)

3.) *Adopt-A-Highway*: To be held on April 11 or April 18. Sheri will check with Sam.

4.) *All-Arizona Star Party*: We decided that the All-Arizona Star Party will be held on October 17. (MSP)

5.) *Name Tags*: Kathy Woodford will take orders for name tags and Robert Kerwin will get them made up.

6.) *EVAC Party Line*: Robert Kerwin reports that the Party Line is underutilized and wants suggestions to make the system work better. We decided that he will periodically explain how the hotline works at the business meeting and place an article in an upcoming newsletter.

7.) *Mt. Graham Field Trip/Discovery Park*: Tom Polakis will call and find out how many visitors they can handle.

8.) *Honorarium*: Henceforth all featured speakers will receive fifty dollars. (MSP)

9.) *New Business*: Dave Richardson voiced concerns about lack of membership contact with visitors at meetings and offered to take charge of contacting visitors. We will have a visitor sign-up sheet at meetings. Visitors who leave their address and phone number will be contacted by Dave and will receive a complimentary newsletter.

10.) *Beginner Sessions*: Sheri will check and see if the room will be available at 7:00 pm for beginner sessions. Don Wrigley will give a planetarium show on April 18th at the Sierra Entrada homeowners clubhouse in Apache Junction. There will be a sign-up sheet for the show at future meetings.

11.) *Treasurer's Report*: Kathy Woodford presented the treasurer's report and placed it on file for audit.

12.) *Next Board Meeting*: The next Board Meeting will be Friday, April 8th at Bernie Sanden's home. We adjourned the Meeting at 9:03 pm.

For Sale

Canon AE-1 SLR camera body—\$50. (With body cap. Shutter-priority automatic, not the programmable version. Non-working condition; needs shutter and meter repair). Canon 50 mm f/1.8 lens—\$30. (With UV[0] filter, lens cap). Canon 200 mm f/4 lens—\$120. (With soft case, skylight filter, lens cap, back cap). Tokina 28-85 mm f/3.5 zoom lens—\$120. (With soft case, skylight filter, lens cap, back cap, polarizer; fits Canon). All lenses are in fairly good condition. Note: these are NOT auto-focus lenses. Vivitar 3X Teleconverter—\$30. (With front and back cap; good condition; fits Canon). Will sell individually or everything for \$300. Will not ship; you must pick up, or I can bring to a club meeting. *Contact Joe Orman—602/675-2470.*

Sonotube from 8" f/6 Dobsonian - \$10. Lumicon vinyl endcap for 13.1" Odyssey - \$10. White nylon thumbscrews (10-32 thread) to replace metal screws on Celestron /Meade/Orion finderscope brackets - \$2/set. Kodak 140 Carousel slide trays (14 available) - \$5/each. *Contact Sam Herchak—924-5981.*

Editor's Corner

M. Aaron McNeely, Editor
amcneely@primenet.com

I would like to thank Dr. Benny Peiser for permission to reprint "Comets and Disaster in the Bronze Age." I would also like to thank the following EVAC members for their contributions and help in the preparation of this newsletter: Kathy Doyle, Sam Herchak, Bernie Sanden, Bill Smith, Kathy Woodford, and Don Wrigley.

1998 EVAC Lunar Occultation Predictions

by Sam Herchak, EVAC

Included in this newsletter are predictions of occultations visible from the Phoenix area in 1998. I computed these with the DOS program Occult 4.06 by David Herald of the International Occultation Timing Association (IOTA) running on my PowerPC Macintosh computer with the application "Virtual PC" and Windows 95. The predictions are for the coordinates of the Phoenix airport and have about 2 second accuracy at that point (notice some daytime events for Aldebaran and Mars). Although visual occultation timings (vs. video) for the Moon are of little scientific value now, they are still beautiful to watch. Lunar grazing and asteroid occultation timings however are of great value. Any members wishing to help collect this type of data should check out IOTA at the following website or contact myself (924-5981): <http://www.sky.net/~robinson/iotandx.htm>. The format for the predictions is as follows:

Day—The day of the event.

Time—The Universal Time, in hours, minutes and seconds.

P—The type of event (phase).

D—disappearance.

R—reappearance.

Gr—grazing occultation at site. At mid-occultation, or closest approach, the star is less than 4" from the limb of the Moon (either above or below).

Star No—the star identification number from the USNO XZ catalogue

D—a double star code.

Sp—the star's spectral type.

Mag—the star's magnitude.

% illum—the percent illumination of the Moon. If followed by a +, values are for a waxing Moon; - for a waning Moon and e for illumination during a lunar eclipse.

Elon—the elongation of the Moon from the sun, in degrees. During a lunar eclipse, this gives the percent distance of the star from the center of the umbral shadow, and is followed by 'U'.

Sun Alt—the altitude of the sun, but only if it is greater than -12 deg.

Moon Alt—the altitude of the Moon.

Moon Az—the azimuth of the Moon.

CA Cusp Angle—the angle of the event around the limb of the Moon, measured from the nearest cusp. Negative values indicate a bright limb event. The cusps are usually N (north) or S (south), but near full Moon can be E (East) or W (west). If a lunar eclipse is in progress, CA gives the % distance from the center of the umbra, and is followed by a 'U'. Values up to 103% are possible.

PA—Position Angle - the angle of the event around the limb of the Moon, measured counterclockwise from true (celestial) north.

WA—Watts Angle - the angle of the event around the limb of the Moon, measured eastward from the Moon's north pole. Essential for reappearances, as it locates the event with reference to lunar features. Use a protractor to mark a map of the Moon around the circumference at 10 deg intervals, starting at the north pole. Mare Crisium is at

about 300 deg.

Long Libn—the libration of the Moon in longitude, as seen from the site at the time of the event.

Lat Libn—the libration of the Moon in latitude. The longitude and latitude librations are the selenographic coordinates on the Moon's surface through which a line from the Moon's center to the prediction site on the Earth passes.

A—coefficient for correcting the prediction for changes in site location. The units are seconds of time per minutes of arc. The correction to the prediction for a change in site, in seconds of time, is found by multiplying A by the change in site longitude (in minutes of arc, positive to the East) from the prediction site.

B—same as for A, but for changes in latitude (positive to the north).

EVAC Lunar Occultation Predictions for Phoenix

E.Long. -112 00 30 Lat. +33 26 15 Alt. 345 m. Telescope dia 75 mm.

1998 January

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B
	h m s		No D			ill		Alt	Alt Az	o	o	o	Lib	Lib	m/o	m/o
15	7 32 56	R	1442	M8	4.4	93-	149		54 120	58S	260	239	+3.9	+2.1	+2.2	+1.4
			1442 = R LEO, 4.40 to 11.30V, Var Type M, Phase .02													

1998 February

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B
	h m s		No D			ill		Alt	Alt Az	o	o	o	Lib	Lib	m/o	m/o
3	4 15 35	D	322	G0	5.7	41+	79		36 255	83N	64	85	+3.1	+5.6	+1.2	-0.0
3	5 23 25	D	327	kG5	4.5	41+	80		22 266	48N	29	50	+3.0	+5.7	+0.7	+1.5
			327 = 5.3 & 5.3, Sepn 0.100, PA 90													
6	3 16 22	D	741	xK0	5.7	73+	117		74 176	88N	78	85	+5.6	+7.0	+2.4	+0.6
			741 = 6.5 & 6.5, Sepn 0.080, PA 240													
16	14 03 44	R	1941	M0	4.8	78-	124	-2	34 234	42N	338	315	-3.1	-4.0	+1.1	-3.3

1998 March

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B
	h m s		No D			ill		Alt	Alt Az	o	o	o	Lib	Lib	m/o	m/o
4	23 16 08	D	692	aK5	0.8	46+	85	25	59 115	43N	35	43	+6.9	+7.2	+1.1	+3.1
			692 = 1.1 & 11.3, Sepn %132.4, PA 32: & 13.6, Sepn 30.800, PA 110													
			692 = Alpha TAU, 0.75 +/- 0.95V, Var Type LB:													
5	0 20 46	R	692	aK5	0.8	46+	86	13	69 141	-59N	294	302	+6.7	+7.1	+2.7	-1.0
			692 = 1.1 & 11.3, Sepn %132.4, PA 32: & 13.6, Sepn 30.800, PA 110													
			692 = Alpha TAU, 0.75 +/- 0.95V, Var Type LB:													
11	8 18 21	D	1486	aK2	4.6	97+	160		54 236	87S	109	88	+3.5	+1.7	+1.8	-1.5
			1486 = 4.6 & 13.6, Sepn 7.9, PA 44													
18	11 30 19	R	2223	tK0	4.0	77-	122		42 183	85S	276	262	-5.4	-5.9	+2.6	-0.3
			2223 = 4.7 & 4.9, Sepn 0.100, PA 201: & 11.2, Sepn 41.700, PA 153													

1998 April

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B
	h m s		No D			ill		Alt	Alt Az	o	o	o	Lib	Lib	m/o	m/o

1 2 15 05 D 635 K0 3.9 21+ 55 -7 45 259 18S 156 166 +5.6 +7.0 +0.7-8.3
 Graze of 635 K0 nearby at Lat = +32.74 -0.11(E.Long +112.01), CA = 0.9S
 1 2 26 21 Gr 635 K0 3.9 21+ 55 -9 43 261
 Closest distance to graze path is 76km at azimuth 188
 7 2 39 11 D 1442 M8 4.4 81+ 128 -10 59 129 49S 149 129 +5.7 +2.0 +1.7-2.6
 1442 = R LEO, 4.40 to 11.30V, Var Type M, Phase .99
 28 16 20 13 D 692aK5 0.8 8+ 32 44 18 81 30N 31 40 +6.0 +7.2 -0.3+2.5
 692 = 1.1 & 11.3, Sepn %132.4, PA 32: & 13.6, Sepn 30.800, PA 110
 692 = Alpha TAU, 0.75 +/- 0.95V, Var Type LB:
 28 17 02 41 R 692aK5 0.8 8+ 32 52 26 87 -63N 298 306 +6.0 +7.2 +1.0+0.1
 692 = 1.1 & 11.3, Sepn %132.4, PA 32: & 13.6, Sepn 30.800, PA 110
 692 = Alpha TAU, 0.75 +/- 0.95V, Var Type LB:
 29 3 27 39 D 741xK0 5.7 10+ 36 15 281 89N 91 97 +5.0 +7.0 +0.2-1.0
 741 = 6.5 & 6.5, Sepn 0.080, PA 240

1998 May

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B
	h m s		No	D		ill	Alt	Alt	Az	o	o	o	Lib	Lib	m/o	m/o
5	5 37 27	D	1525	M0	5.6	67+	110		46 245	47S	154	132	+4.7	+0.9	+0.7	-3.2
			1525 = DE LEO, 5.60 +/- 0.07V, Var Type SRB:													
9	8 20 44	D	1941	M0	4.8	95+	155		37 229	29N	57	34	-0.8	-4.0	+2.7	+0.8
13	6 09 03	R	2399	K0	5.0	97-	160		27 138	74N	281	274	-4.1	-5.9	+1.6	+0.6

1998 June

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B
	h m s		No	D		ill	Alt	Alt	Az	o	o	o	Lib	Lib	m/o	m/o
8	4 48 55	D	2223t	K0	4.0	96+	157		39 158	68N	92	78	-2.6	-5.8	+2.5	+0.4
			2223 = 4.7 & 4.9, Sepn 0.100, PA 200: & 11.2, Sepn 41.700, PA 153													
19	12 01 44	R	249	K0	4.7	27-	62	-4	36 110	84S	241	263	-0.7	+5.8	+1.0	+1.7
22	12 05 22	D	692a	K5	0.8	4-	22	-3	10 77	-55N	33	41	+3.6	+7.2	-0.4	+2.3
			692 = 1.1 & 11.3, Sepn %132.4, PA 32: & 13.6, Sepn 30.800, PA 110													
			692 = Alpha TAU, 0.75 +/- 0.95V, Var Type LB:													
22	12 46 17	R	692a	K5	0.8	4-	22	4	18 82	40N	297	305	+3.7	+7.2	+0.6	+0.3
			692 = 1.1 & 11.3, Sepn %132.4, PA 32: & 13.6, Sepn 30.800, PA 110													
			692 = Alpha TAU, 0.75 +/- 0.95V, Var Type LB:													

1998 July

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B
	h m s		No	D		ill	Alt	Alt	Az	o	o	o	Lib	Lib	m/o	m/o
29	4 17 31	D	1821o	F0	2.9	28+	64		17 257	19N	41	17	+0.8	-3.5	+1.2	+2.0
			1821 = 3.5 & 3.5, Sepn 3.7													
29	4 17 32	D	X54027	F0	3.5	28+	64		17 257	19N	41	17	+0.8	-3.5	+1.2	+2.0

1998 August

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B
	h m s		No	D		ill	Alt	Alt	Az	o	o	o	Lib	Lib	m/o	m/o
3	6 06 32	D	2399	K0	5.0	75+	120		26 224	89S	102	94	-5.0	-6.0	+1.8	-1.3
16	10 49 13	R	741x	K0	5.7	32-	68		35 91	58N	294	300	+5.3	+7.1	+1.3	+0.2
			741 = 6.5 & 6.5, Sepn 0.080, PA 240													

1998 September

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B	
	h	m	s	No	D		ill	Alt	Alt	Az	o	o	o	Lib	Lib	m/o	m/o
Graze of 249 K0 nearby at Lat = +33.78 +0.43(E.Long +112.01), CA = 9.2N																	
9	6	14	44	Gr	249	K0	4.7	89-	141								
Closest distance to graze path is 33km at azimuth 332																	
9	6	19	17	R	249	K0	4.7	89-	141								
10	9	55	44	R	405v	F0	4.4	79-	125								
405 = 4.5 & 8.5, Sepn 0.050, PA 133																	

1998 October

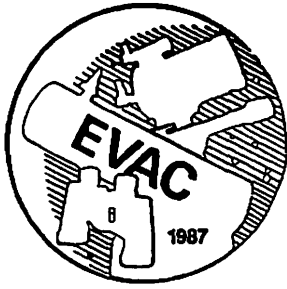
Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B	
	h	m	s	No	D		ill	Alt	Alt	Az	o	o	o	Lib	Lib	m/o	m/o
9	8	54	43	R	635	K0	3.9	82-	130								
10	13	12	03	R	814t	B3	5.3	71-	115								
814 = 5.7 & 6.6, Sepn 0.108, PA 98: & 10.1, Sepn 10.100, PA 306																	
30	1	15	50	D	3206	F0	5.2	66+	109								
33S 127 148 -7.3 +0.4 +2.8-1.2																	

1998 November

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B	
	h	m	s	No	D		ill	Alt	Alt	Az	o	o	o	Lib	Lib	m/o	m/o
3	3	09	33	D	249	K0	4.7	98+	164								
10	13	24	56	R	1336	A3	5.2	55-	95								
13	10	00	18	R	1644	A0	4.1	26-	62								
13	18	33	15	D	Mars		1.5	24-	59								
Duration of Partial Stage for Disk = 15 secs																	
13	19	40	45	R	Mars		1.5	24-	59								
Duration of Partial Stage for Disk = 13 secs																	
14	11	37	16	R	1749	K0	6.1	18-	50								
24	2	48	39	D	2902v	G5	6.0	21+	55								
2902 = 6.8 & 6.8, Sepn 0.050																	
26	4	30	08	D	3173j	G5	5.3	40+	79								
3173 = 5.5 & 7.5, Sepn 0.001																	
27	2	11	02	D	3307v	A0	4.9	50+	91								
3307 = 5.7 & 5.7, Sepn 0.050																	
30	4	47	29	D	192	A2	5.3	83+	131								

1998 December

Day	Time	P	Star	Sp	Mag	%	Elon	Sun	Moon	CA	PA	WA	Long	Lat	A	B	
	h	m	s	No	D		ill	Alt	Alt	Az	o	o	o	Lib	Lib	m/o	m/o
4	12	25	36	R	832	M1	4.2	99-	168								
832 = CE TAU, 4.23 to 4.54V, Var Type SRC																	
10	8	52	01	R	1609c	F0	4.7	53-	93								
1609 = 4.7 & 11.0, Sepn 4.5, PA 271: & 9.0, Sepn 56.244, PA 309																	
22	0	50	00	D	2987z	F0	5.0	9+	35								
2987 = 5.2 & 7.2, Sepn 1.116, PA 5: & 6.7, Sepn 56.768, PA 149																	
29	0	39	05	D	405v	F0	4.4	78+	124								
405 = 4.5 & 8.5, Sepn 0.050, PA 133																	



East Valley Astronomy Club

Membership Form

Please complete the information on the form and return to the address below along with a check payable to EVAC for the appropriate dues amount. See below:

Kathy Woodford, EVAC Treasurer
PO Box 213
Apache Junction, AZ 85217
Call: 857-3438 evenings

Enclosed:

- ___ \$20 annual
- ___ \$15 April -Dec.
- ___ \$10 July - Dec.
- ___ \$ 5 Sept.-Dec.

Please Print

Indicate any information
you want kept confidential.

Name _____

Address _____

_____ Zip _____

Phone # _____

Email address _____

New

Renewal

Change of Address

If you have a web page or URL, please indicate address _____

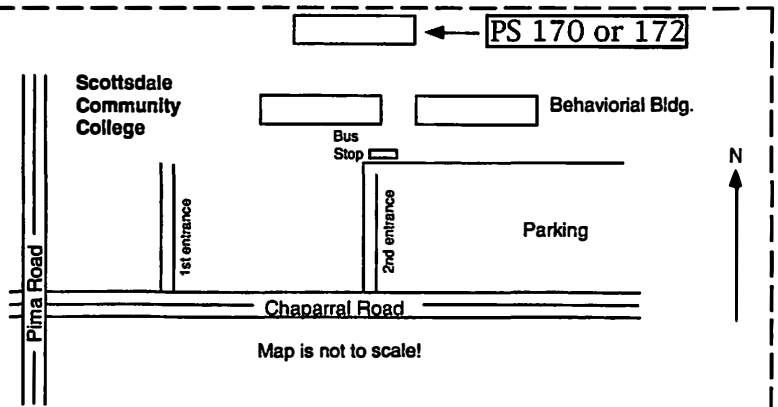
How did you hear about the East Valley Astronomy Club? _____

Major area(s) of interest:

- General observing
- Lunar observing
- Planetary observing
- Telescope Making
- Astrophotography
- Deep Sky
- CCD/Computer
- Other _____

CLIP AND SAVE

Monthly business meetings
are on the 2nd Wednesday of
each month at 7:30pm.



- 1998 Lunar Occultations
 - Schmidt Camera Photography
 - Eclipses
 - Bronze Age Disasters
- IN THIS ISSUE:**

Next EVAC Meeting — February 11 Thank you for renewin

Valued member since 1/17/92



EAST VALLEY ASTRONOMY CLUB
 M. Aaron McNeely, Editor
 4402 North 36th Street, #22
 Phoenix, AZ 85018

EAST VALLEY ASTRONOMY CLUB—1998

EVAC Homepage—<http://www.goodnet.com/~rkerwin/evac/evac.html>

PRESIDENT: Sheri Cahn 602/841-7034	VICE-PRESIDENT: Kathy Doyle 602/953-8184	TREASURER: Kathy Woodford 602/857-3438	SECRETARY: Don Wrigley 602/982-2428	PROPERTIES: Enrico Alvarez 602/837-0486
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MEMBERSHIP & SUBSCRIPTIONS: \$20 per year; renewed in December. Reduced rates to *Sky & Telescope* and *Astronomy* available. Contact Kathy Woodford, P.O. Box 213, Apache Junction, AZ 85217, 602/857-3438.

CLUB MEETINGS: Second Wednesday of every month at the Scottsdale Community College, 7:30 pm. Normally Room PS 170 or 172 in the Physical Sciences Building.

NEWSLETTER: Mailed out the week before the monthly Club meeting. Send your thoughts and stories to M. Aaron McNeely, 4402 North 36th Street, #22, Phoenix, AZ 85018, 602/954-3971. Email—amcneely@primenet.com

CHANGES: Address, Phone Number, or Email: Send to Bill Smith, 1663 South Sycamore, Mesa, AZ 85202, 602/831-1520. Email—bsmithaz@aol.com.

EVAC LIBRARY: The library contains a good assortment of books, downloaded imagery, and helpful guides and is usually brought to the Club meetings. Contact Enrico Alvarez for complete details, 602/837-0486.

BOOK DISCOUNTS: Great savings for members through Kalmbach and Sky Publishing. Contact Don Wrigley, 423 West 5th Avenue, Apache Junction, AZ, 602/982-2428.

EVAC PARTY LINE: Let other members know in advance if you plan to attend a scheduled EVAC observing session. Contact Robert Kerwin, 602/837-3971. Email: p24493@email.mot.com