Smoky Mountain Astronomical Society

Volume 28, Number 1
January 2005

S.C.R.A.P.S.

Society's ChRonological Astronomical PaperS

From the President - Michael McCulloch

January 14th SMAS MEETING

Where: PSTCC, Main Campus, Hardin Valley Road
Alexander Bldg, Room 223
Time: 7 - 9 PM

Guest Speaker

Dr. Christian Cardall, of UT, will speak to us about supernova research currently in progress at UT and Oak Ridge. Dr. Cardall is involved with computer simulations of supernovae in large stars. This lecture is suitable for a general audience and will introduce even the beginner to the wonderful things science has revealed to us about the universe in which we live.

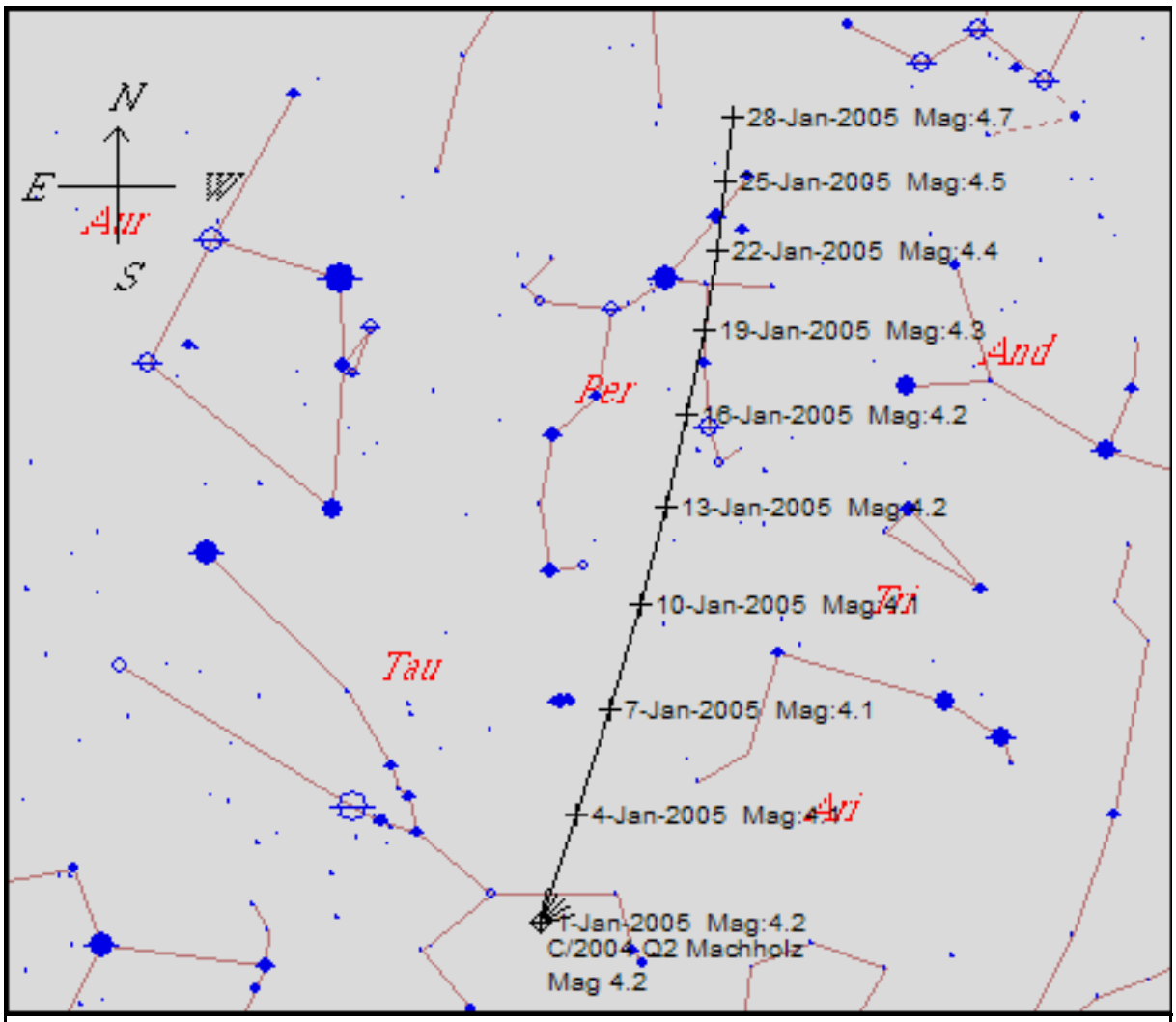
Comet Machholz in January

Comet Machholz is rapidly brightening in the southern winter sky. It is currently in the constellation Taurus and is moving higher in the sky each evening. The comet itself is predicted to brighten to magnitude 4.0, which should be visible to the naked eye in rural locations. The dust and ion tails are visible in photographs, but are currently too faint to be seen visually (as of late December). (*Photograph Opposite)*

It is not known if either the dust tail or ion tail will brighten in January, but it may be worth keeping current on the comet's appearance over the coming month. The comet is moving toward its closest approach to earth which will occur on Jan 5/6. A finder chart is included on the following page. The Skyhound comet chasing page is also a good source of data at http://www.skyhound.com/sh/skyhound.html.

Note that the comet will be within 4 degrees of the Pleiades *(page 3)* the nights of January 6-8. This could be an excellent view in a pair of wide-field binoculars and may make for a nice photograph.

(Continued)



Finder chart for comet Machholz (C/2004 Q2) in January 2005

I have enjoyed my time as SMAS president, however I must step down to pursue some major individual goals for my home business and part-time engineering job in 2005. I am sure SMAS will be in good hands over the coming year with new leadership as selected by the membership. Thanks for the support in 2004, and I plan to remain active in SMAS in 2005 in ways other than as an officeholder.

Specific thanks is offered to Erik Iverson and Angela Quick for planning and executing our Astronomy Day activities this past year, Lee Erickson for scheduling excellent speakers for SMAS meetings, Pete Bush for managing SCRAPS, and Mike Fleenor for keeping the SMAS website current. Bob Arr was also of great help behind the scenes.—*Michael*

The Pleiades
Michael McCulloch

The Wiz

Dear Wiz,

I think it's just too darned cold to go out observing in the winter, but I know some people go anyway. What can you say that might change my mind?

F. Balzof

Dear Frazier,

About all I can do is list the pros and cons and some general advice. You'll have to make up your own mind.

****

Pros:

Transparency is greatly improved over summer skies. Jet black sky comes early; you can get 4 hours of observing in before 11 pm.

(Continued)

If you dress properly, you can tolerate really cold temperatures. Multiple thin layers (at least 50% cotton) are far warmer than thick garments. You may want to buy some specialized gear.

A parka hood (not the parka, just the hood) that fastens under the chin, protects the head and neck. (That said, a parka is not a bad idea either. Any outer garment that covers the butt is highly recommended.)

Multiple socks might necessitate oversized high-top shoes. Heated socks can be had at Walmart, and run on a single D battery.

Large pockets on your outer coat will do the most to keep your hands warm. Gloves are an uncertain blessing; heavy ones may cause you to drop eyepieces, or interfere with focusing. Chemical heat pads (kneed them to activate the reaction) will keep the pockets toasty.

Very few, if any, curiosity seekers. Traffic is sparse (virtually no motorcycles).

Fogging of equipment seldom an issue because humidity is too low.

Cons:

If your discomfort threshold is simply too high, it will overwhelm all other considerations. Forget observing, read some good books at home.

The jet stream is often at our latitude. Seeing may be unexpectedly poor in what promises to be a pristine sky. High magnifications may be blurry; be prepared to look at things that don't require high power. Hint: you can see the position of the jet stream(s) before you leave home at:

http://www.weatherimages.org/data/imag192.html
****

General Considerations:

Reflector mirrors need to cool down as do all closed-OTAs before observing begins. Set them outdoors in the shade a couple hours before you leave home.

Your car is your ace-in-the-hold for warming up if you get cold soaked. Engineer some means of shielding your interior lights from ruining your companions' night vision.

If any of your equipment uses batteries, be sure they are fresh (or fully charged). Take

(Continued)

spares, but keep them in an insulated box inside your car.

A Thermos of hot chocolate or coffee also helps (take styrofoam cups, others cool too quickly). Snacks are recommended to keep the energy level up.

One last bit of advice. When you get home, do **NOT** rush your frigid equipment into the warm house. Moisture will condense on metal and glass in a heartbeat. If you can leave them in the car overnight, you can warm them gently the next day in the drier air outside your house.

If you must bring a reflector inside immediately, be sure to leave its end cap on (to keep out the moist indoor air). Point the tube horizontally so that the mirror is standing on edge, rather than flat (to allow the cold boundary layer air to sink away from the mirror surface before it begins pooling condensate).

If you bring in eyepieces immediately, do not open their case (which contains air that's drier than your house's.)

Sounds like a lot of stuff to remember, but if you'll use this document to refresh your memory a couple times, it will become old hat.

Clear skies and warm feet.

"Most peoples' possession of knowledge deprives them of a sense of wonder … I say that after we know all there is to know, there is still wonder and mystery of a deeper kind." - Anaïs Nin

Holiday Gastronomy (Sustenance Selebrating for the Solstice / Christmas Party)

December 3rd. 2004, members of SMAS met and dined at the Knoxville Chop House. About 14 of us were present, plus one Nova Gastronomer (infant)!
Comparative gastronomy was discussed extensively as we examined the gastronomical charts (menu) and made our decisions. As usual, my meal was delicious. And I do not remember, or have successfully repressed, any complaints from the other gastronomers. However, once was not enough and a follow-on Gastronomy party was discussed - the date set to coincide with the impending discovery of the "meateor" Pigasus. This required travel to Texas (as in Roadhouse) in Alcoa, Tennessee.

(Continued)

Incoming “meateor” approaching Texas

Again our intrepid SMAS gastronomers were successful and observed "meateor" Pigasus in person (aka in the flesh). Comparative observation revealed that Pigasus was not, as expected, made of a mix of ice and organic molecules, but rather, was fond of such a mix.

Most SMAS members took home a rack of "meateor" ribs. Some even used a take-out box to do so. One thing we did observe: it took unusually long to observe "meateor" Pigasus without the accompanying organic (BBQ) sauce. Apparently, ordering ribs with BBQ sauce caused a time dilation effect. This resulted in a differential passage of time for SMAS members - with those who ordered BBQ sauce enjoying their "meateor" while slightly younger. Unfortunately, SMAS members were not prepared to observe this phenomenon until it was well underway. Future gastronomers will have to watch for this occurrence carefully. (Or … if you want to try to experience this phenomena yourself, I would suggest a control group of gastronomers order the ribs with BBQ sauce on-the-side and carefully note in your gastronomy journal the times of first contact for those with and without BBQ sauce.) Perhaps some enterprising SMAS member could apply for a government grant to fund regular "meateor" observing on the part of several members.

Respectfully submitted,
Noah Kidding
SMAS lead gastronomer

Ancient Computer—Peter J. Bush

How far back in human history do you guess computer technology goes? Would you say Charles Babbage (1792-1871)? Pascal and Leibniz in the seventeenth century? What if I told you that a simple analog computer may have been developed as early as 87 BC? That it was constructed by the ancient Greek - and was used to predict the movements of the Sun, the Moon, and the five known planets of the time!

In 1900, sponge divers off the coast of the small Greek island of Antikythera found the remains of a Roman shipwreck about 140 feet below the surface. Diving technology wasn't very advanced at the time, as this was before scuba apparatus and breathing tanks. The treacherous conditions injured several and killed one. Their yearlong perseverance however, allowed them to exhume a great bounty from the sea – original bronze life-size statues, marble reproductions of older works, jewelry, wine, ceramics, amphorae, and four bronze pieces in a crumbling wooden case. The bronze pieces had been crushed in the shipwreck - submersion in salt water for almost 2000 years had corroded them, encrusting the parts with a hard calcareous deposit. They were all but unrecognizable, and were placed aside so that the seemingly more valuable artifacts could be studied. But it's these few bronze pieces that would change our perception of the Hellenistic Greek and what they were capable of. These corroded specimens have been touted as one of the most important archeological finds of the 20th century!

The pieces had remained essentially idle for over 50 years until Dr. Derek De Solla Price science historian at Yale began a 20-year study of the pieces that would come to be called the **Antikythera Mechanism**. Price's initial examinations found what appeared to be gears and numerous inscriptions, but it wasn't until the advent of X-ray and Gamma-ray technology that Price was able to peer inside the encrusted blocks. The mechanism Price would come to describe is astonishingly small - about 12-5/8" tall, 6-1/4" wide, and 3-1/2" thick. The complex gear train, consisting of 30-32 gears of various sizes, was constructed of low Tin Bronze - about 95% Copper. (The gears would've been rather soft and pliable). The teeth on these gears numbered between 15 and 225 and were hand-cut triangular 60° angles.

The Mechanism was hinged like a book. On the front cover was one large circular dial with two concentric scales. A fixed scale names the signs of the Zodiac while a second movable slip ring shows the months of the year. There were two pointers going round on that dial. The first pointer showed where the Sun was in the Zodiac on a particular date. The other

(Continued)

pointer showed where the Moon was. There were also extensive astronomical inscriptions on every available surface, and a Parapegma plate (a pegboard for marking astronomical events) with keyed letters that corresponded to matching letters on the zodiacal scale. Later examination by Edmunds & Morgan (2000) deduced the significance of the inscriptions. They include helical risings and settings, and numbers that appear to refer to the Metonic and Saros cycles. *(see the sidebar at the end of this article)*

On the back were two smaller, less legible dials, one above the other. The lower dial had three slip rings, while the upper had four. Each had a subsidiary dial similar to the "seconds" dial of a watch. The lower dial is thought to predict the phases of the Moon as well as its risings and settings. The upper dial is believed to give the risings and settings, stations, and retro-gradations of the planets known to the Greeks (Mercury, Venus, Mars, Jupiter and Saturn).

A single handle protruded from the side. When it was cranked, all 32 gears turned. Arms, like those of a modern clock, would turn as well as the eight slip rings. Once the operator set the position of the Sun or Moon on the front plate, the Antikythera Mechanism would automatically adjust all the dials providing solar, lunar, and planetary data for the corresponding time indicated by the user. Based on the gear ratios the mechanism would have been accurate to 1 part in 86,000! Close examination reveals that the device was repaired twice, indicating that it saw frequent use.

One of the most amazing pieces in Price's Antikythera Mechanism is the inferred presence of a differential gear (a gear with one input and two outputs – similar to the drive train of an automobile). This is fascinating, since it's unknown in Western Technology for another 1,600 years! When you turned that crank, the single input to the differential drove the front gear-face as well as the two back ones. I say inferred however, since subsequent work by Michael Wright the curator of mechanical engineering at the Science Museum in London cast the differential gear as merely an epicyclical arrangement, which involves wheels orbiting around other wheels. When you see pictures of the pieces in question, you'll realize that it's very difficult to conjecture at all.

About four years ago, John Gleave an orrery maker from Yorkshire England constructed a working model based upon De Solla Price's work. *(An orrery, so named in honor of the Earl of Orrery, is an apparatus which illustrates, by the revolution of balls moved by wheelwork, the relative size, periodic motions, positions, orbits, etc., of bodies in the solar system.).* While Gleave's interpretation will turn, it's only just barely. It certainly couldn't have been mechanized in any fashion, as it would've seized up. This suggests that Wright's explanation may be more likely than Price's.

Close examination of the inscriptions, as well as the other relics from the shipwreck, place

(Continued)

the construction of the mechanism around 87 BC and the shipwreck at 76 BC. Scientists have also deduced that the ship originated from the Greek isle of Rhodes, and currently believe Posidonius, or one of his students, constructed the Antikythera Mechanism.

So beautiful and unique an anachronism is the clockwork mechanism, that some people studying it would rather attribute its construction to space aliens or time travelers rather than the ancient Greek. "The Antikythera Mechanism suggests that, in the 1st Century BC, the Greek were perfectly capable of designing and constructing complicated mechanisms. The fact is, literature at the time mentions instruments: the Roman author Cicero, who was very interested in Greek science and philosophy, mentions the planetarium made by a man called Posidonius in Rhodes with whom he studied. He also mentions similar instruments rescued from Syracuse (when Syracuse fell to the Romans in 212 BC) that survived to Cicero's day."

"Until we saw what was inside the Antikythera mechanism, it was usual to imagine that these instruments mentioned by Cicero were really rather simple, naïve little devices and that if Cicero implied that they were complicated, well this was just a literary trick. But ever since Price published his findings, we've had to accept that what Cicero was talking about could have been quite sophisticated, quite complicated little mechanical models."

As De Solla Price points out,

> "*The Antikythera Mechanism must therefore be an arithmetical counterpart of the much more familiar geometrical models of the solar system which were known to Plato and Archimedes and evolved into the orrery and the planetarium. The mechanism is like a great astronomical clock without an escapement, or like a modern analogue computer which uses mechanical parts to save tedious calculation.* […] *It is certainly very similar to the great astronomical cathedral clocks that were built all over Europe during the Renaissance.*"

References

(Please explore the links to appreciate just how complex the Mechanism was.—Pete)

An Ancient Greek Computer – Derek De Solla Price
Price's 1959 article in Scientific American
http://etl.uom.gr/mr/Antikythera/price.htm

The Antikythera Mechanism I – Bill Casselman
Casselman did a study for the American Mathematical Society. He has several pictures as well as an excellent Java animation.
http://www.ams.org/new-in-math/cover/kyth2.html

The Clockwork Computer – The Economist September 2002
Actual picture of one of the Mechanism's faces and discussion of recent research.
http://www.economist.com/displaystory.cfm?story_id=1337165

(Continued)

The Antikythera Mechanism: Challenging the Classic Research – Tony Freeth
Excellent source of graphics and analysis of gearing.
http://www.rhodes.aegean.gr/maa_journal/docs/volume2%20No1%20Jun2002/theantikytheramechanism.pdf

The Antikythera Mechanism: Physical and Intellectual Salvage from the 1st Century B.C. – Rob S. Rice Article for the Naval History Symposium on Greek naval history.
http://ccat.sas.upenn.edu/rrice/usna_pap.html

Simulation of the Antikythera Mechanism - Manos Roumeliotis
Three simulations from different angles. (Large files)
http://etl.uom.gr/mr/Antikythera/640X480.html

A Reconstruction of the Antikythera Mechanism – Grand Illusions
A Picture of John Gleave's working model.
http://www.grand-illusions.com/antikyth.htm

The Metonic Cycle

The "Metonic Cycle" is named after a Greek called Meton, who lived around 430 BC.
A Sideral Lunar Month – one Lunar orbit through the constellations - is 27.322 days, but the Moon doesn't return to the same phase.
The length of time between two Full Moons (Lunation) is called a Synodic Month and equals 29.53059 days.
A Solar Year equals 365.242199 days
The Moon makes 254 sidereal revolutions of the Earth and 235 synodic revolutions in 19 solar years.
19 years = 19 x 365.242199 = 6,939.60 days
235 Synodic Months = 235 x 29.53059 = 6,939.69 days
254 Sideral Months = 254 x 27.322 = 6,939.79 days
Thus, the Earth and Moon return very closely to their exact orientation in the heavens every 19 years.

Saros Eclipse Cycle

The ancient Babylonian discovered the cycle, but it takes its name from the Greek word meaning "to repeat".
A Saros Cycle = 18.03 years or 223 Synodic Months or 19 Eclipse Years.
An Eclipse Year = 346.62 days
The Saros Eclipse Cycle is used to predict solar eclipses (partial, annular, and total) as well as lunar eclipses. The Saros cycle evolves and decays over about 1,300 years for solar eclipses and 800 years for lunar eclipses. These longer cycles are the times it takes subsequent eclipses to traverse from North Pole to South Pole.
By following the Saros Cycle, one could predict the approximate time, location, and amount of eclipse.

January 2005

SUN	MON	TUE	WED	THU	FRI	SAT
	UTK—roof of Neilson Physics Building on The Hill at UT 1st & 3rd Fridays TAO —Tamke-Allan Observatory Public Stargaze Watts Bar Lake, Roane County 1st & 3rd Saturdays					1 New Years
2	3	4	5	6 <Comet Machholz by The Pleiades>	7	8
9	10 *New Moon*	11	12	13 Saturn at Opposition (Its biggest)	14 **SMAS Meeting PSTCC Rm 223 7 pm**	15
16	17	18	19	20	21	22
23	24	25 *Full Moon*	26	27	28	29
30	31					