STELLA

June 2005 Newsletter of the Omaha Astronomical Society Issue 210

OAS Observing Site Cleanup
Weeping Water, Nebraska

General Meeting of the
Omaha Astronomical Society
Friday, June 3 at 7:30 PM
Durham Science Center, Room 169
UNO Campus

Program: See Page 3

Events

June Club Star Party

Saturday June 4, 2005
Club Site Weeping Water

Mahoney Public Star Parties

June 10, 2005
July 8, 2005
August 12, 2005
September 9, 2005

Planning Meeting for 2005 Nebraska Star Party

June 9, 2005 @ 7:30PM
Mahoney State Park Lodge
Join us and do your part to help plan NSP 12!

NSP 12

OAS members may still register for the NSP 12 at the June 3rd meeting at the discounted price of $20.00 per adult instead of $30.00. Eric Balcom will have brochures at the meeting for them to fill out the Registration Forms.

STELLA is a publication of The Omaha Astronomical Society. Please send related correspondence to: STELLA, c/o Omaha Astronomical Society, P O Box 540424, Omaha, NE 68154

Bulletins

June Meeting Presentation

Jeff Huston on **'Astro Sketching'**

Good June Dates to Observe at the OAS Club Site or at any other good location

Friday 3 June , new moon
Saturday 4 June , new moon

Upcoming Events

Astropark Cleanup #2
25 June @ 10 A.M.

Deep Impact Project

Deep Impact will impact Temple 1
July 4th, 2005 1 A.M.
Look Southwest Low the Horizon
In Virgo above Spica

Nebraska Star Party 12
July 31st to August 5th 2005
Merritt Reservoir

An Astronomy Quiz

1. What planet's "day" (rotational period) is nearly the same as it's "year" (revolution around the sun)?
2. How can we tell which way a spiral galaxy rotates?
3. What is this quote from:

   "Can you bind the beautiful Pleiades?
   Can you loose the cords of Orion?
   Can you bring forth the constellations in their seasons
   or lead out the Bear with its cubs?"
4. Alkes, a 4.1 magnitude star, whose name means "wine cup" in Arabic, is in a constellation that has a similar name. What is it?
5. What, apparently made of iron and nickel, did the Mars Rover Opportunity find in mid-May?
6. When and from where is the next total eclipse of the sun visible?
7. T or F Our galaxy, the Milky Way, completes a rotation about once every 250,000 years.
8. Why do so many stars have Arabic names?
9. What does this describe? {5 degrees by 7 degrees, apparently "starless", southern hemisphere, about 500 light years away.}
10. A star burns hydrogen for a) 85% b)90% or c)99% of it's lifetime.
11. All stars have some color, (according to their surface temperature), but almost all appear white to us. Why?

Submitted by an Anonymous Reader

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Http://www.omahaastro.com/DigitalStella

Omaha Astronomical Society Meeting Minutes

May 6, 2005

Old Business

1. **Messier Observing Committee. Clark & Deb Cheney**

Deb & Clark Cheney reported that the night of May 3rd the Moon occulted the major planet Jupiter.

2. **International Space Station**

OAS President Al Dorn reported on an ISS pass through the cup of the Big Dipper.

New Business

1. **OAS Business Meeting Schedule**

OAS Member George Allen suggested that the OAS meeting time be pushed back one hour to 8:30 pm during the part of the year that Daylight Savings Time is observed. This suggestion will be entertained later in the year for next calendar year's schedule.

2. **Weeping Water Astro Park**

OAS Vice President Deb Cheney is planning another Clean Up Day at the Astro Park to finish the projects that were not completed during the Clean Up day in April. The date will be announced and the type of work, tools needed, etc, will be discussed during the June 2005 Business Meeting.

3. **Astro Site Port-A-Potty**

OAS Treasurer Bill Bond stated that there is now a new company servicing the Port-A-Potty located at the OAS Astro Park. The new Company is Deffenbaugh Recycling Company. Bill is negotiating with the Company on a price to maintain the facility.

The June Sky

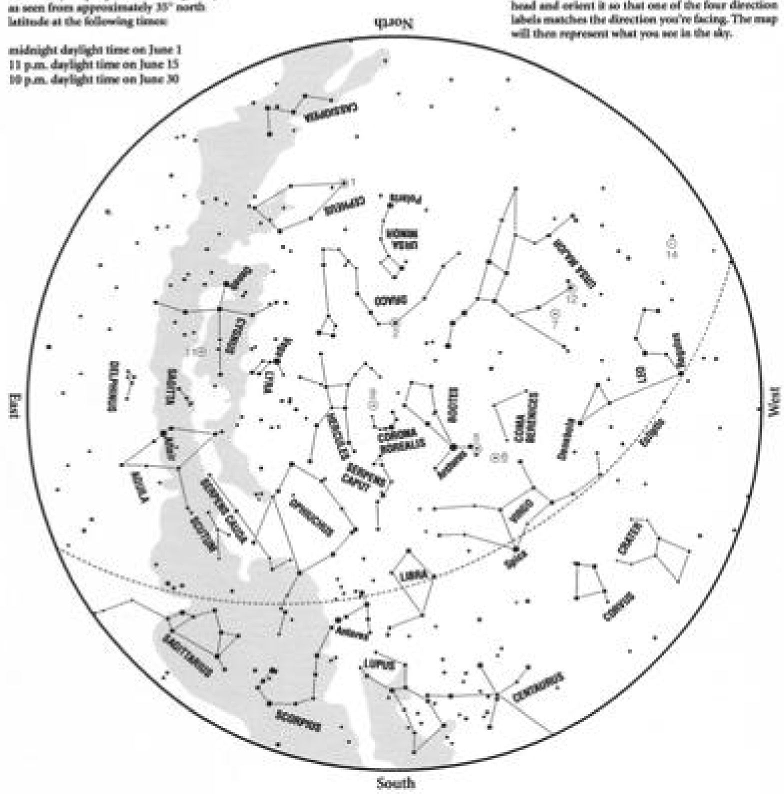
Where are the Distant Worlds?

June

The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

midnight daylight time on June 1
11 p.m. daylight time on June 15
10 p.m. daylight time on June 30

To locate stars in the sky, hold the map above your head and orient it so that one of the four direction labels matches the direction you're facing. The map will then represent what you see in the sky.



Stars visible to the unaided eye known to have planets — listed brightest to dimmest (stars visible this month are circled and numbered on the map)

1 – Gamma Cephei
2 – Iota Draconis
3 – Epsilon Eridani
4 – Upsilon Andromedae
5 – Tau Bootis
6 – 70 Virginis
7 – 47 Ursae Majoris
8 – HD 19994 (Cetus)
9 – Rho Coronae Borealis
10 – 51 Pegasi
11 – Gliese 777a (Cygnus)
12 – HD 89744 (Ursa Major)
13 – HD 38529 (Orion)
14 – 55 Cancri

June Sky Calendar

6th New Moon
14th First Quarter Moon
21st Summer Solstice
22nd Full Moon
28th Last Quarter Moon

Recent Observing Awards None

New Members…None

Astronomy Quiz Answers

1. Venus.
2. We can observe which direction the spiral arms trail, which lets us know rotational direction.
3. Job, Ch.38, v.31, 32, the Bible, NIV.
4. Crater, “the cup.”
5. A meteorite, the first found on another planet.
6. March, 29th, 2006, from parts of Africa, Turkey, Asia and the Atlantic.
7. F It’s rotational period is 250 *million* years.
8. With the collapse of Greco-Roman civilization, much ancient knowledge of stars, planets and star lore was lost. Some of it was recorded by Arab scholars and later, during the Renaissance, Europeans rebuilt their astronomical knowledge base using Arab records and borrowing Arab terms and star names.
9. “Coal Sack”, dark nebula in Crux, the “Southern Cross”.
10. b) 90%.
11. Our eyes are not sensitive to color at low light levels. We detect color only at about 1st magnitude or brighter.

Our Earth Revolves Around the Sun — Part Two

From Circumstantial to Proof Positive

Harlan Seyfer

In the May issue of Stella we began looking at the history behind a fact, which we take for granted today: that the Earth revolves around the Sun. To sum up, back in the fourth century BC, Aristotle “proved” that the Earth was immovable and at the center of the universe. “The same point is the center of the Earth and of the Universe,” he declared. In the second century AD, Ptolemy described in great detail how the Sun and planets revolved around the Earth. His *Almagest* was literally the definitive textbook on astronomy for nearly 1500 years; until well after the time of Columbus. In 1543 Copernicus’s book *The Revolutions* challenged the universe of Ptolemy by stating flatly that the Earth went around the Sun, as did all the “other” planets. But his book was largely ignored until the pivotal year of 1609, when Galileo Galilei turned his telescope on the sky and Johannes Kepler published his three laws of motion based upon his mentor Tyco Brahe’s data.

As a result of these events, at the end of the sixteen hundreds a substantial amount of evidence was in place to show that the Earth was in motion around the Sun. But this evidence was circumstantial. There was, as yet, no direct proof. Tyco Brahe had also described a workable system in which the Sun and Moon revolved around an immovable Earth, while all the planets and stars circled the Sun. While the Copernican System was mathematically simpler than the Tyconic, there was no direct proof which of the two reflected reality.

It was with this in mind that astronomers sat out to measure parallax, the apparent change in position of an object when viewed from two different angles. If some stars could be demonstrated to annually shift back and forth, that would prove the Earth revolved around the Sun.

Parallax was well understood in Galileo’s time and was one of the main criticisms of the Copernican theory. Why, if the Earth went around the Sun, didn’t we see the stars change position? In 1632 Galileo attacked that criticism in his *Dialogo sopra I due massimi sistemi del mondo* (*Dialogue on the Two Chief World Systems*). In it, he proposed an approach to the problem. Assume that two stars appeared close to each other, a brighter one and a dimmer one. The bright star would be closer than the dim one. As the Earth revolved around the Sun, the bright star would appear to move relative to the dim star. Galileo, as did all other astronomers of the time, assumed that all stars were like the Sun and had the same size and brightness. Proof that that was not true would have to wait for over a hundred more years. It was not until 1803 that William Herschel demonstrated that double stars, with one of the pair dimmer than the other, revolved around a common center of gravity and, therefore, had to be at the same distance despite the difference in their luminance. Unfortunately Galileo never did have time to follow up on his research idea.

In the mid-1600s Christiaan Huygens (discoverer of Saturn's moon Titian) decided to gage the distance to Sirius by measuring the difference in brightness between it and the Sun. He did this by putting various sized holes in a screen then viewing the Sun through the holes. He measured the size of the hole that appeared to have the same brightness as Sirius. Huygens then used the ratio of diameter of the hole to the apparent diameter of the Sun to calculate the distance of Sirius. With this crude approach, he estimated that Sirius was 27,664 AUs (astronomical units) away. In 1668 the Scottish astronomer James Gregory, using a slightly different method, estimated the distance to Sirius as 83,190 AUs. Since Saturn, the furthest known planet at the time, is an average of 9.4 AUs from the Sun, these numbers were staggeringly large. Obviously telescopes in the late 1600s were not up to measuring the extremely small angles involved. Astronomers had their work cut out for them. (We now know that the challenge was even greater than they thought. The currently assumed distance to Sirius is 8.65 light years or 547,026 AUs.)

The next star we'll encounter is second-magnitude gamma Draconis, whose declination (51° 29') is approximately the latitude of London – an important fact. But first we need to look at atmospheric refraction, an annoying source of error for astronomers attempting to measure the position of stars. The error due to refraction was not a trivial amount, accounting for more than half a degree at the horizon. (When we see the Sun set, it is actually below the horizon. Earth's atmosphere bends the light rays up around the horizon, making the Sun appear "higher" than it actually is – refraction.) Cassini had worked out a table of refractions, but spoil-sport Newton pointed out that refraction was not constant, it varied with temperature and barometric pressure.

In 1725, Samuel Molyneux, a wealthy amateur astronomer living near London, commissioned an instrument maker to build a telescope designed to measure the position of stars directly overhead, thus avoiding the effect of refraction. He recruited his friend the Reverend James Bradley another amateur to help. This telescope was mounted against a chimney stack in Molyneux's house and extended through holes in the second floor, attic, and roof. They chose to observe – surprise – gamma Draconis. As the star passed overhead, the telescope could be moved a little north-south so that the star passed through the center of the field of view. A plumb bob then measured the angle the telescope was tilted. From their calculations, the pair assumed gamma

Draconis would reach its most southerly position on December 18 and its most northerly, six months later in June. Beginning in November 1725, Molyneux and Bradley measured the star as it gradually moved south. To their great surprise, it didn't stop moving in December but continued moving south until March when it gradually slowed, stopped, then began moving north. Gamma Draconis had moved 20 arc-seconds further south than its December position! By June it was back to its December position, finally reaching its most northerly position in September. This motion could not be due to its parallax.

The only explanation, or so Molyneux and Bradley first thought, was that the Earth's atmosphere wasn't uniformly dense. To test this hypothesis, they needed to measure more stars. Unfortunately Molyneux was called away by the British Admiralty, leaving Bradley to carry on alone. Bradley ordered his own zenith telescope, which was able to tilt farther. He mounted it in his aunt's house, which had only one story, so the telescope poked through the roof and floor down to the basement. As Alan Hirshfeld put it, "James Bradley would be viewing the heavens from the coal cellar." Within a year Bradley confirmed that *all* the stars he observed behaved similarly.

Molyneux had planned to return to observing with his friend, but died suddenly in April 1728. Bradley was left to ponder the problem alone.

Sir Robert Ball in his 1895 classic *Great Astronomers* describes what happened next.

> One day [in 1727] when Bradley was out sailing he happened to remark that every time the boat [changed direction] the vane at the top of the boat's mast shifted a little, as if there had been a slight change in the direction of the wind. After he had noticed this three or four times he made a remark to the sailors to the effect that it was very strange the wind should always happen to change just at the moment when the boat was going about. The sailors, however, said there had been no change in the wind, but that the alteration in the vane was due to the fact that the boat's course had been altered. In fact, the position of the vane was determined both by the course of the

> boat and the direction of the wind, and if either of these were altered there would be a corresponding change in the direction of the vane. This meant, of course, that the observer in the boat which was moving along would feel the wind coming from a point different from that in which the wind appeared to be blowing when the boat was at rest, or when it was sailing in some different direction.

Serendipitous Eureka! Bradley immediately realized the explanation for what he and Molyneux had stumbled across.

Imagine you are in a car slowly moving through a gentle snowfall. The snowflakes are falling straight down; however, as viewed from the moving car, the flakes appear to be coming from ahead of you. Because light has a finite speed of 299,792.458 km/s and since the Earth has an orbital velocity of 29.8 km/s, the same effect applies to starlight reaching an observer on Earth. In the time it takes light from a star to travel the length of a telescope, the Earth has moved taking the telescope along with it. Thus the light of the star appears to come from a point slightly ahead of its actual position if the Earth is moving towards it. The starlight appears to come from slightly behind the star if the Earth is moving away from it. Because the orbital velocity of the Earth is tangential to its orbit, and parallax is measured perpendicular to the orbit, the parallax motion of a star and it aberrational motion will be 90 degrees (three months) out of phase.

James Bradley had discovered an error in all previous measurements of star positions. More importantly – from our perspective here – this was solid proof that the Earth revolved around the Sun and not visa versa. Copernicus was indeed right. Nice try Tycho.

For his contributions to astronomy, Bradley succeeding Edmond Halley as the third Astronomer Royal in 1742. A post he served in until his death in 1762.

Keep looking up. The observing season is upon us.

MARK YOUR CALENDERS NOW

7th ANNUAL OAS_PAC BANQUET

October 14th, 2005 at 7:30 PM

Club Officers ....

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BENEFITS OF MEMBERSHIP

- Members receive the STELLA, our monthly newsletter.
- Each member is automatically a member of the Astronomical League, the only nation-wide organization for amateur astronomers.
- Use of the observing site at Weeping Water, NE
- The opportunity to borrow one of several club-owned telescopes.
- Organized trips to local observatories, planetariums and museums.
- Significant savings on subscriptions to **Sky & Telescope** and **Astronomy** magazines.
- Savings on astronomy books and printed materials.

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