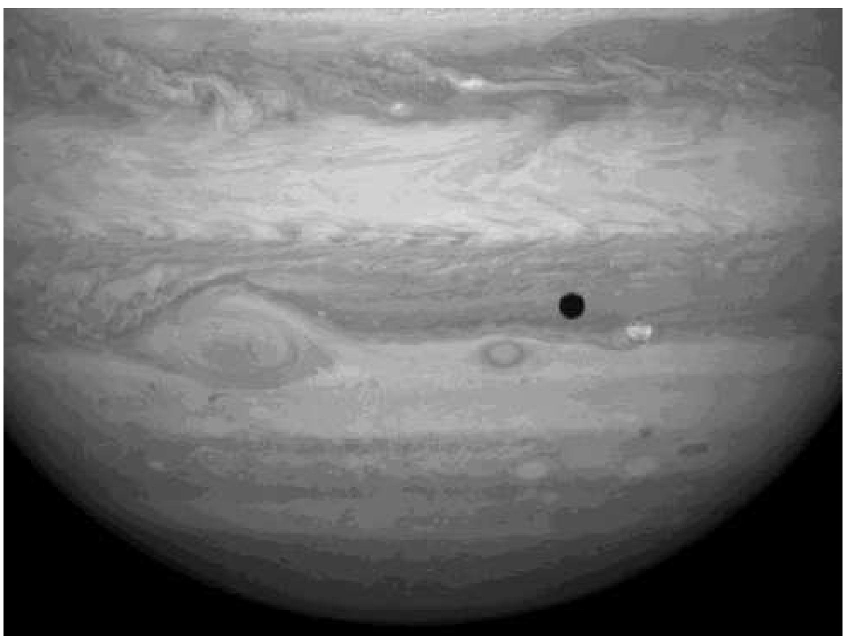
REFLECTIONS REFRACTIONS

of the University Lowbrow Astronomers

January 2001

The University Lowbrow Astronomers is a club of Astronomy enthusiasts which meets on the third Friday of each month in the University of Michigan's Physics and Astronomy building (Dennison Hall, Room 130 or 807). Meetings begin at 7:30 pm and are open to the public. Public star parties are held twice a month at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; further directions at the end of the newsletter) on Saturdays before and after the new Moon. The party may be canceled if it's cloudy or very cold at sunset. For further information call (313) 480-4514.



Jupiter, Io, and Shadow
Credit: Cassini Imaging Team, Cassini Project, NASA

Explanation: Just as planets orbit our Sun, Jupiter's Moons orbit Jupiter. Pictured above is the closest of Jupiter's Galilean Satellites, Io, superposed in front of the giant planet it circles. To the left of Io is a dark spot that is its own shadow. The tremendous complexities that can be seen in Jupiter's banded, swirling atmosphere are being studied and may provide insight as to how Earth's atmosphere behaves. The above true-color contrast-enhanced image was taken two weeks ago by the robot spacecraft Cassini, currently passing Jupiter and on its way to Saturn in 2004. Engineers continue to study the Cassini spacecraft itself to understand why it required more force than normal to turn one of its maneuvering wheels.

This Month:

January 19 - Meeting at 130 Dennison - Dr. Carl Akerlof, University of Michigan Physics Department, Doing Forefront Astronomical Research with a 4" Refractor.

January 20 - Public Star Party at Peach Mountain Observatory - Burr! Baby it's cold outside. Don't go licking any metal telescopes.
January 27 - Public Star Party at Peach Mountain Observatory - A three day old Moon with Venus, Jupiter, and Saturn. It doesn't get any better than this for a Planetologist (unless you add Mars).

Next Month

February 16 - Meeting at 130 Dennison - Fred Schebor present the Lobrow's "Artsy Meaningless Slide Show". A Lowbrow tradition. Don't miss it.

February 17 - Public Star Party at Peach Mountain Observatory - See Jupiter's moons Io and Europa at 9" apart at 11:04 PM EST.

February 24 - Public Star Party at Peach Mountain Observatory - Orion and Auriga on the meridian with Gemini and Canis Major just behind. Its winter observing at its best.

Fall 2000 Saturday Morning Physics: X-ray Astronomy

By Dave Snyder

Over the past few years Saturday Morning Physics has covered a variety of topics, many of them have an astronomical focus. This fall there were nine lectures, three of which were on X-ray astronomy. Dr. Martin Sulknen gave the three X-ray astronomy lectures. He covered the history of X-ray Astronomy, current X-ray observatories including Chandra and plans for future X-ray observations.

Visible light has been used to explore the universe since the 1600's. Astronomers have gained knowledge from visible light, however as astronomers have viewed the skies in other parts of the electromagnetic spectrum, they have learned many new things. In 1932, Jansky observed radio waves that came from space. Visible light and radio waves can be detected from earth's surface, however the atmosphere absorbs UV and X-rays. The only practical way to observe UV or X-rays is to have an observatory outside the Earth's atmosphere. The earliest attempts used captured V2 rockets. In 1946 a rocket observed UV. The first attempt to observe X-rays failed but a 1949 attempt successfully observed X-rays. Both the UV and X-rays came from the Sun. After detecting X-rays from the Sun, in 1962 a different rocket found the next brightest X-ray source in the sky. It is located in Scorpio and is now known as Scorpius X-1.

A variety of devices can detect X-rays. The 1949 attempt used a device known as a proportional counter. It is also possible to detect X-rays with photographic plates or with Geiger-Muller Counters that are equipped with special filters. However proportional counters are able to determine the energy of X-ray photons, which is not possible with either photographic plates or Geiger Counters. More recent instruments use electronic detectors such as the Charge Coupled Detector known as ACIS.

However simple detection of X-rays is not enough. It is important to collimate the X-rays. In other words only detect X-rays from specific directions. Without collimation astronomers would have no way to determine the location of X-ray sources. In addition astronomical X-rays are generally dim. It is necessary to focus X-rays to obtain enough signal to detect any sources beyond the Sun. You cannot focus X-rays with glass lenses or glass mirrors. X-rays reflect off Nickel, Gold and Iridium if hit at a grazing angle. A cone made of any of these metals can both collimate and focus X-rays. A set of cones placed one inside the next, sort of like a set of Russian Dolls, works even better than a single cone. Most X-ray observations since the 1970's have been made from satellites, rather than rockets, equipped with nested metal cones as the focusing mechanism. In the 70's three satellites, SAS 1 (better known as Uhuru), HEAO 1 and HEAO 2 (the later known as Einstein) conducted systematic searches for X-ray sources. In the early 1990's, two new satellites were launched: Rosat and Asuka.

These satellites lead NASA to embark on a grand project. A set of four observatories in Earth orbit which collectively can observe most of the electromagnetic spectrum. This project included The Compton Gamma Ray Observatory, which was deorbited this past June, the Shuttle IR Telescope, the Hubble Space Telescope, which observes visible and UV light, and Chandra, which observes X-rays.

Chandra was named for Subrahmanyan Chandrasekhar (1910-1995) awarded the Nobel Prize in 1983. Chandrasekhar is best known for his theory that predicts, among other things, that stars with mass greater than 1.44 solar masses would rapidly collapse into a black hole.

Chandra has a collection area of 300 square centimeters (for comparison, an eight inch telescope has a collection area of 324 square centimeters), a focal length of 10 meters and can detect X-rays that have energies anywhere from 100 to 10,000 electron volts. It consists of a single telescope along with a detector and a spectroscope. The spectroscope is useful only for small and relatively bright sources. The electronic detector can detect X-ray energies (like the spectroscope). While it doesn't have the resolution of the spectroscope, it can be used for dim or spread out sources. In addition, it has an optical telescope, which is used to guide the X-ray telescope.

Chandra took eight years to construct. Great care was needed to build the metal cones, which must be very smooth. The shape takes into account gravitational forces. When Chandra was placed into orbit, the reduced gravity caused the cones to assume the correct shape. Chandra was put into a highly elliptical orbit. Such an orbit was designed so that Chandra can avoid the Van Allen radiation belts. It has to shut down when it is inside the radiation belts, but is able to make observations the rest of the time.

X-rays are expected within extreme environments such as gas at 10 million degrees Kelvin, (for example near a neutron star or a black hole), strong magnetic fields, or the shock waves from supernovae. Since its launch in the July 1999, Chandra has been able to make numerous contributions to science by looking at such regions.

Chandra has taken photographs of Cassiopeia A, the Crab Nebula, the Vela Pulsar, the Orion Nebula, the Antenna Galaxies, the Andromeda Galaxy, the black hole region of our galaxy, the black hole region of M82, brown drawfs and Eta Carninae, among others. These photographs have as much detail as photographs taken with visible light. Chandra has also produced spectra, a variety of elements have been detected from Chandra's spectra, including iron, calcium, argon, sulfur, silicon, magnesium, neon and oxygen. The observations of Cassiopeia A suggest it is an unusual object known as a magnetar. These objects have enormous magnetic fields that could explain the X-ray emissions. Astronomers have discovered small black holes, about 1 solar mass, and large black holes, about 1 million solar masses, but black holes with intermediate sizes had never been observed. The black hole at the center of M82 appears to be such a mid-sized black hole. In addition Chandra has collected observations that may explain faint emissions of X-rays that can be seen in all directions within the celestial sphere. This required precise imaging to detect the numerous objects that make up this background radiation.

Chandra has observed galaxy clusters. There is little matter and no stars at the gravity well of a galaxy cluster, but X-rays form in the gravity wells); the central black hole of both Centaurus A and Pictor A (the central black hole of these galaxies have jets of material that produce X-rays, such jets are common but poorly understood); and Comet S4 (Linear) (a few recent comets have been observed to emit X-rays).

In December 1999, the X-ray Multi-Mirror Mission-Newton Observatory (XMM for short) was launched. It has one-tenth the resolution of Chandra, but has three times the collection area. XMM and Chandra complement each other. XMM does better at spectroscopy, but Chandra produces more detailed photographs. XMM imaged the Coma Cluster, a source of hot gas and hence X-rays and has provided data on the central black holes for a number of galaxies.

However XMM and Chandra do not tell astronomers everything they would like to know. If we had better resolution we could image the accretion disks around supermassive black holes, image the corona of stars (currently we can do that only for our own sun), use X-rays to provide an independent measurement of the Hubble Constant and presumably discover new phenomena.

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A new mission called Constellation is planned for 2015. Unlike previous X-ray observatories, it will use flat metal mirrors (the X-rays reflect when they hit at a grazing angle) instead of cones. It will use inferometry to achieve its increased resolution. A set of spacecraft will collect X-rays and send them to a detector located in another spacecraft located 500 kilometers away (approximately 300 miles). Positioning the telescope requires moving the collectors hundreds of kilometers and rotating the detector so that everything lines up within a few millimeters, in the process the distance of 500 kilometers must be maintained within 10 meters (slewing is a very slow operation). This will allow much greater resolution than is possible with either XMM or Chandra. Unlike previous detectors, Constellation will use calorimeters to detect X-rays, allowing high-resolution imaged spectroscopy.

The first step toward Constellation will be the Micro Arcsecond X-ray Inferometry Mission (known as MAXIM Pathfinder), planned for 2010. This is the detector component of Constellation; it has 0.0001 arcsecond resolution and can detect the polarization of X-rays, (which has previously been impossible). We expect that ability will allow astronomers to study sources of synchrotron radiation (synchrotron radiation emits polarized X-rays). Some five years later the rest of the spacecraft are expected to be launched.

For more information, see the web site for the Chandra Observatory, http://chandra.harvard.edu . The following two articles cover much (but not all) of the information in this article.

Ron Cowen, October 21, 2000, Science News, "Invisible Universe" pp.
266-268.
Ron Cowen, October 28, 2000, Science News, "X-ray Visionaries" pp. 282-283.

In addition, the following article discusses one of the many Chandra
observations:

_____, October 2000, Sky & Telescope, "Brown-Drawf Flare" p. 29.

SHADES OF X-FILES

(It does have something to do with Astronomy -- BF)

Credit Laura Sullivan

Surprises: Astronomers who took over an abandoned spy base find remarkable, expensive and often incomprehensible stuff at every turn.

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TRANSYLVANIA COUNTY, N.C. - Along the long, twisting road through the Pisgah National Forest, the first sign that something is out of the ordinary is a line of giant transformers. Then, around the bend, a barbed-wire fence, guard shack and surveillance cameras protect what looks like nothing more than another hill of trees and dense shrubbery. It is anything but.

This is the entrance to one of the National Security Agency's former spy stations, a place shrouded in secrets and denials, the source of local lore that seems right out of "X-Files." What is inside that giant geodesic dome that looks like a golf ball? Where do the tunnels snaking beneath the 202-acre site lead? Why are the rugs welded to the floors of the windowless buildings? Few people have been beyond these gates, deep inside the Appalachian Mountains, 50 miles southwest of Asheville.

The NSA abandoned the site to the U.S. Forest Service five years ago, leaving behind a deserted minicity in the middle of nowhere. Now, some of the secrets are being revealed. Last year, with the base boarded up and close to demolition, the property was transferred to a group of astronomers in exchange for a piece of land in western North Carolina. Over the past year, they have begun piecing together the site's past.

"There are things on this site you will never see anywhere else," said site manager Jim Powers. "I've never had someone come here that wasn't blown away." The astronomers, who formed the Pisgah Astronomical Research Institute, were attracted by two 85-foot satellites dishes on the site - some of the largest in the country - which could be repositioned to catch deep-space radio signals and allow them to study the life and death of stars.

When the group arrived in January 1999, they expected a basic, albeit large, government facility, but as the weeks passed they realized little about the site was what it appeared. As they began to install their computers, they found hundreds of miles of top-of-the-line cabling running under every floor. They discovered that the self-contained water and sewer treatment plant could handle tens of thousands of gallons of water at a time and the generator could produce 235 kilowatts of energy - powerful enough to light up a small city. In a basement room of one of the larger buildings, they found the entrance to a 1,200-foot tunnel system that connects two of the site's main buildings. Every inch of floor in more than four buildings was covered with two-by-two-foot squares of bleak brown carpet. When the astronomers tried to replace it, they discovered it was welded with tiny metal fibers to the floor. The result, they eventually realized, is that the rugs prevent the buildings from conducting static electricity. Even the regular lighting looks different, covered by sleek metal grids that prevent the light bulbs from giving off static interference. The few windows are bulletproof.

But what fascinated the astronomers was the still-operable security system that, among other things, sounds an alarm in the main building any time the front perimeter is crossed. The group can watch on monitors as cars approach from miles away. Inside the site, the agency had taken further measures. One area is in a small, sunken river ravine surrounded by barbed wire and an additional guard post. Steps, with reflective metal paneling to shield the identity of those walking beneath, lead down a small hill and wind their way to two small buildings with conference rooms inside - both of which once emanated "white noise" to prevent electronic eavesdropping.

What Powers and several others in the group find remarkable, though, is not just the expansive network of buildings and security, but the extraordinary cost of all they items they have found - items the agency discarded. He said the extensive fiber optic cabling that runs for miles under the floors and through the tunnel system is the most expensive on the market.

When a state regulator came out to issue a permit for a massive underground storage tank with a double lining, the astronomers said he told them he wished he had a camera. He wanted to take a picture to show his co-workers because he had never seen a system so sophisticated. And the agency didn't just install one water tank; it installed two. In a basement room, beneath a system that pressurizes wells, is another system just like it. "You see this kind of thing everywhere here," Powers said. "They never have just one of something." Even most of the heavy bolt locks - which every door has - are covered by black boxes locked with padlocks.

Despite the site's stark appearance, there are some human - and humorous - vestiges. A bright happy face is painted on the smallest of the four satellite dishes on the site, something one former em ployee said was done so that they could "smile back at the Russians." Inside the tunnels, too, are chalk drawings of animals and warriors resembling those found in caves thousands of years ago. Aside from the rustling of deer and the wild turkeys that run rampant across the hundreds of vacant parking spaces, everything about the place is now eerily quiet.

Paperwork in the guard shack is held in place by a stapler though no one has been inside the small building in years. Security cameras still work and alarms all still sound, though no one is listening. When the agency withdrew in 1995, some of the 300 workers, especially those who grew up locally and got hired on as groundskeepers and mechanics, returned to the nearby towns, though many say they are still forbidden to talk about their work. Most of the others - the security officers, military personnel and cryptologists - left the area for their next Department of Defense post.

The site dates back to the early 1960s, when a scaled-down version was carved out to support the space program. It was operated at first by the National Aeronautics and Space Administration, and scientists used the early satellite dishes to track the flights into outer space and kept the door open for school groups and visitors who wanted to learn more about space missions.

But suddenly in 1981, the NSA took over from NASA. Local hikers and hunters who stumbled onto some of the agency's acreage would be suddenly surrounded by armed guards who appeared as if from nowhere to escort them out of the woods. Vans with darkened windows shuttled past the local coffee shops, fueling rumors. The agency's presence was hard on the local employees as well.

Don Powell began working on the site in 1967 as a car mechanic and spent the next three decades learning the mechanics of every inch of the satellite dishes for the Defense Department. He also learned to avoid questions about his work and to lie to his neighbors. For 15 years people would approach him and the few other local workers, asking what was out there, what they did and, of course, what is that golf ball? "The kids would always ask, what's in [that] giant dome?" He would tell them it was "filled with chocolate pudding," he said. "I couldn't even tell my wife. I couldn't tell anyone."

The 1995 closure appears to have caught the agency by surprise. It had recently cleared several more areas and laid the foundations for additional smaller satellite dishes that were never built. One newly built satellite dish, which one insider says was never turned on, was dismantled and shipped to England.

The Forest Service tried unsuccessfully to engineer a land trade for three years, hampered by a site that posed many problems for the few interested parties - from the remote location to the expense of removing satellite dishes embedded 80 feet into the ground. The agency was about to return with a bulldozer when the astronomers group, headed by benefactor J. Donald Cline, a scientist and former computer executive, offered to buy and trade 375 acres along the French Broad River in North Carolina for the spy station.

What made the site, shielded from interference in a natural bowl-shaped terrain, so perfect for the NSA made the site perfect for the astronomers as well. They plan to use the satellite dishes to read the characteristics of elements given off by dying stars.

"This area is free of light pollution," Powers said, as he stood in the middle of a vast, empty parking lot. "It's also clean in terms of electromagnetic interference like cell phone towers or things that create electromagnetic noise. "And we can be sure there won't be any in the future because the Forest Service owns everything around here. . It's easy to see why they liked this place."

Recently, in one of a dozen large empty rooms in one of four mostly empty office buildings where the group decided to set up shop, four scientists stood around a portable panel of monitors and computers, watching the results of a test appear on a screen.

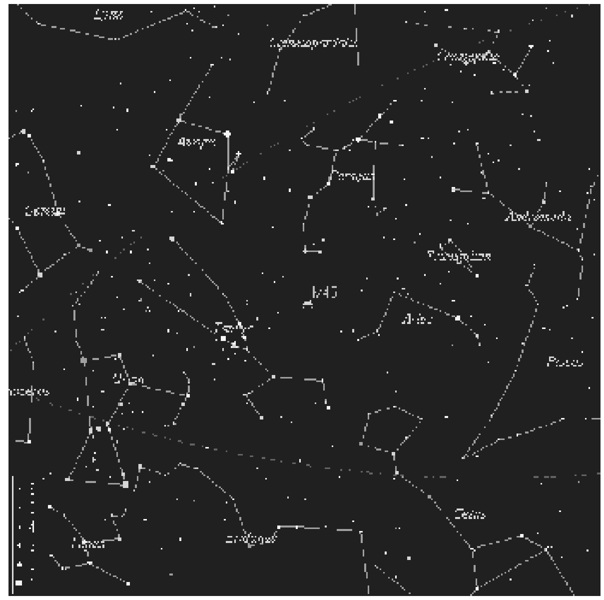
"It's stardust," said the site's technical director, astronomer Charles Osborne. "This stuff is just floating around out there. It's the building blocks of life."

In order to use the satellite dishes, they had to spend months trying to slow them down. Both of the 85-foot dishes swing on two axes, an extravagance the astronomers suspect allowed the agency to swing the face around swiftly to catch up with satellites orbiting Earth. The astronomers need the dishes to move no faster than the speed of Earth itself. But there is much on the site that the astronomers don't know what to do with, such as the paper-shredding building up on one hill, the large helicopter pad on top of another, and down in a valley of well-manicured grass, that giant golf ball, similar to those seen at NSA headquarters at Fort Meade. nothing about this place is what it seems."

Kristina Nyland presents "My Universe III" at the Crestwood High School Planetarium on Tuesday, Wednesday, and Thursday, February 13,14, and 15, 2001 at 7:30 p.m. The planetarium is located at 1501 N. Beech Daly Rd., Dearborn Heights, Michigan.

The phone number there is (313) 274-3711. The admission is $1 for adults and 75 cents for students and children. More information is available on the internet site:

http://csdm.k12.mi.us/pages/pl.html



Many a night I saw the Pleiads, rising thro' the mellow shade,
Glitter like a swarm of fireflies tangled in a silver braid.
- *Alfred, Lord Tennyson, 1837-8,* Locksley Hall

The Pleiades

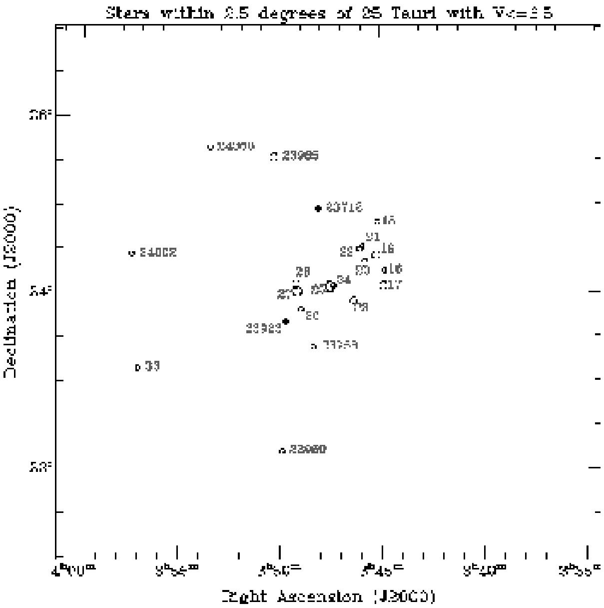
Reprinted with permission of Steven Gibson
[gibson@ras.ucalgary.ca]
Royal Astronomical Society of Canada

The Pleiades star cluster, also known as the Seven Sisters and Messier 45, is a conspicuous object in the night sky with a prominent place in ancient mythology. The cluster contains thousands of stars, of which only a handful are commonly visible to the unaided eye. The stars in the Pleiades are thought to have formed together around 100 million years ago, making them 1/50th the age of our sun, and they lie some 130 parsecs (425 light years) away. From our perspective they appear in the constellation of Taurus, with approximate celestial coordinates of 3 hours 45 minutes right ascension and +24 degrees declination. For northern hemisphere viewers, the cluster is above and to the right of Orion the Hunter as one faces south, and it transits -- reaches its highest point in the sky, midway between rising and setting -- around 4am in September, midnight in November, and 8pm in January.
XEphem charts showing the cluster's position. **Left:** a 90-degree star field centered on the Pleiades;
north is up and east is to the left. **Right:** same field with the cluster marked (as M45), as well as
constellations and the celestial and Galactic equators (red solid and dashed lines, respectively).

The image at the top of the page shows the central part of the cluster, where the brightest stars are found. This color photograph was taken in three filters, each exposed for about a half-hour, by David Malin with the UK Schmidt Telescope. The image is roughly 1.5 degrees wide, or three times the angular diameter of the moon. North is up and east is to the left. The cluster distance of 130 parsecs makes the physical width of the picture about 3.4 parsecs (11 light years); the cluster itself has a width perhaps 10 times greater, but most of the bright stars are found within one or two degrees of the core.

Brightest Pleiads

The figure at right, covering somewhat larger area than the AAO photograph, shows the brightest stars in the vicinity, most of which are members of the Ple iades cluster (some appear in the same part of the sky but actually lie at a different distance). Data for these stars are listed in a table below. All stars selected have magnitudes of 6.5 or brighter, which is about the limit of human vision under ideal conditions -- how many you actually see depends on your own eyesight, local atmospheric transparency, and light pollution levels. While few people can see stars as faint as magnitude 6.5, this limit is interesting for a different reason: it includes all stars in the vicinity which are listed in the 1725 *British Catalogue* of John Flamsteed, the first British Astronomer Royal. In a crude fashion, Flamsteed's stars correspond to the best the eye can do. The Greek-letter designations in Johann Bayer's 1603 *Uranometria* are also commonly used to label visible stars, but Bayer's catalog doesn't go as faint as Flamsteed's, and consequently only



the brightest Pleiad has a Bayer designation.

The following table lists the bright stars in order from west to east (right to left in the figures above), giving the name, Bayer and Flamsteed designations where applicable. More modern Henry Draper catalog numbers are also given, in addition to apparent visual magnitude, spectral type, and cluster membership status. Additional information on each star is available by selecting the appropriate link.

As a matter of perspective, the faintest stars listed above are still 40 times brighter than our own sun would appear at a similar distance, and the brightest Pleiad, Alcyone, is 1000 times more luminous! Stars like our sun, of which there are a few in the cluster, appear as faint flecks of light in the AAO photograph at the top of this page, and are well below the sensitivity of the human eye. They are easy to confuse with the numerous stars behind the cluster which also appear in the picture and look very similar. Careful observation and analysis is required to determine which of these fainter stars are cluster members.

A separate membership issue is also worth mentioning. Mythologically speaking, Atlas and Pleione are *not* Pleiades, but rather the *parents* of the Seven Sisters. Why do they get two stars named after them? Atlas is already pretty busy holding the heavens up on his shoulders, and myths vary as to whether or not Pleione was placed in the sky with her daughters. So how did the current naming scheme come about? Beats me. If you know, send me email.

Reflection Nebula

Several Pleiads appear surrounded by intricate blue filaments of light. This nebulosity is the result of starlight scattering (reflecting) off minute grains of interstellar dust in the vicinity. The dust particles are inside a cloud of mostly hydrogen gas which the cluster seems to be plowing into.

Brightest Pleiads

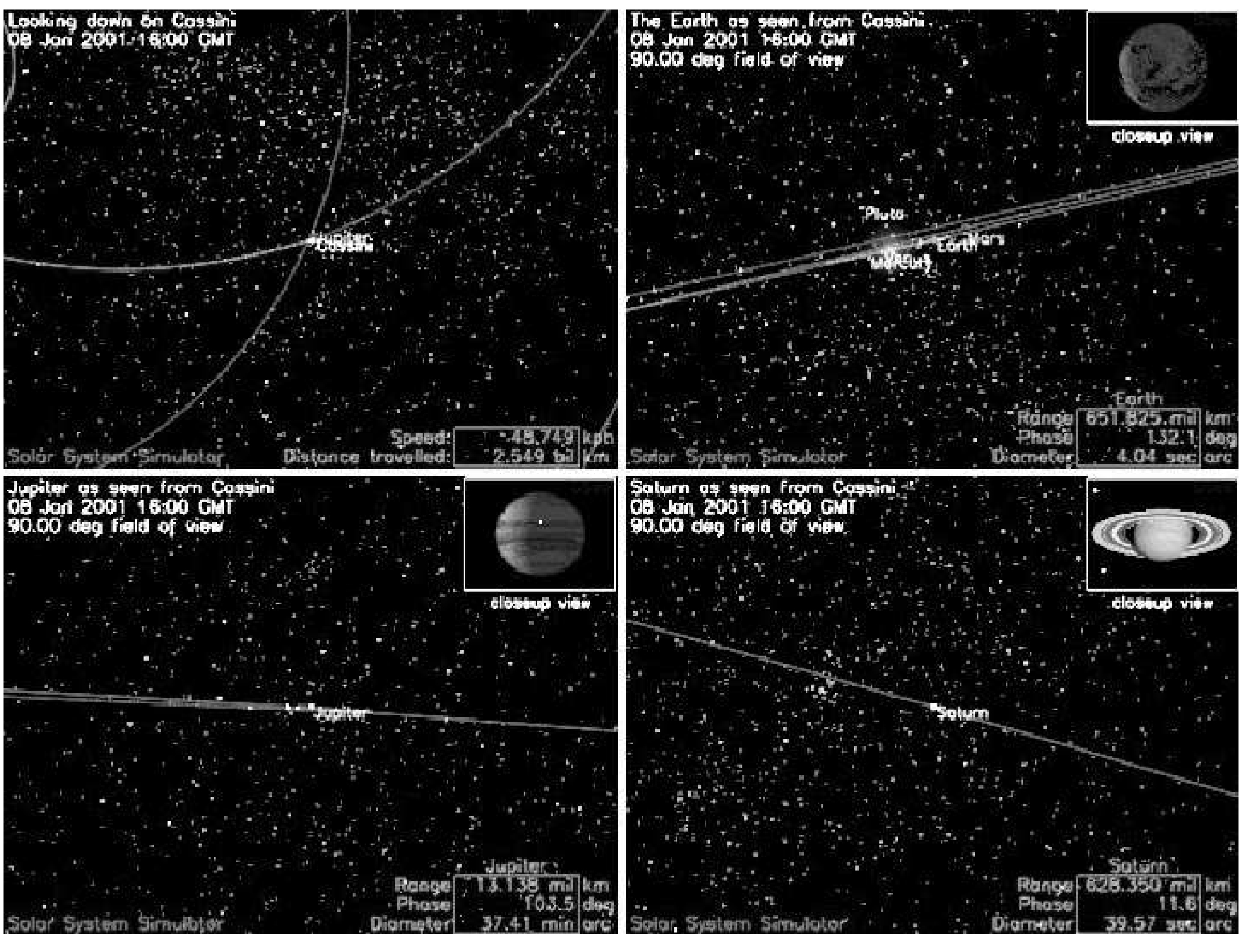
Name	Bayer	Flamsteed	HD	V mag	Spectral Type		Mem?	More
Celæno	--	16 Tauri	23288	5.46	B7 IV	variable	Yes	data
Electra	--	17 Tauri	23302	3.70	B6 IIIe	emiss. line	Yes	data
--	--	18 Tauri	23324	5.64	B8 V		Yes	data
Taygeta	--	19 Tauri	23338	4.30	B6 IV	variable	Yes	data
Maia	--	20 Tauri	23408	3.87	B8 III	variable	Yes	data
Asterope 1	--	21 Tauri	23432	5.80	B8 V	variable	Yes	data
Asterope 2	--	22 Tauri	23441	6.43	A0 Vn		Yes	data
Merope	--	23 Tauri	23480	4.18	B6 IVe	emiss. line	Yes	data
--	--	24 Tauri	23629	6.29	A0		Yes	data
Alcyone	Eta	25 Tauri	23630	2.90	B7 III	emiss. line	Yes	data
--	--	--	23712	6.49	K5	variable	No	data
--	--	--	23753	5.44	B8 V	variable	Yes	data
--	--	26 Tauri	23822	6.47	F0		No	data
Atlas	--	27 Tauri	23850	3.62	B8 III	spect. binary	Yes	data
Pleione	--	28 Tauri	23862	5.09	B8 IVevar	irreg. var.	Yes	data
--	--	--	23923	6.17	B8 V		Yes	data
--	--	--	23950	6.07	B8 III		Yes	data
--	--	--	23985	5.23	A2 V	variable	No	data
--	--	--	24368	6.34	A2 V	variable	No	data
--	--	33 Tauri	24769	6.05	B9.5 IV	ellips. var.	No	data

These computer-rendered images were generated by David Seal using his Solar System Simulator. For more information about the Cassini program, check out the Cassini home page. Web site:
http://www.jpl.nasa.gov/cassini/english/where/

Cassini web Home page:
http://www.jpl.nasa.gov/cassini/english/

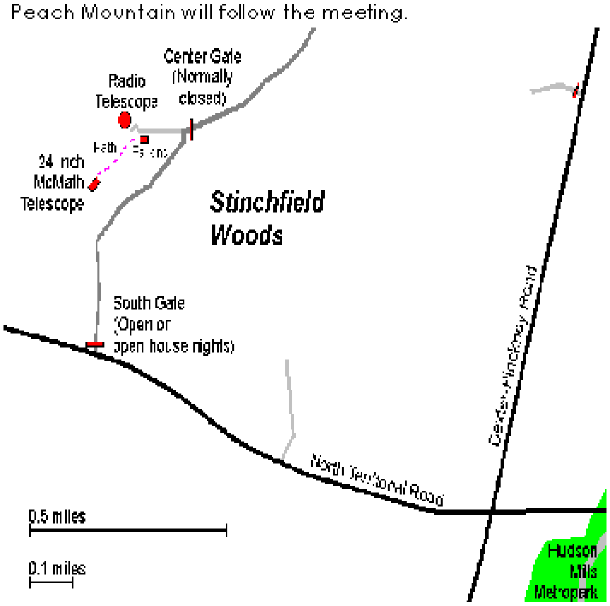
Text and images courtesy: NASA JPL ESC ASI (Italian Space Agency)

These images show SIMULATED views of and from the Cassini spacecraft. The upper left view shows Cassini on its trajectory to Saturn, as well as its speed with respect to the Sun and the distance it has traveled since launch. The upper right view shows the view to Earth from Cassini. The lower left view shows the view to the next body Cassini will encounter, and the lower right view shows the view to Saturn, Cassini's final destination.



Places and Times:

Dennison Hall, also known as The University of Michigan's Physics and Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. It is found in Ann Arbor on Church Street about one block north of South University Avenue. The meeting is held in room 130. Monthly meetings of the Lowbrows are held on the 3rd Friday of each month at 7:30 PM. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.



Peach Mountain Observatory is the home of The University of Michigan's 25 meter radio telescope as well as the University's McMath 24 inch telescope which is maintained by the Lowbrows. The observatory is located northwest of Dexter. The entrance is on North Territorial Road, 1.1 miles west of Dexter-Pickney Road. A small maize-and-blue sign marks the gate. Follow the gravel road one mile to a parking area near the radio telescopes. Walk along the path between the two fenced in areas (about 300 feet) to reach the McMath telescope building.

Public Star Parties:

Public Open House/Star Parties are held on the Saturday before and after each new Moon at the Peach Mountain Observatory. Star Parties are canceled if the sky is cloudy at sunset or the temperature is below 10 degrees F. Call 480-4514 for a recorded message on the afternoon of a scheduled Star Party to check on the status. Many members bring their telescopes and visitors are welcome to do likewise. Peach Mountain is home to millions of hungry mosquitoes - bring insect repellent, and it does get cold at night so dress warmly!

Amateur Telescope Making Group meets monthly, with the location rotating among member's houses. See the calendar on the front cover page for the time and location of next meeting.

Membership:

Membership dues in the University Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students and seniors (age 55/+). This entitles you to the monthly REFLECTIONS newsletter and the use of the 24" McMath telescope (after some training). Dues can be paid to the club treasurer Charlie Nielsen at the monthly meeting or by mail at this address:

6655 Jackson Road #415
Ann Arbor, MI 48103

Magazines:

Members of the University Lowbrow Astronomers can get a discount on these magazine subscriptions:

Sky and Telescope: $29.95 / year
Astronomy: $29.00 / year

For more information contact the club Treasurer. Members renewing subscriptions are reminded to send your renewal notice along with your check when applying through the club Treasurer. Make the check payable to "University Lowbrow Astronomers".

Newsletter Contributions:

Members and (non-members) are encouraged to write about any astronomy related topic of interest. Call or E-mail to Newsletter Editors at:

Bernard Friberg (743)761-1875 Bfriberg@aol.com
Chris Sarnecki (734)426-5772 chrisandi@home.net

to discuss length and format. Announcements and articles are due by the first Friday of each month.

Telephone Numbers:

President: Mark Deprest (734)662-5719
Vice Presidents: Dave Snyder (734)747-6537
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Lowbrow's Home Page:

http://www.astro.lsa.umich.edu/lowbrows.html
Dave Snyder, webmaster
http://www-personal.umich.edu/~dgs/lowbrows/

Monthly Meeting
January 19th, 7:30 pm
Room 130 Dennison Hall
Physics & Astronomy Building
The University of Michigan

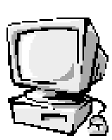
This month's meeting:

Dr. Carl Akerlof,
University of Michigan
Physics Department

Doing Forefront Astronomical Research with a 4" Refractor

Christmas Eclipse by John Ridley - This picture was taken with a Hi-8 Sony Handicam shooting handheld (OK, braced against a tree) with a solar filter (Baader SolarFilm) just pressed against the lens. Resolution suffers somewhat due to the fact that I used a lot of digital zoom. I tried max optical zoom and then cropping, but the digital zoomed pic looked better to me. Captured with Snappy 3.0

UNIVERSITY LOWBROW ASTRONOMERS
3684 Middleton Drive
Ann Arbor, Michigan 48105



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Check your membership expiration date on the mailing label !