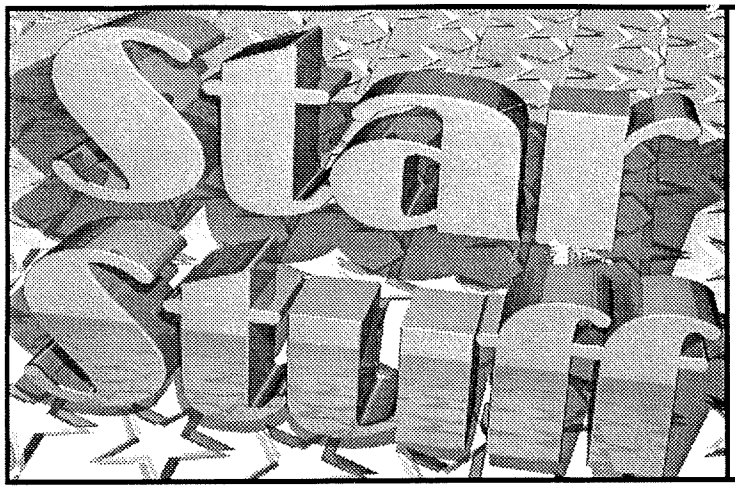

The Ford Amateur Astronomy Club Newsletter

Volume 4, Number 8 December 1995

HUBBLE PEERS INTO CROWDED HEART OF DENSEST STAR CLUSTER

By pinpointing individual suns in the glare of the most tightly packed cluster of stars in our galaxy, the Hubble Space Telescope has unveiled hints of either a massive black hole or another remarkable phenomenon: a "core collapse" driven by the intense gravitational pull of so many stars in such a small volume of space.

A team of astronomers used the telescope's sharp images to count an extraordinary number of stars in the ancient globular cluster M15, about 37,000 light-years away. Hubble spied hundreds of stars in a tiny area at the center of M15, whereas earthbound telescopes see a single blur of light. Careful analysis of the distribution of these and thousands of neighboring stars suggest that at some point in the distant past, the stars converged on M15's core, like bees swarming to their hive. This runaway collapse, long theorized by researchers but never seen in such detail, may have lasted a few million years—a flash in the 12-billion-year life of the cluster.

Thanks to the laws of physics, the core probably stopped collapsing before many of the stars collided. Rather, stars near the center would have settled into an uneasy cosmic waltz, both attracted to each other by gravity and repelled by close encounters that slingshot them through space. An alternate scenario also could explain the pileup of stars at M15's core: a black hole that may have formed early in the cluster's history. The black hole would have gradually gained mass as more stars spiraled inward. If it exists, it would now be several thousand times more massive than our sun.

The study, which will appear in the January 1996 issue of the Astronomical Journal, was led by Puragra Guhathakurta of UCO/Lick Observatory, UC Santa Cruz. Coauthors are Brian Yanny of the Fermi National Accelerator Laboratory, Donald Schneider of Pennsylvania State University, and John Bahcall of the Institute for Advanced Study in Princeton. All of the astronomers were associated with the Institute for Advanced Study when the research began.

A precise reading of the speeds at which stars move near M15's core would reveal whether the stars are packed so tightly because of the influence of a single massive object, or simply by their own mutual attraction. Stars would orbit more quickly in the grip of a black hole's gravitational field. Such measurements are time consuming but possible with the Space Telescope. "It is very likely that M15's stars have concentrated because of their mutual gravity," Guhathakurta says. "The stars could be under the influence of one giant central object, although a black hole is not necessarily the best explanation for what we see. But if any globular cluster has a black hole at its center, M15 is the most likely candidate."

The team began using Hubble to observe the centers of globular clusters in 1991 and now has data on about twenty clusters, but the images of M15 are by far the most stunning. Hubble's Wide Field Planetary Camera 2 (WFPC2) probed M15 in April 1994, four months after astronauts installed the corrective optics. "I first started thinking about this observation in 1970," says Bahcall. "I never expected that Hubble would see things as clearly as it does. The results are so exciting that they are a dream come true."

Bahcall and astrophysicist Jeremiah Ostriker of Princeton University first proposed in 1975 that M15 might harbor a black hole. While distinguished by its extreme density of stars, M15 is in other respects similar to the rest of the dozens of globular clusters that freckle space in and around our Milky Way. Each cluster is like a miniature galaxy, with 100,000 to one million stars in a compact spherical blob. The largest and closest—including M15, in the constellation Pegasus—are visible to the naked eye on dark nights as faint hazy patches.

Globular clusters contain almost no gas or dust and show few signs of recent star formation. Astronomers believe they are primordial remnants, left over from the birth of the Milky Way. As such, they are ideal laboratories for studying how stars evolve. Cluster stars also provide a limit on the age of the universe, independent of the expansion of the universe itself.

Stars at the core of M15 may be crowded closer together than anywhere in the Milky Way except in the galaxy's hidden heart. Attempted studies of this exotic locale with ground-based telescopes proved frustrating. Atmospheric blurring washed out the interesting details at the core. Astronomers used Hubble before its repair mission to examine M15, but even after correcting the distorted images they could not discern the true distribution of the innermost stars. In contrast, the latest WFPC2 photos of the inner 22 light-years of the cluster revealed about 30,000 distinct stars. That's a fraction of M15's population, but far more stars than scientists had ever imaged in such a small region of a globular cluster.

The astronomers used the Planetary Camera (the highest-resolution part of WFPC2) to study M15's core. The closer they looked toward the core, the more stars they found. This increase in stellar density continued all the way to within 0.06 light-years of the center—about 100 times the distance between the sun and Pluto.

"Detecting separate stars that close to the core was at the limit of Hubble's powers," Yanny says. Beyond that point, even Hubble's eagle eye could not reliably resolve individual stars or locate the exact position of the core. However, the researchers suspect that stars jam together ever more tightly inside that radius. The team plotted the distribution of the stars as a function of distance from the core. Computer simulations helped them include stars they may have missed when bright stars drowned out faint ones in the Hubble images. The resulting pattern matches the predictions of Bahcall and others for what would happen under the influence of a central black hole. But the pattern also is consistent with a core collapse, known as a "gravothermal catastrophe." Astronomers think the cores of about 20 percent of all globular clusters may have collapsed in this way.

For a gravothermal catastrophe to occur, globular clusters must transfer energy from the inner parts of the cluster to outer regions. As this happens, stars near the core lose some of the energy of their random ("thermal") motions. Several billion years might pass before the stars become too lethargic to resist the gravitational pull of their neighbors. At that point, they begin to collapse inward as a group. "It's a catastrophe in the sense that once it starts, this process can run away very quickly," Guhathakurta says. "But other processes could cause the core to bounce back before it collapses all the way." The major such process, researchers believe, is the powerful jolt of new motion that binary-star systems can impart to a third star that wanders too close—effectively spreading the stars out again. ✪

HUBBLE DISCOVERS NEW CLASS OF GRAVITATIONAL LENS

NASA's Hubble Space Telescope has discovered a new distant class of quadruple, or cross-shaped, gravitational lenses which might eventually provide astronomers with a powerful new "magnifying glass" for probing a variety of characteristics of the universe. The two gravitational lenses were discovered in about 100 fields of sky imaged by Hubble's Wide Field Planetary Camera 2 (WFPC 2). Because the combined area surveyed is about that of a full Moon, astronomers expect there may be as many as half a million similar lenses scattered across the heavens — though Hubble is expected to only detect about three per year through snapshots of the sky.

Hubble's high resolution allows astronomers to extend the search to much fainter, and hence much farther lenses, than those few examples ground-based telescopes have uncovered relatively nearby. Hubble can explore a larger volume of space which could provide enough examples of this rare cross type of lensing to allow astronomers to address a variety of fundamental cosmological questions. "This is a big jump for the young field of gravitational lenses — which was theory until less than two decades ago. This opens up a new class of lens, which is a galaxy with well understood properties," said Kavan Ratnatunga of Johns Hopkins University, Baltimore, MD. "The distinctive cross-like pattern around an elliptical galaxy makes them unambiguous quadruple lens candidates, even before spectroscopic observations, which are typically used to confirm lenses."

The discovery is reported by Ratnatunga and other astronomers of Johns Hopkins University in the November 1 issue of the Astrophysical Journal Letters. The first cross-shaped lens was discovered serendipitously by Eric Ostrander while processing HST images for the Medium-Deep Survey, a Hubble key project led by Richard Griffiths. A second fainter and smaller lens was identified a few weeks later by Myungshin Im. Each configuration is in the form of four faint blue images situated symmetrically around a much brighter red elliptical galaxy. A gravitational lens is produced by the enormous gravitational field of a massive object which bends light to magnify, brighten and distort the image of a more distant object. Depending on the alignment between the objects and the mass distribution of the foreground lens, the more distant object can be smeared into arcs or split into pairs, triples, or even quadruple images.

Gravitational lenses were predicted by Albert Einstein, though the resolution of ground-based optical telescopes at the time made him remark: "there is no great chance of observing this phenomenon". Since 1979, few examples of lensing have been observed. Arc-shaped, objects are the most common, followed by pairs of lensed objects. However, it is impossible to identify the true gravitational lenses without observations which show the two objects have exactly the same spectral fingerprint and so are "multiple" images of a single object. Bright quadruple lenses, which have a distinctive cross pattern, are extremely rare. Only two examples are known by ground-based surveys of the whole sky. The lensing objects for these cases are also unusual - the first lens, discovered in 1985 and dubbed the "Einstein cross", is a quasar lensed by a supermassive black hole at the center of a nearby bright galaxy; the other, discovered in 1988 and dubbed the "clover leaf", is a quasar lensed by an unseen mass.

More than simply showing lenses as astronomical curiosities, the new Hubble observation offers a new tool for probing the cosmos. The researchers say this may be as significant as the discovery of Cepheid variable stars earlier this century, that allow astronomers to measure cosmic distances to neighboring galaxies. Astronomers can use quadruple lenses to estimate the density of matter in space by comparing the redshift of the lensing galaxy and lensed object with the geometric distance (as measured by the angular deflection by the lens). If the density of matter is high, then space is positively curved and the universe will eventually collapse and come to an end. A low mass-density means the universe will expand forever.

"Preliminary analysis of the two new HST lenses seems to suggest that the density of matter in space is probably low enough to allow the universe to expand forever," said Myungshin Im. A sample of at least a dozen lenses of this type is needed before a more definitive estimate can be made. Detailed image analysis of the lens has also been used to probe the distribution of dark matter in the foreground galaxy. "The model for the observed lens configuration clearly shows that the mass of these galaxies consists of predominantly dark matter in a very elliptical distribution", said Ratnatunga. This shows that the mysterious dark matter is more than 90% of the mass of a typical elliptical galaxy and provides an upper limit to the masses of black holes that may dwell at the centers of these galaxies. ✪

STAR STUFF
Monthly Publication of the Ford Amateur Astronomy Club

Star Stuff Newsletter
P.O. Box 7527
Dearborn, Michigan 48121-7527

1995 CLUB OFFICERS

President:	Chuck Boren	24-83446
Vice President:	John St. Peter	313-535-2755
Secretary:	Harry Kindt	313-835-1831
Treasurer:	Al Czajkowski	84-57886

GENERAL MEETINGS

The Ford Amateur Astronomy Club holds regular general meetings open to the public on the fourth Thursday of the month at 5:00 PM. Meetings are held at the Ford Motor Credit Company (FMCC) building, Northeast of the World Headquarters build in Dearborn, in conference room 1491, lower floor, East side of the building.

OBSERVING SITE

The Ford Amateur Astronomy Club has an established observing site, by permit, at the Spring Mill Pond area of the Island Lake Recreational Area in Brighton, Michigan located near the intersections of I-96 and US-23. Members are responsible for opening and closing the gate after the parks 10:00pm closing time. The combination for the lock should be available on our hotline number. Always close the gate behind you after 10:00pm whether entering or leaving the park.

OBSERVING HOTLINE NUMBER - (313) 39-05456

On Friday and Saturday nights, or nights before holidays, you can call the hotline number up to 2 hours before sunset to find out if we will be observing that night. Assume that any clear Friday or Saturday night is a candidate observing night unless something else is going on or none of the club officers are able to make it.

MEMBERSHIP AND DUES

Membership to the Ford Amateur Astronomy Club is open to both Ford and Non-Ford Motor Company employees. The general public is also welcome to join. The dues structure is as follows:

Annual Individual/Family	$20.00
Lifetime Membership	$100.00

Membership benefits include a subscription to the Star Stuff newsletter, discounts on subscriptions to Astronomy and/or Sky & Telescope magazine(s), after hour use of the observing site at Island Lake Recreation Area, and discounts at selected area astronomical equipment retailers.

NEWSLETTER STAFF

Editor:	Paul Mrozek (pmrozek@pms061.pms.ford.com) (PROFS = pmrozek)	313-33-73619
Contributing Editors:	Greg Burnett	

NEWSLETTER SUBSCRIPTION

A yearly subscription at a rate of $12.00 is available to those who are not members of the Ford Amateur Astronomy Club. Subscription are free to any other astronomy clubs wishing to participate in a newsletter exchange.

Articles presented herein represent the views and opinions of their authors and not necessarily those of the Ford Amateur Astronomy Club or the Star Stuff Newsletter. Commercial advertisers appearing in the newsletter are not endorsed or in any way affiliated with Ford Motor Company, the FAAC, or Star Stuff newsletter.

DECEMBER 1995

SUN	MON	TUE	WED	THU	FRI	SAT
31					1	2
3	4	5	6 ○	7 FAAC Meeting	8	9
10	11	12	13	14 Geminid peak	15 ◑	16
17	18	19	20	21 ●	22 Winter solstice	23
24	25	26	27	28 ◑	29	30

Dec 06 Full Moon (8:30 pm EST +/- 2 mins)
Dec 06 Comet Perrine-Mrkos Perihelion
Dec 13 Geminids Meteor Shower
Dec 15 Last Quarter Moon (0:36 am EST +/- 2 mins)
Dec 21 New Moon (9:25 pm EST +/- 2 mins)
Dec 22 Winter Solstice (3:18 am EST +/-15 mins)
Dec 22 Ursids Meteor Shower
Dec 25 Comet Honda-Mrkos-Pajdusakova Perihelion
Dec 28 First Quarter Moon (2:09 pm EST +/- 2 mins)

MEETING ANNOUNCEMENT

The Ford Amateur Astronomy Club (FAAC) holds regular general meetings on the fourth Thursday of each month, except November and December. Our next meeting will be **Thursday, December 7, at 5:30 p.m.**

The program for the meeting will be a presentation by Dr. Donald Bord from the Department of Natural Sciences at the University of Michigan-Dearborn. Dr. Bord's presentation will be similar to his October lecture on "The Interstellar Medium and Star Birth."

The FAAC meets in the Ford Motor Credit Company (FMCC) building, conference room 1491, located on the lower floor on the east side. FMCC is the low building immediately northeast of (but not attached to) Ford World Headquarters in Dearborn. The FMCC building is secured with a card entry system. The easiest way to enter the building for meetings is to park in the northeast lot (Employee Lot 7) and enter through the lower northeast door or lower east door. At 5:00 pm no one seems to have much trouble getting in because many people are leaving around that time. At the east door you can dial 0911 on the security phone and say that you are here to attend a Ford club meeting, and security will admit you. You may, of course, find your way into the building any way you see fit, but direction signs will only be posted fromthe lower northeast and lower east doors. ✪

CALL FOR NOMINATIONS

The Ford Amateur Astronomy Club is calling for nominations for the offices of President, Vice-President, Secretary and Treasurer. If you would like to run for one of the offices or would like to submit the name of a nominee, please contact one of the members of the nominating committee, listed below. Nominations are being held open until our January 1996 meeting at which time nominations will be accepted from the floor. The election of officers will take place at our February meeting. Keep in mind that nominees for the position of President and Treasurer must be current employees of The Ford Motor Co., the positions of Secretary and Vice President may be selected from the at large membership.

Nominating Committee:

Harry A. Kindt 73521,1710@compuserve.com; Phone: 313-835-1831
Chuck Boren III cboren (PROFS); Phone: 24-83446 ✪

DECEMBER SPACE HISTORY

by Harry A. Kindt (73521.1710@compuserve.com, or hakindt@aol.com)

Dec 01 1988 Atlantis (US) launched.
Dec 02 1594 Gerardus Mercator died.
1971 Mars 3 (USSR) made the first soft landing on Mars.
1974 Soyuz 16 (USSR) launched.
1988 US space shuttle launched on a secret mission.
Dec 03 1973 Pioneer 10 (US) made the first flyby of Jupiter.
Dec 04 1965 Gemini 7 (US) launched.
1978 Pioneer Venus 1 (US) became the first craft to orbit Venus.
Dec 06 1957 First US satellite launch attempt (max. altitude, 5 feet).
Dec 07 1972 Apollo 17 (US), final manned lunar landing mission, launched.
Dec 10 1977 Soyuz 26 (USSR) launched.
1984 First "planet" outside our solar system discovered.
Dec 11 1863 Born, Annie Jump Cannon, American astronomer.
1719 First recorded sighting of the Aurora Borealis.
1972 G. Cernan and H. Schmitt (Apollo 17) landed on the Moon.
Dec 12 1970 Explorer 42 launch, 1st orbiting X-ray astronomy platform.
Dec 14 1546 Born, Tycho Brahe, Danish astronomer and mathematician.
1962 Mariner 2 was first spacecraft to pass another world (Venus).
Dec 15 1965 Gemini 6 (US) launch.
1970 Venera 7 (USSR) became the first craft to soft land on Venus.
1984 Vega 1 (USSR) launched.
Dec 16 1965 Pioneer 6 (US) launch.
Dec 17 1969 "Project Blue Book" (US Air Force UFO investigation) closed.
Dec 18 1958 Atlas satellite (US) launched.
1965 A US spacecraft returned to Earth after 14 days in orbit.
1973 Soyuz 13 (USSR) launched.
Dec 19 1971 Intelsat 4 F-3 (US) launched.
1972 Apollo 17 splashed down.
1984 Cosmos 1614 (USSR) (unmanned space shuttle) launched.
Dec 21 1969 Apollo 8, first manned spacecraft to orbit the Moon, launched.
1988 Space endurance record of 365 days set (USSR)
Dec 23 1672 Giovanni Cassini discovered Saturn's moon Rhea.
Dec 24 1968 Apollo 8 became the first manned craft to orbit the MOON.
Dec 25 1642 Born, Sir Isaac Newton, English mathematician & scientist.
Dec 27 1571 Born, Johannes Kepler, German astronomer & mathematician.
1968 Apollo 8 astronauts returned to Earth after 10 Moon orbits.
1984 First artificial comet made.
Dec 28 1948 US announced a study to launch an Earth satellite.
1973 Come Kohoutek at perihelion.
Dec 30 1873 American Meteorological Society formed.

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DECEMBER 1995 SPACE EVENTS

The following December 1995 events come from the 10/27/95 edition of "Space Calendar." This calendar is compiled and maintained by Ron Baalke (baalke@kelvin.jpl.nasa.gov). Note that launch dates are subject to change.

Dec ?? P91-1/Argos Delta-2 Launch
Dec ?? LIFESAT-03 Launch
Dec ?? Data Relay Satellite Launch (ESA)
Dec ?? Koreasat-2 Delta 2 Launch
Dec ?? IRS-1C Molniya Launc (Russia)
Dec 02 Galileo, Trajectory Correction Maneuver #28A (TCM-28A)
Dec 02 XTE (X-Ray Timing Explorer) Delta 2 Launch
Dec 05 Molniya Molniya Launch (Russia)
Dec 06 Comet Perrine-Mrkos Perihelion
Dec 06 GLONASS Proton Launch (Russia)
Dec 07 Galileo, Io Gravity Assist
Dec 08 Galileo, Jupiter Orbit Insertion (JOI), 12:23 AM UTC
Dec 09 Galileo, Orbital Trim Maneuver #1 (OTM-1)
Dec 09 POLAR Delta Launch
Dec 14 Galaxy III-R Atlas IIA Launch
Dec 15 Progress M-30 Soyuz Launch (Russia)
Dec 19 Galileo, Solar Conjunction
Dec 20 Panamsat-3R/Measat-1 Ariane 4 Launch
Dec 27 Gorizone Proton Launch (Russia)
Dec 29 NOAA-K Titan 2 Launch ✪

WEATHER AND ASTRONOMY

from Todd Gross (toddg@weatherman.com)

Starting April 1, 1995, I began publishing a 12-month series of articles devoted to Weather and Amateur Astronomy. This month's feature is "Weather and Solar Eclipses." Please note, that while I may speak authoritatively, I am just an amateur astronomer, like you, and all the information above reflects my personal opinion(s) only based on my experiences to date.

The first, and most obvious change is the temperature. It goes down. Sometimes way down. Even though the sky darkens only slightly up to totality, by the time you reach over 90% eclipse, there is over 90% loss in incoming solar radiation to warm your part of the Earth. If winds are light, and skies clear, radiational cooling will take place, just as it would at sundown, with a loss of 10°-20° not impossible. If the wind is high or the clouds are thick, then smaller temperature decreases will take place, just as they would on a cloudy, windy night.

With the drop in temperature comes something called "subsidence". That is the lack of any "lift" to the air, and in fact, a resumption of night-time like settling of cooling air downwards. This will under most circumstances aid in breaking up building cumulous clouds that may have formed during the day until the eclipse started. You see, the sun shining strongly on the Earth, tends to produce cloudiness, in many situations, as it produces rising air currents. As these air currents get "shut off", and the air begins to settle, the puffy, rolly polly clouds will flatten, and then diminish. However, if this process happens when the cumulous clouds have already built up into towering thunderstorms, then even an eclipse won't solve the problem!.

A great example of this decreasing cloudiness happened on May 10, 1994. With an unstable air mass over the Northeast, it appeared likely that a partly cloudy day was in store. Indeed my forecast on Television for that day was "developing clouds, diminishing during the eclipse.... " Sure enough, skies which featured broken clouds, gave way to hardly any at all throughout New England, as the eclipse reached towards it's Annularity!

The flip side of the temperature drop though, and cloud formation comes when you are dealing with low clouds, and fog. One important thing to remember is that when the temperature drops, the relative humidity of the air near the ground rises. Thus low lying stratus clouds, as opposed to the cottony cumulous clouds mentioned above, are more apt to stick around when the sun is not shining brightly. If you are starting the day with a low strataform overcast, perhaps with some fog, or drizzle, and the sun is required to burn away those conditions (such as often happens in Los Angelos, Ca.) then you will not be served well by a solar eclipse! That is why I would recommend early afternoon eclipses over morning ones. Remember, if the air is not dry to begin with, then the decrease in temperature will also cause an increase in humidity, that is what happened in Hawaii in 91' that brought the cloud deck back (some of us saw the burning away of the cloud deck from our vantage point prior to the clouds return, others were not able to detect this). With this in mind, here are some things to look for to improve your chances of seeing an eclipse, despite the weather!

1. Pick a site that is known to have more sunny days
2. Pick an eclipse Midday, after the humidity has already been worked out of the air by the sun, but before clouds have built up to their final late afternoon stages. (Also, you have more chance of seeing the sun between the clouds when it is higher in the sky)
3. Pick a local site on a main road, where you can dart to a "hole" in the clouds at the last minute... or better yet, get to another location down the highway at the last minute, because you "know" the weather is better there from some sort of communications you have rigged up such as a laptop computer, cell phone, tie-in to weather data, etc. (Email me for ideas on where to get such data if you like)
4. If you can (like in the European eclipse in Aug, 1999), don't settle on a site until after 24-48 hrs. before the eclipse, and base your site on the weather forecast! You have a number of cities you can end up in along the path of totality....many of which you can drive to at the last minute, if you pick an interim location well.

Well, my next eclipse was planned back on July 11, 1991, while listening to my son tell me he missed his "favorite" part (the corona), and that is going to be in the Carribean in 1998. Hopefully mother nature, and a little bit of luck and good planning will be on my side this time!

ASTRO TRIVIA

by Paul Mrozek (pmrozek, pmrozek@pms061.pms.ford.com)

On the one year anniversary of this column, I thought I might update some of the questions from the first edition.

Q: Who invented the telescope?

A: The German-Dutch lens grinder Hans Lippershey was the first person to apply for a patent on the invention, but he did not make the initial discovery. While Lippershey was away one day, his apprentice was playing with the lenses and accidentally found a combination that made things appear closer. When he was shown this unique result, Lippershey enclosed the lenses at two ends of a tube.

Q: Is it true that the Earth is closer to the Sun in the Winter than in the Summer in the Northern Hemisphere?

A: As I stated last year, the Earth is closest to the Sun (its perihelion) around January 3, but the Northern Hemisphere is tilted away from the Sun at this time (hence the colder Winter temperatures). I then posed a question if the Southern Hemisphere has colder Winters and warmer Summers compared to the Northern Hemisphere. I was never able to find a good answer until I recently saw the following discussion in the USENET newsgroup sci.astro.

From: hdaumas@ja2.jsc.nasa.gov
Organization: NASA Johnson Space Center, Houston, TX, USA
Subject: Earth Perihelion/Aphelion question

I have what may be a trivial question to some of you, but which confuses me. I hope someone can shed some light on it for me. The premise of my question is the following:

The difference between earth's perihelion and aphelion is approximately 3 million miles. Perihelion coincides with the southern hemisphere's summer season, while aphelion coincides with the northern hemisphere's summer season. At perihelion in January, the southern pole of the earth is tilted 24 degrees toward the sun, the southern hemisphere receives most of the radiant heat from the sun due to the tilt, and the earth is 91.4 million miles away from the sun. Conversely, at aphelion in July, the northern pole of the earth is tilted 24 degrees towards the sun, the northern hemisphere is receiving most of the radiant heat from the sun due to the tilt, but the earth is 3 million farther from the sun at 94.4 million miles.

Since the earth is closer to the sun when the southern hemisphere is having its summer, than when the northern hemisphere is having its summer, does this mean that the southern hemisphere's summer is hotter than the northern hemisphere's? Likewise is the southern hemisphere's winter colder than the northern hemisphere's winter? Is the 3 million miles insignificant?

I would expect to see the average temperature of the southern hemisphere to be both hotter and colder in the winter and summer respectively than the northern hemisphere, due to the 3 million mile difference. Is this not true? If not, why? Thanks for any information on this subject

---

From: jfh3@cus.cam.ac.uk (Dr J.F. Harper)
Organization: University of Cambridge, England
Subject: Re: Earth/Perihelion/Winter question

>I would expect to see the average temperature of the southern hemisphere
>to be both hotter and colder in the winter and summer respectively than
>the northern hemisphere, due to the 3 million mile difference.

Your expectation would be correct if the distribution of continents and oceans was the same in the Northern and Southern hemispheres. But most of the land is in the Northern hemisphere. Oceanic climates are more equable, other things being equal. (Compare summer temperatures in, say, Colorado and at the same latitude on the US Pacific coast)

(continued on page 5)

(continued from page 4)

From: strobel@u.washington.edu (Nicolas Strobel)
Organization: University of Washington
Subject: Re: Earth/Perihelion/Winter question

It's due to the amount of water in the southern hemisphere vs. how much is available in the northern hemisphere (take a globe and look at it from above the north pole and contrast that with what you see looking at it from above the south pole). Land heats up/cools off faster than water does. Air and ocean currents will also play an effect in how the temperature is distributed. Also the Earth's nearly circular orbit keeps things moderate. The Earth's orbital eccentricity is only 0.0167 so at perihelion it is 2*0.0167/(1+0.0167) times closer than at aphelion and receives 1/((1-2*0.0167)*(1-2*0.0167))= 1.07 times more solar energy than at aphelion. Mars on the other hand is an extreme case for the reason along the lines you're querying about.

Mars' southern hemisphere has extreme seasons because it is tilted away from the sun when it is farthest from the sun in its more elliptical orbit (than Earth's). The southern hemisphere is tilted toward the sun when it is closest to the sun. Mars' orbital eccentricity is 0.0934 and it receives 1.45 times more solar energy at perihelion than at aphelion. Also, the lack of lots surface water and a very thin atmosphere prevents significant energy storage and transport.

From: jfh3@cus.cam.ac.uk (Dr J.F. Harper)
Organization: University of Cambridge, England
Subject: Re: Earth/Perihelion/Winter question

>If I may restate what you are saying, then there is no "apparent" temper-
>ature difference due to the unequal distribution of continents and oceans
>between the hemispheres.

I did not say that. What I tried to say was that the astronomical heat input is not the only thing determining terrestrial temperatures, and the other important effect is the distribution of continents and oceans. In the middle of a continent in temperate latitudes summers are hotter and winters colder than in coastal or island regions at the same latitude. Another point I didn't make but probably should have, is that ocean currents can make a big difference. The classic example is the Gulf Stream which keeps western Europe much warmer than eastern USA and Canada in winter at the same latitude. ✪

PHYSICS NEWS UPDATE

from The American Institute of Physics Bulletin of Physics News (physnews@aip.org)

PROBLEMS WITH BIG BANG NUCLEOSYNTHESIS? Along with the expansion of the universe and the cosmic microwave background, the most prominent artifact of the big bang is the synthesis of several species of light nuclei, namely D, He-4, He-3, and Li-7, only seconds after the explosion. Cosmologies which make predictions of the amount of early nucleosynthesis must account for the present-day abundances of these nuclei, consisting of the primordial inventory plus any that may have been manufactured (or destroyed) in the cores of stars. Measurements (particularly of He-4) have improved over the years to such an extent that various theories can now (or soon) be put to the test. Not only are cosmological theories at stake but various features of the standard model of particle physics. For example, the more species of "light" neutrinos (meaning neutrinos which are massless or nearly so; particle theory suggests three species: electron, muon, and tau) there are, the faster the early universe would have expanded, leaving behind more neutrons, which in turn would lead to a larger amount of He-4. Although the measurement uncertainties are still considerable, the observed abundances of He-4 and D seems to be at odds with the main big bang model. Two groups, publishing papers in the same upcoming issue of Physical Review Letters, assess this discrepancy. One group (N. Hata et al.; Ohio State) suggest that although the data might be at fault, one or more factors, maybe betokening "new physics," might be at work. An example of this would be a tau neutrino with considerable mass. The other group (Craig J. Copi et al.; U of Chicago), however, suggests that within the uncertainties the data and the standard theory are still consistent with each other. ✪

ASTRONOMY WORKSHOP

The following article was reprinted from ASTRONET, Issue 21, September 1, 1995. For more information, please contact resource@rahul.net.

WINTER OBSERVING
by Ian Gore (gore@trucks.enet.dec.com)

The first thing to remember about Winter observing is that it's cold! That should be stating the obvious, but I've had people turn up at observing sessions in shirt sleeves and then complain about the temperature. Even being slightly cold is bad news. The body tries to maintain its temperature by converting chemical energy stored in the muscles to heat; you shiver, which makes observing somewhat difficult. Over time, a lassitude develops, again doing nothing for the quality or enjoyment of your observing. As an aside, I'm told that, because of that lassitude, freezing to death is quite a pleasant way to go. I'd be interested to hear from anyone who's experienced it! As its temperature falls, the body employs techniques known as non shivering thermogenesis to try and keep warm. By this time though, I doubt that you'd have much interest left in astronomy! So, in no particular order, here are some pointers for keeping warm:-

1) The first* rule an Eskimo learns is "don't sweat". This may seem odd advise, but struggling to carry and setup a heavy 'scope can be quite a sweaty business. Get help or carry several light loads. Some thermal underwear, e.g. "Lifa", works by wicking sweat away from the skin. This shouldn't be necessary so it's not much use in these circumstances. (It's great for skiing and backpacking though!)

2) Stay out of the wind. The wind chill from even a light breeze can make life miserable. If you can't, then wear a windproof jacket and trousers. For preference these should be made of a "breathable" material such as Goretex to reduce the possibility of moisture condensing on the inside of the clothing and wicking its way back to your skin. Elastic cuffs at wrists and ankles help keep the wind out. Avoid towelling cuffs though, they tend to get wet.

3) Keep your head covered. About 20-30% of body heat is lost from the head. (It used to be thought that the brain was a radiator for cooling the blood!)

4) Wear several layers of light clothing rather than a few heavy layers. The best defence against cold is insulation, and air is a pretty good insulator. By wearing several layers you trap more air. Although mountaineering jackets used to be made of a heavy cotton material, in general, cotton is a poor insulator and denim jeans are especialy bad. The clothes should be a reasonably snug fit to prevent the air moving around, but...

5) Don't have the clothing too tight, it restricts the blood flow and allows the extremities to cool. Mittens are generaly better than gloves as they are less restrictive and allow the fingers to share their warmth.

6) Make sure you keep your trunk warm. It's the extremities that most feel the cold, but the trunk is where most of the heat's generated. Don't waste it. It pays to have a good overlap between jacket and trousers, if only to keep your kidneys warm. Why should you be concerned about that? Well, ...

7) Try and avoid "lavatorial functions". Quite apart from not wanting to expose any more extremities to the elements, you're throwing heat away. Again, there's a "but".

8) Make sure you're fed and watered. Your body heat ultimately comes from the food you eat, while cold can increase the rate of dehydration. Glucose is a good energy source, and I've heard that sucking boiled sweets helps observing, though that may be for different reasons.

9) Make sure your feet are well insulated. Most heat loss is via convection, but conduction to the ground should be avoided. Again, multiple layers are best. If you're going out in snow, avoid boots with cleated soles. Snow gets trapped in the cleats and speeds up the conduction.

10) Don't drink alcohol. It causes the small blood vessels near the surface of the skin to dilate, and hence increases the blood flow through them. This gives the temporary illusion of warmth, but in reality you're just causing the body to lose heat more rapidly.

* The second rule is "don't eat the yellow snow!" ✪

COSMIC RAY MYSTERY SOLVED?

Physicists from Japan and the United States have discovered a possible solution to the puzzle of the origin of high energy cosmic rays that bombard Earth from all directions in space. Using data from the Japanese/U.S. X-ray astronomical satellite ASCA, physicists have found what they term "the first strong observational evidence" for the production of these particles in the shock wave of a supernova remnant, the expanding fireball produced by the explosion of a star. "We are very pleased to contribute to the solution of an 83-year old mystery," said Dr. Koyama, of the Department of Physics at Kyoto University, Kyoto, Japan. Cosmic rays were discovered in 1912 by the Austrian physicist Victor Hess, who subsequently received the Nobel Prize in Physics for that work. They are subatomic particles, mostly electrons and protons, that travel near the speed of light. Ever since their discovery, scientists have debated where cosmic rays come from and how ordinary subatomic particles can be accelerated to such high speeds. Supernova remnants have long been thought to provide the high energy cosmic rays, but the evidence has been lacking until now.

The international team of investigators used the satellite to determine that cosmic rays are generated at a high rate in the remains of the Supernova of 1006 AD — which appeared to medieval viewers to be as bright as the Moon — and that they are accelerated to high velocities by a process first suggested by the nuclear physicist Enrico Fermi in 1949. The satellite contains telescopes for simultaneously taking images and spectra of X-rays from celestial sources, allowing astronomers to distinguish different types of X-ray emission from nearby regions of the same object. The tell-tale clue to the discovery was the detection of two oppositely-located regions in the rapidly expanding supernova remnant, the debris from the stellar explosion. The two regions glow intensely in what is called synchrotron radiation, which is produced when electrons move at nearly the speed of light through a magnetic field in space. The remainder of the supernova remnant, in contrast, produces ordinary "thermal" X-ray emission, meaning radiation from hot gases such as oxygen, neon, and gaseous forms of magnesium, silicon, sulfur, and iron.

The cosmic rays are accelerated in the two regions that glow with synchrotron radiation, the physicists concluded. Specifically, charged particles are accelerated to nearly the speed of light and energies of 100 trillion electron volts as they bounce off turbulent regions inside the shock front from the supernova explosion. This amount of energy is over 50 times higher than can be produced in the most powerful particle accelerator on Earth. Like a ping pong ball bouncing between a table and a paddle while the paddle is brought ever closer to the table, an electron, proton or an atomic nucleus bounces back and forth within the supernova remnant, continually gaining speed, until it attains a high energy. This process was first proposed as a theory by Fermi in 1949.

"Since we found cosmic ray acceleration under way in the remnant of Supernova 1006, this process probably occurs in other young supernova remnants," according to Dr. Robert Petre, of NASA's Goddard Space Flight Center's Laboratory for High Energy Astrophysics, Greenbelt, MD. Astronomers estimate that there is a supernova explosion in the Milky Way galaxy, which contains the Earth, about once every 30 years. Supernova 1006 is classified by astronomers as the explosion of a white dwarf star, known as a Type IA supernova. Other types of supernovae, involving the collapse of massive stars in the Milky Way, and in galaxies beyond, may also produce cosmic rays.

The discovery observations were made with solid-state X-ray cameras on the ASCA satellite, which was launched from Kagoshima Space Center, Japan. Major contributions to the scientific instrumentation were provided by Goddard's Laboratory for High Energy Astrophysics and by the Center for Space Research at M.I.T. "The capability to obtain spatially resolved X-ray spectra — that is to determine the different spectra at various locations in an image — is a tremendous advance in space technology," said Dr. Stephen Holt, Director of Space Sciences at Goddard.

Approximately 25 cosmic rays bombard one square inch every second in space just outside the Earth's atmosphere. The atmosphere shields the surface of the Earth from these "primary" cosmic rays. However, collisions of the primary cosmic rays with atoms in the upper atmosphere produce slower moving "secondary" cosmic rays, some of which reach ground level and even may penetrate to depths of many feet below the ground. ✪

GHOST OF COMETS PAST

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From explorer@filebank.com

"When its discoverer saw that blob of fuzz on his photographic plates, the comet was about 450 million miles from the sun ... For it to have been already visible to instruments nine months before it reached that closest point meant without doubt that it was an enormous comet, and unprecedentedly brilliant, perhaps, according to the science correspondent of The Times, about ten times more brilliant than any known comet since astronomers began keeping accurate records."[1]

Comet Hale-Bopp was discovered last July 23 by PhD astronomer Alan Hale of New Mexico State University, and Thomas Bopp, an amateur astronomer in Phoenix. At Hale-Bopp's distance from the sun at its discovery, it was 1000 times brighter than Comet Halley was at the same distance. This fact has led some to speculate that Hale-Bopp will be the astronomical event of the century. Maybe ... but just keep this in mind. The quote above is not about Comet Hale-Bopp. Rather, it refers to one of astronomy's greatest duds — Comet Kohoutek, or as some called it Comet Kohou*flop*.

So, similarities to Kohoutek aside, what can we expect from Hale-Bopp? I hate to hedge, but the fact is that we simply don't know. Astronomers have learned a great deal from the studies of Comet Halley in 1986, including up-close images by the European spacecraft Giotto and others. One project being considered, called Stardust, would rendezvous with a comet and return some of the "comet dust" back to Earth. But we still don't know enough to make accurate predictions about a comet so far from the sun.

We know that comets far from the sun typically are faint and dull. As they approach the sun they begin to brighten because surface materials (ices) on the comet's nucleus begin to sublimate or turn directly to gas. The comet brightens due to increased reflection of sunlight, and from a process of fluorescence as the gas molecules are excited (energized) by solar radiation.

Currently the comet is faint and very difficult to see in the constellation Sagittarius. By December it will be awash in the glare of the sun and not visible again until next spring. If all goes as hoped, observers in the Northern Hemisphere may be able to locate Hale-Bopp easily in binoculars next fall. In the spring of '97, it may be visible to the naked eye — it may even become the "Comet of the Century." Or it may not. And I say that with complete confidence.

By the way, at its discovery Comet Hale-Bopp was 666 million miles from the sun, a fact that has contributed to some minor hysteria over the "Doomsday Comet" that will destroy Earth. The number 666 is the Biblical "mark of the beast" or the sign of the Devil. In reality, Hale-Bopp will never venture closer than 120 million miles from Earth.

[1] "The Comet" by Douglas Hill, New English Library, 1973, page 10. ✪

LEAP SECOND ON 12/31/95

from Dennis D. McCarthy, Acting Director of Time, U.S. Naval Observatory

TIME SERVICE ANNOUNCEMENT SERIES 14, UTC TIME STEP

1. The International Earth Rotation Service (IERS) has announced the introduction of a time step to occur at the end of December 1995.
2. Coordinated Universal Time (UTC) will be retarded by 1.0s so that the sequence of dates of the UTC markers will be:

1995 December	31	23h	59m	59s
1995 December	31	23h	59m	60s
1996 January	01	0h	0m	0s

3. The difference between UTC and International Atomic Time TAI is:

from 1994 Jul. 1, 0h UTC, to 1996 Jan. 1, 0h UTC: TAI-UTC = +29s
from 1996 Jan. 1, until further notice: TAI-UTC = +30s ✪

SKY & TEL. NEWS BULLETINS

from the editors of SKY & TELESCOPE magazine

GALILEO: GOOD NEWS, BAD NEWS

Galileo's faulty tape recorder has responded to commands from Earth, so it's not broken. The suspicion is that part of the tape has weakened, causing it to slip in the transport mechanism. So the recorder has been commanded to wind over the suspect segment 25 times and to make that portion "off limits" for the rest of the mission. The good news is that this fix should not jeopardize the return of some 2,000 images of Jupiter and its moons planned in the months ahead. The bad news is that a test image of Jupiter, taken October 11th, is on the damaged segment and will not be played back.

The *really* bad news is that, as a precaution, project managers have decided to forego virtually all scientific measurements by the orbiter on December 7th, when it reaches the planet. Instead, all the available tape and free computer memory will be devoted to recording more than an hour of data from Galileo's probe as it descends through the Jovian atmosphere. That means there will be no pictures and infrared maps of Io, even though the spacecraft comes only 1,000 km from its colorful, volcanic surface. Nor will there be any scans of the south pole of icy Europa. "Our priorities are clear," says project manager William O'Neil. "We have to get all the probe data."

THE FACE OF VESTA

Planetary astronomers recently got their first look at a crude compositional map of the asteroid 4 Vesta, thanks to images taken at several key wavelengths by the Hubble Space Telescope. Vesta, the third largest asteroid, is known to exhibit bright and dark markings. The new Hubble data suggests that one hemisphere is dominated a type of basalt similar to many lava flows on the Earth's surface. The other half has the spectral signature of a basalt that solidified underground. Each of these rock types are also found in specific types of meteorites, called eucrites and diogenites, and it's widely thought that Vesta is their source. According to Hubble investigator Ben Zellner, the big asteroid also has a distinct dark circular area roughly 200 kilometers across.

GLIESE 229B: A BROWN DWARF?

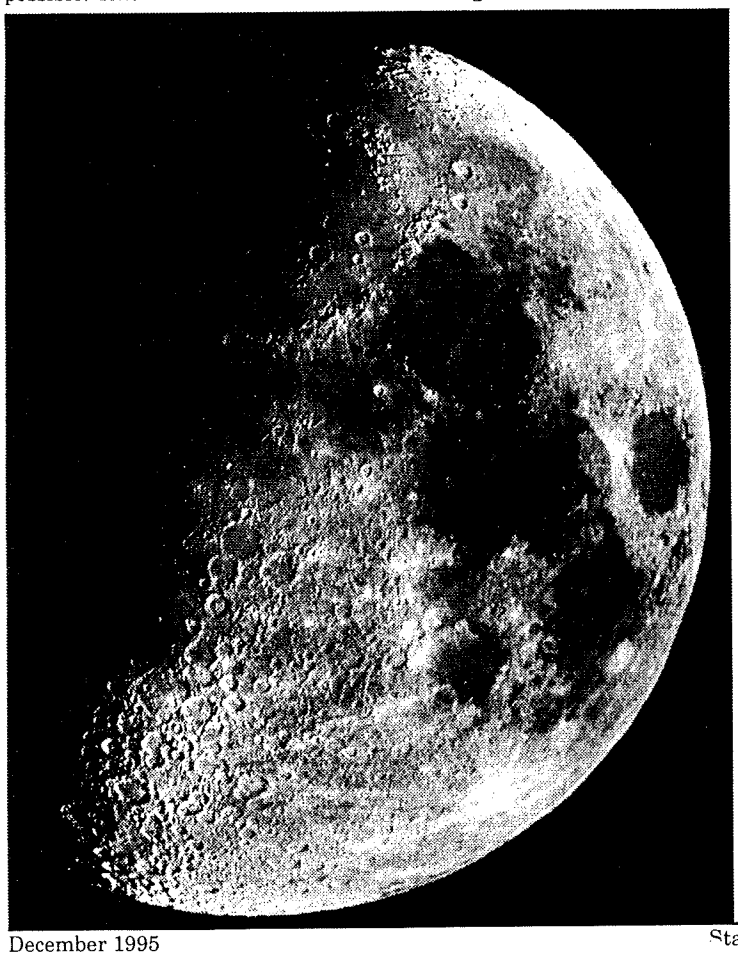
At the same meeting that made 51 Pegasi a household word last October, astronomers also learned about a billion-year-old brown dwarf. Gliese 229B was discovered by Tadashi Nakajima and others lurking just 7 arcseconds from an 8th-magnitude M-type red dwarf only 19 light-years from Earth. The object glows feebly at a few millionths our Sun's luminosity and looks redder at infrared wavelengths than any known star. Because the star it orbits (Gliese 229A) has an apparent age of at least a billion years, Gliese 229B has probably dimmed somewhat since forming and thus must have roughly 50 times Jupiter's mass to be seen at all. Because they lack the mass required to sustain hydrogen fusion, brown dwarfs are only dimly visible and may exist undiscovered in huge numbers throughout the galaxy. ✪

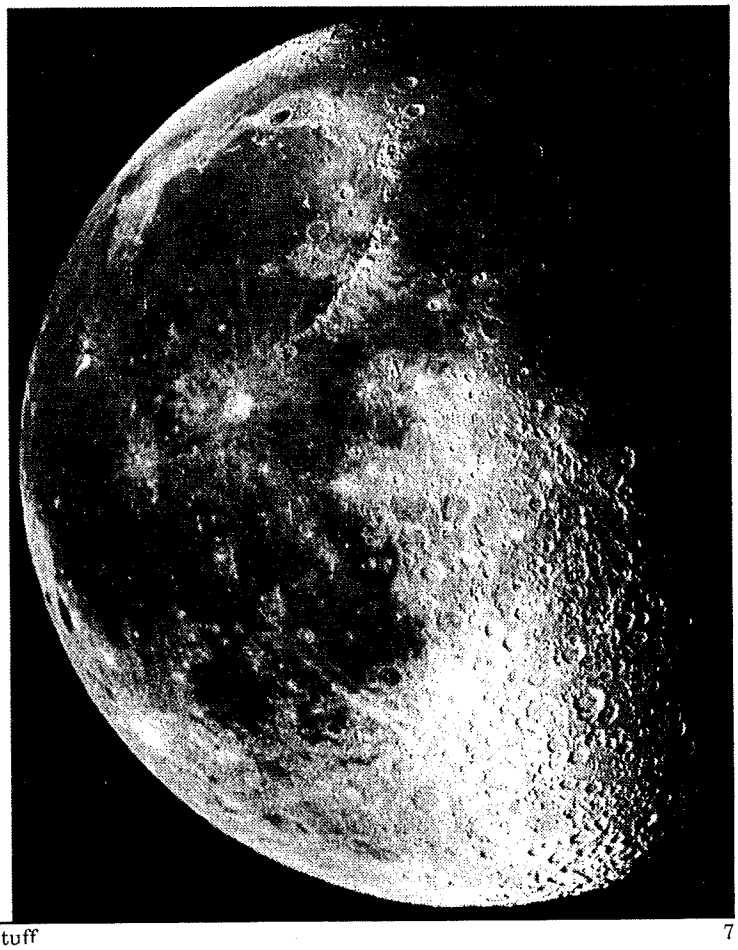
F.A.A.C. PHOTO GALLERY

The StarStuff newsletter is always in need of articles and pictures (photographs, cartoons, etc.). Our primary interest is to publish articles/pictures that were done by F.A.A.C. members. Starting with the January 1996 issue, the StarStuff newsletter will become very short in length as the number of articles taken from the internet is greatly reduced. I encourage anyone who may have some astronomy related subject matter to please consider sharing it with your fellow club members. Articles/pictures for the newsletter can be sent to me via e-mail at pmrozek@pms061.pms.ford.com or prmozek (PROFS), or via Ford inter-company mail at Room 1150, Building 5. Almost any format is acceptable, and all originals will be returned as soon as possible. This month's contribution is from Greg Burnett.

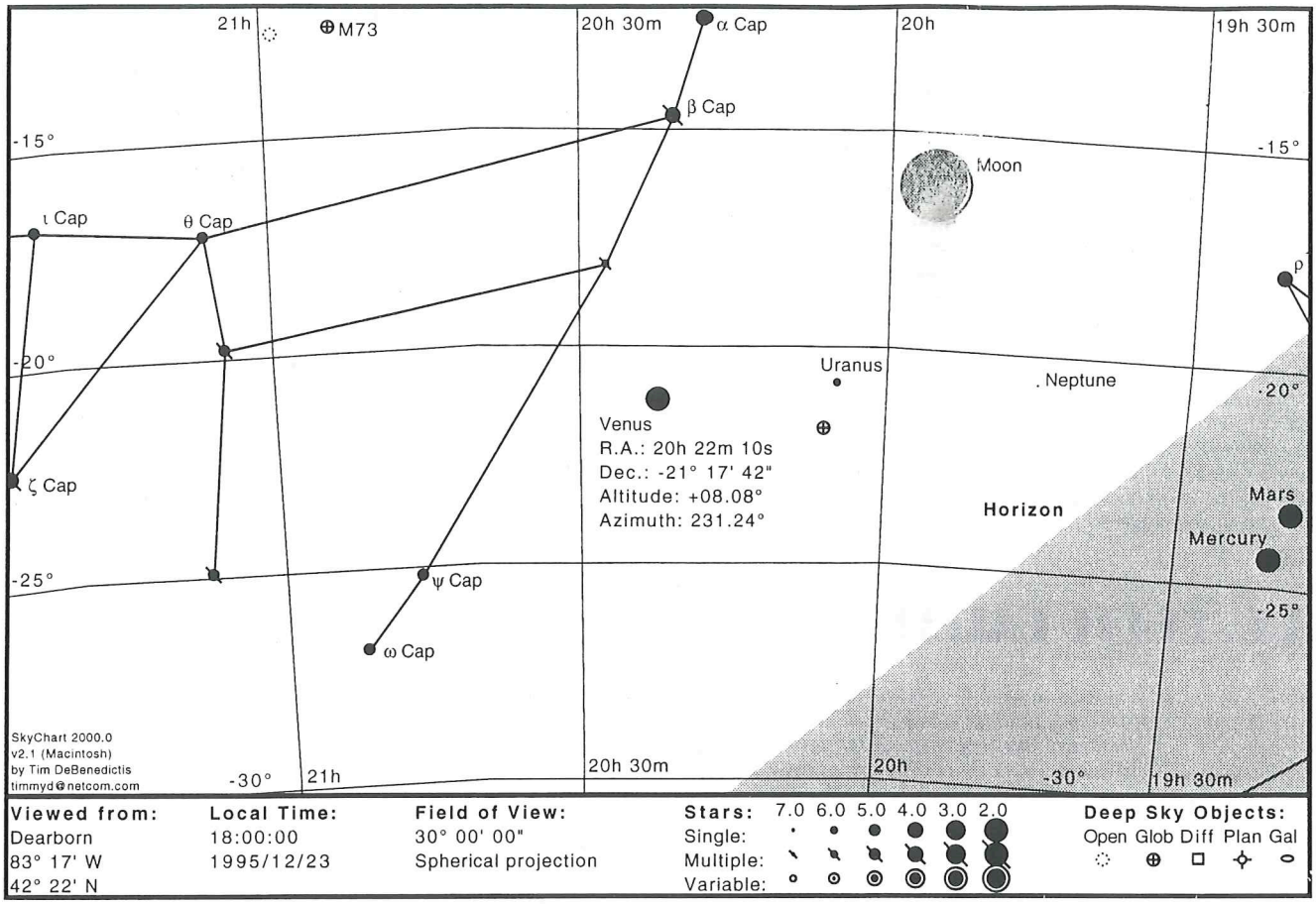
These are two pictures of the Moon that represent an early attempt at astrophotography. They are not super-high resolution, but are probably better than your average snapshot. They were taken with my 6" Astrophysics refractor, using an Astrophysics 2x Barlow to give an effective focal length of 96 inches and f/16. At this magnification the image of the Moon fits neatly in the 35mm frame.

The film was T-Max (TMX) 125 pushed to 400. It is probably not visible in the newsletter reproductions, but the graininess of the film at this speed was not objectionable. The Last Quarter Moon was shot on October 29, 1988. The exposure was 1/125 second through a yellow (#12) filter. The First Quarter Moon was shot on November 17, 1988, at 1/250 second with no filter. The filter didn't make any obvious difference in the contrast or sharpness of the two photos. — Greg Burnett ✪





FINDING VENUS AND A YOUNG MOON



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83° 17' W	1995/12/23	Spherical projection	Multiple:							
42° 22' N			Variable:							

Ford Amateur Astronomy Club
Star Stuff Newsletter
P.O. Box 7527
Dearborn, MI 48121