STAR STUFF

The Ford Amateur Astronomy Club Newsletter

Volume 3 Number 12 December 1994

HUBBLE RULES OUT A LEADING EXPLANATION FOR DARK MATTER

Two teams of astronomers, working independently with NASA's Hubble Space Telescope (HST), have ruled out the possibility that red dwarf stars constitute the invisible matter, called dark matter, believed to account for more than 90 percent of the mass of the universe. Until now, the dim, small stars were considered ideal candidates for dark matter. Whatever dark matter is, its gravitational pull ultimately will determine whether the universe will expand forever or will someday collapse.
"Our results increase the mystery of the missing mass. They rule out a popular but conservative interpretation of dark matter,"said Dr. John Bahcall, professor of natural science at the Institute of Advanced Study, Princeton, NJ, and leader of one of the teams.

The group, led by Bahcall and Andrew Gould of Ohio State University, Columbus, OH, (formerly of the Institute for Advanced Study), showed that faint red dwarf stars, which were thought to be abundant, actually are sparse in the Earth's home galaxy, and in the universe by inference. The team, led by Dr. Francesco Paresce of the Space Telescope Science Institute in Baltimore, MD, and the European Space Agency, determined that the faint red stars rarely form and that there is a cutoff point below which nature does not make this type of dim, low-mass star.

The space telescope observations involved accurately counting stars and gauging their brightness. The observations overturn several decades of conjecture, theory and observation about the typical mass and abundance of the smallest stars in the universe.

PREVIOUS GROUND-BASED RESULTS INCONCLUSIVE

In our own stellar neighborhood, there are almost as many red dwarfs as there are all other types of stars put together. The general trend throughout our galaxy is that small stars are more plentiful than larger stars, just as there are more pebbles on the beach than rocks. This led many astronomers to believe that they were only seeing the tip of the iceberg and that many more extremely faint red dwarf stars were at the limits of detection with ground-based instruments. According to stellar evolution theory, stars as small as eight percent of the mass of the Sun are still capable of shining by nuclear fusion processes.

Over the past two decades, theoreticians have suggested that the lowest mass stars also should be the most prevalent and therefore might provide a solution for dark matter. This seemed to be supported by previous observations with ground-based telescopes that hinted at an unexpected abundance of what appeared to be red stars at the faintest detection levels achievable from the ground.

However, these prior observations were uncertain because the light from these faint objects is blurred slightly by Earth's turbulent atmosphere. This makes the red stars appear indistinguishable from the far more distant, diffuse-looking galaxies.

PINNING DOWN THE LONG-SOUGHT HALO POPULATION

Hubble's capabilities made it possible for the team of astronomers led by Bahcall and Gould to observe red stars that are 100 times dimmer than those detectable from the ground – a level where stars can be distinguished easily from galaxies. Hubble Space Telescope's extremely high resolution also can separate faint stars from the much more numerous galaxies by resolving the stars as distinct points of light, as opposed to the "fuzzy" extended signature of a remote galaxy.

Bahcall and Gould, with their colleagues Chris Flynn and Sophia Kirhakos (also of the Institute for Advanced Study, Princeton) used images of random areas in the sky taken with the HST Wide Field Planetary Camera 2 while the telescope was performing scheduled observations with other instruments. By simply counting the number of faint stars in the areas observed by HST, the scientists demonstrated that the Milky Way has relatively few faint red stars.

The HST observations show that dim red stars make up no more than six percent of the mass in the halo of the Galaxy, and no more than 15 percent of the mass of the Milky Way's disk. The Galactic halo is a vast spherical region that envelops the Milky Way's spiral disk of stars, of which Earth's Sun is one inhabitant.

FAINT RED STARS MISSING FROM A GLOBULAR CLUSTER

By coincidence, Paresce pursued the search for faint red dwarfs after his curiosity was piqued by an HST image taken near the core of the globular cluster NGC 6397. He was surprised to see that the inner region was so devoid of stars, he could see right through the cluster to far more distant background galaxies. Computer simulations based on models of stellar population predicted the field should be saturated with dim stars-- but it wasn't.

HST's sensitivity and resolution allowed Paresce, and co-investigators Guido De Marchi (Space Telescope Science Institute and the University of Firenze, Italy), and Martino Romaniello (University of Pisa, Italy) to conduct the most complete study to date of the population of the cluster (globular clusters are ancient, pristine laboratories for studying stellar evolution). To Paresce's surprise, he found that stars 1/5 the mass of our Sun are very abundant -- there are about 100 stars this size for every single star the mass of our Sun -- but that stars below that range are rare. "The very small stars simply don't exist," he said.

A star is born as a result of the gravitational collapse of a cloud of interstellar gas and dust. This contraction stops when the infalling gas is hot and dense enough to trigger nuclear fusion, causing the star to glow and radiate energy. "There must be a mass limit below which the material is unstable and cannot make stars," Paresce emphasizes. "Apparently, nature breaks things off below this threshold."

Paresce has considered the possibility that very low-mass stars formed long ago but were thrown out of the cluster due to interactions with more massive stars within the cluster, or during passage through the plane of our Galaxy. This process would presumably be common among the approximately 150 globular clusters that orbit the Milky Way. However, the cast-off stars would be expected to be found in the Milky Way's halo, and Bahcall's HST results don't support this explanation.

THE SEARCH FOR DARK MATTER

The HST findings are the latest contribution to a series of recent, intriguing astronomical observations that are struggling to pin down the elusive truth behind the universe's "missing mass."

Models describing the origin of helium and other light elements during the birth of the universe, or "Big Bang," predict that less than 5% of the universe is made up of "normal stuff," such as neutrons and protons. This means more than 90% of the universe must be some unknown material that does not emit any radiation that can be detected by current instrumentation. Candidates for dark matter include black holes, neutron stars and a variety of exotic elementary particles.

Within the past year, astronomers have uncovered indirect evidence for a dark matter candidate called a MACHO (MAssive Compact Halo Objects). These previous observations detected several instances of an invisible object that happens to lie along the line of sight to an extragalactic star. When the intervening object is briefly aligned between Earth and a distant star, it amplifies, or gravitationally lenses, the light from the distant star. The new HST finding shows that faint red stars are not abundant enough to explain the gravitational lensing events attributed to MACHOs. Bahcall cautions, however, that his results do not rule out other halo objects that could be smaller than the red stars such as brown dwarfs -- objects not massive enough to burn hydrogen and shine in visible light.

Additional circumstantial evidence for dark matter in the halo of our galaxy has been inferred from its gravitational influence on the motions of stars within the Milky Way's disk. Recently, this notion was further supported by ground-based observations, made by Peggy Sachett of the Institute for Advanced Study, that show a faint glow of light around a neighboring spiral galaxy that is the shape expected for a halo composed of dark matter. This could either be light from the dark matter itself or stars that trace the presence of the galaxy's dark matter.

The reality of dark matter also has been inferred from the motions of galaxies in clusters, the properties of high-temperature gas located in clusters of galaxies and from the relative amounts of light elements and isotopes produced in the Big Bang.

The ultimate fate of the universe will be determined by the amount of dark matter present. Astronomers have calculated that the amount of matter -- planets, stars and galaxies – observed in the universe cannot exert enough gravitational pull to stop the expansion which began with the Big Bang. Therefore, if the universe contains less than a critical density of matter, it will continue expanding forever, but if enough of the mysterious dark matter exists, the combined gravitational pull someday will cause the universe to stop expanding and eventually collapse.

Bahcall stresses, "The dark matter problem remains one of the fundamental puzzles in physics and astronomy. Our results only sharpen the question of what is the dark matter." Bahcall's results appeared in the November 1, 1994 issue of the Astrophysical Journal. Paresce's paper will appear in the February 10, 1995, issue of the Astrophysical Journal.

★

PRESIDENT'S CORNER

Alas, crises everywhere! My son's car died, my VCR quit working, and (so far) there are no nominations for President of the Ford Amateur Astronomy Club. Woe is me!

I promise, this will be my last hand-wringing, pathos-evoking attempt to call forth some leadership from the ranks of Ford FAAC members, but I'm gonna get my money's worth! (*"I can call spirits from the vasty deep!"* "Why so can I, or so can any man; but will they come when you do call for them?" --SHAKESPEARE, KING HENRY IV, Part I).

It seems we are not alone in our leadership crisis; the Ford Photo Club is apparently in peril for the same reason, and the Astronomical League REFLECTOR reports similar troubles at other astronomy clubs. We seem to have a good level of general participation and interest, judging from meeting turnouts and such. Are we destined to become a non-Ford club (and thereby lose many material advantages) simply because no-one is willing to shoulder the (small, really) burden of being a leader for a year? Several folks have already anted up their quota of leadership responsibility, but are prevented from being president only by the FERA rules (the president must be a full-time Ford employee). What does this situation say about Ford? The second largest company in the world? The BEST car company in the world? While you're sitting around waiting for your next promotion..... Well, that's goin' too far; better shut up.

Seriously, here is an opportunity for someone to exercise and demonstrate important life and professional skills, and have fun doing it! What more could you ask?! This club will only be a club if it can establish some continuity, and that doesn't mean two or three individuals providing the only power to make it go. Challenge yourself! I got by OK with some things, but I'd like to see someone else do better at the things I did poorly. If not you, then who??!!

THIS SPACE FOR RENT

Hope to see you soon, from the BACK of the room!
Greg Burnett

STAR STUFF

Monthly Publication of the
Ford Amateur Astronomy Club
Star Stuff Newsletter
P. O. Box 7527
Dearborn, Michigan 48121-7527

1994 CLUB OFFICERS

President:	Greg Burnett	24-81941
Vice President:	Brian Gossiaux	39-03935
Secretary:	John St. Peter	535-2755
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 building 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. Observing at this location is usually held on any clear weekend and holiday evenings or as specified in the observing hotline phone message.

OBSERVING HOTLINE NUMBER (313) 390-5456

On Friday and Saturday nights, or nights before holidays, you can call the hotline numbers 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 if 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 Recreational Area, and discounts at selected local area astronomical equipment retailers.

NEWSLETTER STAFF

Editor:	Brian Gossiaux	39-03935
Contributing Editors:	Patti Smith	Doug Bock
	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. Subscriptions are free to any other Astronomy Clubs wishing to participate in a newsletter exchange.

December 1994

SUN	MON	TUE	WED	THUR	FRI	SAT
				1	2 Moon at perigee NEW MOON	3
4	5	6	7	8	9 Venus at greates brilliancy -4.7 mag. Satum 7° S. of Moon FIRST QUARTER MOON	10
11	12 Geminid meteors	13 Geminid meteors	14 Geminid meteors	15	16	17 FULL MOON
18	19	20	21 Winter Solstice, 9:23pm	22	23 Mars 9° N. of Moon	24
25 LAST QUARTER MOON	26	27	28	29 Jupiter 1.1° S. of Moon Venus 3° N. of Moon	30 Moon at perigee	31

NEXT MONTH **The Ford Amateur Astronomy Club general meeting is January 26th!**

MEETING ANNOUNCEMENT -- January 26, 1995

The Ford Amateur Astronomy Club holds regular general meetings on the fourth Thursday of each month, except November and December. Our next meeting will be Thursday, January 26, at 5:00 p.m.

The presentation on planetary orbital mathematics, and we will have election of officers. The presentation will not be as technical as it may sound, consisting primarily of a qualitative (not quantitative) analysis of Kepler's laws of orbital motion.

The Ford Amateur Astronomy Club meets in the Ford Motor Credit Company (FMCC) building, **conference room 1491,** located on the lower floor on the east side of the building. 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 the lower east door. At 5:00 p.m. 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 I will post direction signs only between the lower northeast and lower east doors and the meeting room.
Hope to see you at the meeting!
Greg Burnett

OUR GANG

No bugs, no dew and clear skies, a fairly descriptive picture of last Wednesdays and Fridays viewing sessions. I was fortunate enough to make it out to Island Lake on both occasions. I must admit, however. that it was rather lonely out there on Wednesday since I was the only one out viewing--not surprising since it was the night before Thanksgiving--missed you and your donuts. Friday evening Steve, a new member, and his young daughter showed up at the viewing site and we all spent a few hours re-introducing ourselves to the winter constellations. The viewing conditions were excellent on both evenings. The wind on Wednesday in addition to creating a substantial wind-chill caused a slight problem with observations at higher magnifications by creating vibrations in the scope tube and on the mount itself. At lower mag's the problem was tolerable. I was able to find some old favorite objects such as the ring, Orion, Andromeda, Saturn, the double cluster and the pleiades. I also added to my small but growing list, M1 and M33. On both occasions I was packed up and headed home by the time of moonrise. I enjoyed my two evenings out under the stars, my only regret is that more people weren't out to share the experience.
'til later
- Harry Kindt Nov 29th, 94

Joint Lunar & Solar eclipse
When the moon gets between the earth and the sun, it is called an eclipse of the sun. When the earth gets between the sun and the moon, it is called an eclipse of the moon. When the sun gets between the moon and the earth, it will be called an eclipse of the earth, and it is likely to be total.
- Chuck Boren III

On-line classified ads for astronomy gear.
"The Pegasus Classifieds, a FREE online astronomy classified service
1-303-294-0239 (data/modem). Telescopes, eyepieces, etc.
- Bill Colwell

Astronomical Analogies: Dealing With Distances
As systems professionals, we become accustomed to dealing comfortably with very small units of time--microseconds, nanoseconds, and so on--when discussing the operation of high speed computers. In astronomy, we explore the other end of the numerical scale in dealing with vast distances. Indeed, the term "astronomical" is a familiar colloquialism for any extraordinarily large number.

One famous computer scientist, Grace Hopper, would illustrate a nanosecond by showing a piece of wire about a foot long; that's how far an electrical signal travels in that length of time. (A microsecond was a huge coil of 1000 feet of wire.) Similarly, it helps us understand the size of our universe if we use scale models in much the same way. Here are a two of my favorite examples...

If you let an average size orange represent our Sun, and let another similar orange represent the nearest star (Proxima Centauri, about 4.29 light-years, or about 25,000,000,000,000 miles away), then how far apart should they be to represent the distance between them in true scale? It turns out that if you're in Detroit, the "nearest star" ends up in Albuquerque, New Mexico, over 1300 miles away!

Now let's construct a model of a galaxy, similar to our Milky Way, using table salt, with each salt grain representing one of the 100 billion stars in a typical galaxy. Doing so will require about 13,300 pounds of salt. With the grains placed an average of 6-1/2 miles apart, the model will span about 150,000 miles, over halfway to the Moon! One grain of your choosing, about two thirds of the way out from the center, could represent our Sun.

With just a little math, you can work out many similar analogies, using your favorite familiar objects. Just a few such calculations can put you in closer touch with our world and our universe.
- Greg Burnett

Physics Lesson....
Antigravity, the Feline Butterology Theory
This question was posed to the Usenet Oracle:

If you drop a buttered piece of bread, it will fall on the floor butter-side down. If a cat is dropped from a window or other high and towering place, it will land on its feet.

But what if you attach a buttered piece of bread, butter-side up to a cat's back and toss them both out the window? Will the cat land on its feet? Or will the butter splat on the ground?
And in response, thus spoke the Oracle:

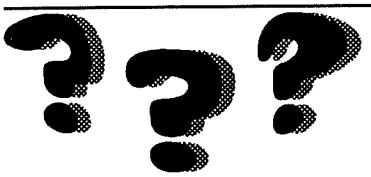
Even if you are too lazy to do the experiment yourself you should be able to deduce the obvious result. The laws of butterology demand that the butter must hit the ground, and the equally strict laws of feline aerodynamics demand that the cat can not smash its furry back. If the combined construct were to land, nature would have no way to resolve this paradox. Therefore it simply does not fall.

That's right, you clever mortal (well, as clever as a mortal can get), you have discovered the secret of antigravity! A buttered cat will, when released, quickly move to a height where the forces of cat-twisting and butter repulsion are in equilibrium. This equilibrium point can be modified by scraping off some of the butter, providing lift, or removing some of the cat's limbs, allowing descent.

Most of the civilized species of the Universe already use this principle to drive their ships while within a planetary system. The loud humming heard by most sighters of UFOs is, in fact, the purring of several hundred tabbies.

The one obvious danger is, of course, if the cats manage to eat the bread off their backs they will instantly plummet. Of course the cats will land on their feet, but this usually doesn't do them much good, since right after they make their graceful landing several tons of red-hot starship and pissed-off aliens crash on top of them.

★



This is the first installment of a recurring article about astronomy trivia; obscure terminology, interesting personal characters, etc. If you have any trivia you would like to submit, please send your question AND answer to Paul Mrozek via pmrozek (PROFS) or mrozek@pms064.pms.ford.com (internet).

ASTRO TRIVIA

Q: Who invented the telescope?
A: Hans Lippershey (ca. 1570-ca. 1619), a German-Dutch lens grinder, is generally credited with the invention because he was the first scientist to apply for a patent (1608). Zacharias Janssen and Jacob Metius also invented telescopes, but Lippershey possesses the strongest claim as being the first.

Q: Is it true that the Earth is closer to the sun in winter than in summer in the Northern Hemisphere?
A: Yes. 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. When the Earth is farthest from the sun (its aphelion) around July 4, the tilt is reversed, and the Northern Hemisphere experiences summer. I have a follow up question on this topic. Does anyone know if the Southern Hemisphere has colder winters and warmer summers when compared to the Northern Hemisphere?

Q: What is a syzygy?
A: A syzygy is when three celestial bodies lie in a straight line. An example would be the sun, Earth, and moon during an eclipse. All of this weeks answers came from "The Handy Science Answer Book" by the Carnegie Library of Pittsburgh.

Next weeks questions:
What is celidography?
What is the Maunder minimum?
How did "sun dogs" get their name?

★

VOYAGER MISSION STATUS
December 1, 1994

Both Voyager spacecraft are healthy and are continuing to make observations of their interplanetary environment. The spacecraft are using their ultraviolet spectrometers to map the heliosphere and study the incoming interstellar wind. The cosmic ray detectors are seeing the energy spectra of interstellar cosmic rays in the outer heliosphere. The magnetometer sensors are still measuring the strength and direction of the solar magnetic field. The plasma detectors looking back at the Sun record the solar wind parameters. The low-energy charged particle experiment studies the energy spectra of particles coming from the Sun. The plasma wave instrument is studying the incoming signals from the direction of the heliosphere.

Voyager 1 is currently 8.7 billion kilometers (5.4 billion miles) from Earth and is traveling at a speed of 61,200 kilometers per hour (39,000 miles per hour). Voyager 2 is 6.7 billion kilometers (4.2 billion miles) from Earth and is traveling at a speed of 57,600 kilometers per hour (36,000 miles per hour).

ASTRONOMY WORKSHOP

by Greg Burnett

PROFS=GBURNETT
InterNet USFMC6SH@IBMMAIL.COM

This month the Workshop takes on an individual subject, black holes, and attempts to satisfy the young inquiring mind; questions posed by a ten-year-old on a subject that didn't exist not too long ago, but will doubtless be old hat to our grandchildren.

Q1: Why do black holes suck things in?

Any object with mass sucks things towards itself, because of the force of gravity. The reason why black holes do this so thoroughly, is because they have such an enormous mass in a very concentrated volume. Say, if the mass of earth was compressed into a black hole, it would be a mere 7mm in diameter. You can use the formula for the gravitational attractive forces:

F = (G*M*m)/(R**2)
Where
G = 6.67*10**(-11)
M = mass of the large object
m = mass of the small object
R = distance between the mass centers of the two objects.

If you consider the earth as we see it now, you know that the closest we can get to the center of the earth, without digging into it, is approximately 4000 miles. If the earth was a black hole, the closest we could get to the center, would be reduced to about 1/8th of an inch! Run those numbers through your calculator, and you will find that the gravitational force is 3.3*10**18 !!!!!!

Q2: Has anyone seen a black hole?

The reason it is called a black hole is because it emits no light, so nobody can see it. The way we can observe that it is there, is by the way it interacts with objects close to it. If there is a star close by, the black hole will tend to suck out matter from this star. And this matter, as it falls into the black hole, will become extremely hot and emit x-rays. Another way of observing a black hole, is if you have a star behind the black hole. A black hole has such enormous gravitational force that it even sucks light towards itself. So light coming from an object behind it will be "refracted" by a gravitational lens; the black hole. In this way, we can see two or more duplicate stars around the black hole that are identical.

Q3: How do we know that they exist?

We don't. At least, not for sure. There are, of course, some objects that are suspected to be black holes. Like the so called "Cygnus X-1" in the constellation Cygnus the swan. If you read the last issue of SKY & TELESCOPE (at least, I think it was SKY&TEL. If not, it must have been ASTRONOMY)... anyway, in this issue (Oct. '94?), there was an article about a new candidate for a black hole that we are more certain about than Cygnus X-1.

Q4: Where do objects go when they go into a black hole?

This is a question heavily debated. Since inside the black hole, time and space cease to exist as dimensions, there have been some theories that the objects maybe appear somewhere else in time and space. They may even escape to other universes. In our universe, there have been observed "white holes". These are locations in space where mass seems to come bursting out of seemingly nowhere. This may be "the other side" of a black hole. Because of the enormous gravitational forces inside a black hole, the mass is thought to be compressed into a point, with no size at all. The black hole, as we call it, is just the limit from where the light can escape. As I mentioned before, light is attracted by the black hole, and from inside it, no light can escape. This is why it is called "black".

Q5: How old is a black hole?

It may be several billion years old. Mr. Stephen Hawking has proposed that after many billion years, the black hole may explode, releasing all its mass and energy. I haven't read this theory, though. So I won't go into the details.

Q6: What is inside a black hole?

Mass, energy and gravitational forces. Enormous amounts of them... Of course, these are only theories. No-one has been there to investigate....

Q7: Do you have any suggestions for a demonstration that I can do for my class?

You could always use the model that S. Hawking uses to explain the forces from an object. It was really meant to explain a part of the theory of relativity, but it can be used for this purpose.
Make a small frame, of wood or something. Wrap some rubber, maybe from a balloon over this frame. Put a marble, ball, or some other heavy, round object on the rubber. You will now see that it makes the rubber bend downwards. If you now take another ball, much lighter than the first, you will see that it tends to run down into the deepening made by the heavier one. This is an illustration of the gravitational forces between them. Even if you give the ball a small speed as it passes the hole, the trajectory will at least be bent towards the deepening. The heavier the first ball, the more it will bend. And if the first ball is heavy enough, the second one will fall into the pit no matter what you do. Make sure the first ball isn't so heavy that the rubber breaks!

Thanks to Chuck Boren for providing this material. And thanks to Paul Mrozek for a couple of additional questions. Now, the rest of you guys, how 'bout some answers???!

Q31. What is meant by an Astrometric night and a Photometric night, are they the same? What are the differences and what type of astronomy are they related to? *[John Paul will be disappointed if SOMEONE doesn't take a stab at this question!]*

Q32. What is the best way to secure a tripod (I have a SCT) so that it doesn't move if you accidentally bump it?

Q33. Has anyone ever looked through one of those StereoScope Binocular Viewer attachments for a telescope? Is the supposed 3-D like effect similar to those "Magic Eye" images.

★

Happy Holidays!!

From the Star Stuff Newsletter Staff

STATISTICALLY SPEAKING....

Dearborn, MI
Latitude: 42°22'00" N Longitude: 83°17'00" W
Local Time = UT - 5.00 hours(EST) Elevation: 180 meters

Times are in 24 hour format.
Abbreviations used in reports:

FQ	First Quarter Moon	SR	Sunrise
FM	Full Moon	SS	Sunset
LQ	Last Quarter Moon	MR	Moon Rise
NM	New Moon	MS	Moon Set
UT	Universal Time	SE	Solar Eclipse
DSO	December Solstice		

Calendar Report for 12/ 1/1994 to 12/31/1994

December 1994

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 SR: 7:43 SS: 17:02 MR: 5:57 MS: 16:08	2 SR: 7:44 SS: 17:01 MR: 7:09 MS: 17:02 NM: 18:55	3 SR: 7:45 SS: 17:01 MR: 8:17 MS: 18:04
4 SR: 7:46 SS: 17:01 MR: 9:16 MS: 19:12	5 SR: 7:47 SS: 17:01 MR: 10:07 MS: 20:22	6 SR: 7:48 SS: 17:01 MR: 10:49 MS: 21:31	7 SR: 7:49 SS: 17:00 MR: 11:26 MS: 22:38	8 SR: 7:50 SS: 17:00 MR: 11:58 MS: 23:43	9 SR: 7:50 SS: 17:00 MR: 12:27 MS: None FQ: 16:07	10 SR: 7:51 SS: 17:00 MR: 12:55 MS: 0:45
11 SR: 7:52 SS: 17:01 MR: 13:23 MS: 1:45	12 SR: 7:53 SS: 17:01 MR: 13:51 MS: 2:44	13 SR: 7:54 SS: 17:01 MR: 14:22 MS: 3:42	14 SR: 7:55 SS: 17:01 MR: 14:56 MS: 4:39	15 SR: 7:55 SS: 17:01 MR: 15:34 MS: 5:35	16 SR: 7:56 SS: 17:02 MR: 16:17 MS: 6:29	17 SR: 7:57 SS: 17:02 MR: 17:05 MS: 7:20 FM: 21:18
18 SR: 7:57 SS: 17:02 MR: 17:57 MS: 8:07	19 SR: 7:58 SS: 17:03 MR: 18:53 MS: 8:49	20 SR: 7:58 SS: 17:03 MR: 19:53 MS: 9:28	21 SR: 7:59 SS: 17:04 MR: 20:54 MS: 10:03 DSO: 21:26	22 SR: 8:00 SS: 17:04 MR: 21:56 MS: 10:35	23 SR: 8:00 SS: 17:05 MR: 23:00 MS: 11:05	24 SR: 8:00 SS: 17:05 MR: None MS: 11:35
25 SR: 8:01 SS: 17:06 MR: 0:06 MS: 12:06 LQ: 14:07	26 SR: 8:01 SS: 17:06 MR: 1:13 MS: 12:38	27 SR: 8:01 SS: 17:07 MR: 2:23 MS: 13:15	28 SR: 8:02 SS: 17:08 MR: 3:34 MS: 13:56	29 SR: 8:02 SS: 17:09 MR: 4:45 MS: 14:45	30 SR: 8:02 SS: 17:09 MR: 5:54 MS: 15:42	31 SR: 8:02 SS: 17:10 MR: 6:57 MS: 16:46

Planet View Info Report for 12/ 1/1994 to 12/31/1994

Mercury

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
12/ 1/1994	7:09	16:37	15h56m42s	-20°17'30"	7°16'49"	0.980	1.40916
12/ 8/1994	7:39	16:44	16h42m46s	-22°54'29"	3°27'16"	0.996	1.44346
12/15/1994	8:07	16:57	17h30m22s	-24°35'27"	1°24'56"	0.999	1.44906
12/22/1994	8:31	17:16	18h19m13s	-25°12'27"	4°49'03"	0.992	1.42659
12/29/1994	8:50	17:42	19h08m42s	-24°38'39"	8°48'42"	0.968	1.37388

Venus

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
12/ 1/1994	4:40	15:19	14h06m32s	-11°43'10"	35°03'34"	0.191	0.36288
12/ 8/1994	4:25	15:04	14h18m24s	-11°38'48"	39°28'46"	0.254	0.40660
12/15/1994	4:17	14:51	14h35m01s	-12°14'02"	42°35'06"	0.312	0.45419
12/22/1994	4:14	14:40	14h55m22s	-13°17'01"	44°40'10"	0.364	0.50437
12/29/1994	4:15	14:30	15h18m47s	-14°36'50"	45°58'31"	0.411	0.55617

Mars

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
12/ 1/1994	22:52	12:51	9h59m19s	14°49'26"	101°46'53"	0.901	1.09378
12/ 8/1994	22:35	12:30	10h07m45s	14°18'11"	106°46'51"	0.907	1.03485
12/15/1994	22:15	12:07	10h14m38s	13°55'25"	112°11'16"	0.914	0.97698
12/22/1994	21:53	11:44	10h19m47s	13°42'44"	118°03'17"	0.924	0.92093
12/29/1994	21:28	11:19	10h22m55s	13°41'48"	124°26'53"	0.934	0.86756

Jupiter

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
12/ 1/1994	6:47	16:26	15h44m05s	-18°58'55"	10°29'17"	1.000	6.35139
12/ 8/1994	6:27	16:03	15h50m26s	-19°19'12"	16°02'53"	0.999	6.32282
12/15/1994	6:07	15:41	15h56m42s	-19°38'19"	21°38'43"	0.999	6.28385
12/22/1994	5:47	15:18	16h02m53s	-19°56'10"	27°16'54"	0.998	6.23485
12/29/1994	5:27	14:55	16h08m56s	-20°12'43"	32°57'53"	0.998	6.17613

Saturn

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
12/ 1/1994	13:03	23:45	22h33m13s	-11°05'48"	87°15'43"	0.997	9.71701
12/ 8/1994	12:36	23:19	22h34m21s	-10°58'10"	80°27'57"	0.997	9.83239
12/15/1994	12:09	22:54	22h35m46s	-10°48'51"	73°44'13"	0.998	9.94546
12/22/1994	11:43	22:29	22h37m28s	-10°37'55"	67°04'24"	0.998	10.05469
12/29/1994	11:17	22:04	22h39m25s	-10°25'31"	60°28'07"	0.998	10.15875

Uranus

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
12/ 1/1994	10:58	20:12	19h43m17s	-21°49'22"	45°17'54"	1.000	20.36890
12/ 8/1994	10:31	19:46	19h44m42s	-21°45'49"	38°31'38"	1.000	20.44990
12/15/1994	10:05	19:20	19h46m12s	-21°41'59"	31°46'09"	1.000	20.51986
12/22/1994	9:39	18:55	19h47m48s	-21°37'55"	25°01'23"	1.000	20.57794
12/29/1994	9:12	18:29	19h49m27s	-21°33'38"	18°17'04"	1.000	20.62340

Neptune

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
12/ 1/1994	10:44	20:04	19h32m38s	-21°09'44"	42°57'52"	1.000	30.88813
12/ 8/1994	10:17	19:38	19h33m33s	-21°07'50"	36°04'39"	1.000	30.96444
12/15/1994	9:51	19:11	19h34m32s	-21°05'46"	29°11'44"	1.000	31.02908
12/22/1994	9:24	18:45	19h35m34s	-21°03'33"	22°19'07"	1.000	31.08122
12/29/1994	8:57	18:19	19h36m39s	-21°01'11"	15°26'38"	1.000	31.12015

Pluto

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
12/ 1/1994	6:11	17:25	15h56m19s	-6°50'37"	16°39'24"	1.000	30.75250
12/ 8/1994	5:45	16:59	15h57m22s	-6°53'43"	21°26'31"	1.000	30.72491
12/15/1994	5:19	16:32	15h58m24s	-6°56'21"	27°06'16"	1.000	30.68404
12/22/1994	4:52	16:05	15h59m24s	-6°58'30"	33°12'31"	1.000	30.63051
12/29/1994	4:26	15:39	16h00m20s	-7°00'09"	39°33'44"	1.000	30.56500

Planet Apsides Report

Mercury
12/12/1994 Aphelion Distance from Sun: 0.47 AU
Venus
12/29/1994 Perihelion Distance from Sun: 0.72 AU

Planet Conjunction/Opposition Report

Mercury

Date	Hour	Event
12/13/1994	21	Superior Conjunction

Moon Apsides Report

Date	Hour	Apsis	Distance (km)	Diameter
12/ 2/1994	7	Perigee	357272	0.5574°
12/15/1994	3	Apogee	406013	0.4905°

Meteor Showers Report

Date	Meteor Shower	ZHR	RA	DEC	Illum.	Frac.	Longitude
12/ 8/1994	Puppids-Velids	15	9h00m	-48°	0.39		257°
12/13/1994	Geminids	75	7h28m	32°	0.84		262°
12/22/1994	Ursids	5	14h28m	78°	0.80		271°
12/25/1994	Puppids-Velids	15	9h20m	-65°	0.50		274°

Twilight Report

Date	Sun		Astronomical		Nautical		Civil	
	Rise	Set	Begin	End	Begin	End	Begin	End
12/ 1/1994	7:43	17:02	5:58	18:47	6:31	18:13	7:06	17:38
12/ 8/1994	7:50	17:00	6:04	18:46	6:38	18:12	7:13	17:37
12/15/1994	7:55	17:01	6:09	18:48	6:43	18:14	7:18	17:38
12/22/1994	8:00	17:04	6:13	18:51	6:47	18:17	7:22	17:41
12/29/1994	8:02	17:09	6:15	18:55	6:50	18:21	7:25	17:46

SKY & TELESCOPE NEWS BULLETIN

LUNAR ASTEROIDS?
According to a study by astronomer William Bottke at the University of Arizona, some fraction of the tiny asteroids discovered whizzing past Earth in recent years may have been blasted into space from the Moon. Many of these asteroids have orbits very similar to Earth's, and Bottke's computer simulations show that some of objects flying off the Moon after a major impact within the last 10 or 20 million years would have gone into heliocentric orbits quite like those of the Earth and Moon. Also, such objects only survive for about that long before colliding with us or being flung from the solar system.

RETURN OF THE GREENWICH CLOCK
After an absence of 275 years, the clock used in establishing Greenwich Mean Time is being returned to its original home. Made by Thomas Tompion, known as the father of English clockmaking, the clock will be restored to its original setting in the Octagon Room of the Royal Greenwich Observatory near London. In the late 17th century it was used to determine that the earth rotated at an even rate. Those findings formed the basis of all measurements of time and space more than 2 1/2 centuries. The clock was sold in 1719 and wound up in the ancestral home of the Earl of Leicester before its return to the observatory.

LEONIDS PUT ON "GOOD" SHOW
Although a full Moon interfered with watching the Leonids last month, many observers reported a "good" show of this annual meteor shower. Tim Hunter of Tucson, Arizona, made a report to Sky & Telescope of seeing several bright Leonids from the northern foothills of town, and lamented that he was not in a darker site. Joe Rao of Levittown, New York, reports that radio monitoring of the shower the morning of November 18th showed a "definite peak" at about 13:15 hours Universal Time. A December 1st Circular from the International Astronomical Union reports that observers in the Netherlands, Japan, and Canada reported enhanced activity. A preliminary time of the shower's peak was estimated for 5 hours Universal Time on the 18th with a possible zenithal hourly rate of about 100.

CLOSE-CALL ASTEROID
On December 9th, shortly after 19:00 Universal Time, a barn-size asteroid hurtled through the Earth-Moon system and missed our planet by a scant 100,000 km. The first warning of its existence had come just 14 hours earlier when James V. Scotti, using the Spacewatch telescope in Arizona, picked up a 17th-magnitude speck of light streaking northwestward through Cetus and Aries. At the time of its closest approach this object, now designed 1994 XM1, was moving incredibly fast, crossing 1 deg of sky every 3 minutes.

CLOSE-IN ASTEROID
Just three days earlier, Robert H. McNaught found a 16th-magnitude asteroid near Orion's Belt on Schmidt plates taken at Siding Spring, Australia. Orbital measurements later showed it to be a rare Aten asteroid, the type that circles the Sun in less time than the Earth does. Fewer than 20 Atens are known, and the new find, designated 1994 XL1, appears to have the shortest revolution period of all -- only 6.5 months. Its mean distance from the Sun is 0.67 astronomical unit, slightly less than the mean orbital radius of Venus! Traveling a route inclined about 30 deg to the ecliptic, this 1994 XL1 is perhaps 300 km across. It probably would not have been discovered but for its highly eccentric orbit; on the night of discovery it was 1.02 a.u. from the Sun, about as far as it ever gets.

THICK-SKINNED MOON
This past week the American Geophysical Union held its semiannual meeting in San Francisco. There planetary geologist Maria Zuber described lunar gravity data gathered earlier this year by the Clementine spacecraft. She notes that the Moon's crust averages 68 km thick and varies from essentially 0 km under Mare Crisium to 107 km north of the crater Korolev on the lunar farside. Zuber also concludes that the lunar exterior became rigid early in its existence and that the Moon's interior is probably more complex than previously thought. But there's no definitive word yet on whether it has a solid-metal core.

★

ULYSSES SPACECRAFT COMPLETES SOUTHERN SOLAR PASS

The Ulysses spacecraft -- the first probe to explore the Sun's environment at high latitudes -- completed a pass Saturday over the southern solar pole, ending the first phase of its primary mission.

The spacecraft reached 70 degrees south of the Sun's equator at 3 p.m. EST on Nov. 5, crossing back into what scientists have defined as a lower latitude region of the Sun's environment, members of the mission operations team at NASA's Jet Propulsion Laboratory (JPL), Pasadena, CA, have reported. Just as the Arctic Circle on Earth lies at about 67 degrees north of the Earth's equator, so too have the polar regions of the Sun been theoretically defined as lying about 70 degrees north and south of the Sun's equator.

As the spacecraft leaves an area of high scientific interest, project scientists have reported some early findings, including:
* In the Sun's polar regions, the solar wind -- a very hot, ionized flow of gases and energetic particles emanating from the Sun -- was found to be flowing at a very high velocity of about 750 kilometers per second (about two million miles per hour), nearly double the speed at which the solar wind is known to flow at lower latitudes.
* The way that Ulysses sees the Sun's magnetic field is very different from the way it is seen by observations from Earth. Measurements from Earth show the Sun having a magnetic field with magnetic poles that are not the same as the Sun's north and south poles; as the Sun rotates, the magnetic poles go around. Ulysses, however, found a uniform magnetic field at the Sun and did not detect any magnetic poles.
* Cosmic ray intensity in this high latitude region increased, but not nearly to the extent that scientists had predicted.

Over the next four months, Ulysses will be heading back toward the Sun's equator, where it will make its closest approach of about 1.3 astronomical units (192 million kilometers or 120 million miles) on March 12, 1995. At that time scientists plan to conduct a "coronal sounding" experiment in which they will use the spacecraft's radio beam to measure the electron content of the Sun's corona. Ulysses will then continue its northern ascent to traverse the Sun's northern pole beginning on June 19, 1995.

Ulysses is managed jointly by NASA and the European Space Agency to study the regions above the Sun's poles. The Jet Propulsion Laboratory manages the U.S. portion of the mission for NASA's Office of Space Science, Washington, DC.

★

HUBBLE IDENTIFIES PRIMEVAL GALAXIES, UNCOVERS NEW CLUES TO THE UNIVERSE'S EVOLUTION

Astronomers using NASA's Hubble Space Telescope as a "time machine" have obtained the clearest views yet of distant galaxies that existed when the universe was a fraction of its current age.

A series of remarkable pictures, spanning the life history of the cosmos, are providing the first clues to the life history of galaxies. The Hubble results suggest that elliptical galaxies developed remarkably quickly into their present shapes. However, spiral galaxies that existed in large clusters evolved over a much longer period -- the majority being built and then torn apart by dynamic processes in a restless universe.

Astronomers, surprised and enthusiastic about these preliminary findings, anticipate that Hubble's observations will lead to a better understanding of the origin, evolution, and eventual fate of the universe. The Hubble observations challenge those estimates for the age of the universe that do not allow enough time for the galaxies to form and evolve to the maturity seen at an early epoch by the Space Telescope.
"These unexpected results are likely to have a large influence on our cosmological models and theories of galaxy formation," says Duccio Macchetto of the European Space Agency and the Space Telescope Science Institute (STScI). "These Hubble telescope images are sufficient to provide a first determination of the properties of these very young and distant galaxies."

"This is compelling, direct visual evidence that the universe is truly changing as it ages, as the Big Bang model insists," emphasizes Alan Dressler of the Carnegie Institutions, Washington, DC. "Though much of the quantitative work can be done best with large Earth-bound telescopes, Hubble Space Telescope is providing our first view of the actual forms and shapes of galaxies when they were young."

"These initial results are surprising," adds Mauro Giavalisco (STScI). "Hubble is giving us, for the first time, a chance to study in great detail the properties of very young galaxies and understand the mechanisms of their formation."

A series of long exposures, taken by separate teams led by Macchetto, Dressler, and Mark Dickinson (STScI) trace galaxy evolution in rich clusters that existed when the universe was approximately one-tenth, one-third, and two-thirds its present age. Their key findings:
* Scientists identified the long-sought population of primeval galaxies that began to form less than one billion years after the Big Bang.

* One of the deepest images ever taken of the universe reveals a "cosmic zoo" of bizarre fragmentary objects in a remote cluster that are the likely ancestors of our Milky Way Galaxy.
* A series of pictures, showing galaxies at different epochs, offers the most direct evidence to date for dynamic galaxy evolution driven by explosive bursts of star formation, galaxy collisions, and other interactions that ultimately created and then

destroyed many spiral galaxies that inhabited rich clusters.

Postcards from Edge of Space and Time
The researchers used Hubble as a powerful "time machine" for probing the dim past. The astronomical equivalent of digging through geologic strata on Earth, Hubble peers across a large volume of the observable universe and resolves thousands of galaxies from five to twelve billion light-years away. Because their light has taken billions of years to cross the expanding universe, these distant galaxies are "fossil evidence," encoded in starlight, of events that happened long ago.

These long-exposure Hubble images will help test and verify ideas about galaxy evolution based on several decades of conjecture, theoretical modeling, and ground-based observation. Ground-based observations have not been able to establish which of several competing theories best describe how galaxies formed and evolved in the early universe. Though the largest ground-based telescopes can detect objects at great distances, only Hubble can reveal the shapes of these remote objects by resolving structures a fraction of the size of our Milky Way Galaxy.

This is allowing astronomers, for the first time, to discriminate among various types of distant galaxies and trace their evolution. Like watching individual frames of a motion picture, the Hubble pictures reveal the emergence of structure in the infant universe, and the subsequent dynamic stages of galaxy evolution.

Now that Hubble has clearly shown that it is an exquisite time machine for seeking our cosmic "roots," astronomers are anxious to push back the frontiers of time and space even further. "Our goal now is to look back further than twelve billion years to see what we are sure will be even more dramatic evidence of galaxies in formation," says Dressler.

★

COSMOMAUTICS NEWS
By Dennis Newkirk

The problem of the Baykonur Cosmodrome has still not been settled after months of bickering between Russia and Kazakstan, even after the signing of an accord between Presidents Yeltsin and Nazarbayev. In March, $115M per year was proposed as a preliminary figure for rent of the cosmodrome and the land around it. Kazakstan had earlier been asking for $150 Million.

By July, Kazakstan raised their request to $480 Million per year, but offered the compromise that satellite communications and environmental monitoring services would be acceptable as a form of payment. On July 1, the sum of 277 Billion roubles was offered by Russia, out of which 83 Billion would go to salaries at the cosmodrome, 89 Billion for cosmodrome systems support, and 105 Billion for capital improvements, but only 49 Billion Roubles have been officially allocated. And, so the saga goes on with no real solution in sight.

In a post flight interview in February, cosmonaut Vasiliy Tsibliyev complained that Progress resupply flights have begun arriving at Mir not fully loaded, with food missing and food packages replaced with other items. Fresh food like milk is lacking compared to earlier years. Western reporters have speculated that the error is either due to failures in planning or pilfering at Baykonur as the supplies are packed.

One of the bargaining chips in the dispute is the continuing Russian maneuvering to establish a new low latitude Russian launch site. The Svobodny cosmodrome project is gaining some support, at least from President Boris Yeltsin. Yeltsin has pledged 4 Trillion Roubles over the next 10 years. It was touted that if the project was started immediately, large boosters could be launched by 2005 and up to 10,000 people could be employed in the construction.

The other alternative is to rely on the Plesetsk Cosmodrome in Russia's arctic. But, it also faces some of the same problems as Baykonur and which Kazakstan in complains about like the debris that falls from the sky. The recent work of cleaning the wilderness around the Plesetsk has been discontinued due to sever lack of funding. In the first few months of 1994, little regular funding was received to run the cosmodrome causing it to also fall behind on payments for power and heat. As of this year, 1,858,000 kg. of booster debris has been collected from 318,000 hectares. Much of this material is awaiting recycling or scrapping because there is no money to transport it anywhere.

The chief of the cosmodrome said in March that facilities at Plesetsk need 5 Billion (1992) roubles for improvements to assume the responsibilities of Baykonur. As for the shortage of personnel, that may be no problem since many of those escaping conditions at Baykonur are destined for jobs at Plesetsk.

A March article has revealed the causes behind the worst launching accident at Plesetsk in March 1980 which killed 51 people. Initial reports that the explosion and fire while preparing a Meteor launch were due to incorrect ground procedures has been rebutted. Now it seems that the explosion was actually due to a defect in a component of the launch pad systems. This was discovered when the same situation occurred again in 1981. The cause was found to be a filter in a Hydrogen Peroxide line. As loading began the filter got very hot, and after quick draining and inspection the filter was found to have been assembled with a lead/tin solder instead of the specified pure tin solder. The lead was reacting with the highly reactive Hydrogen Peroxide resulting in temperatures hot enough to melt the assembly. Apparently there had been a late change in the documentation about which solder to use, but the manufacturing process never caught up with the change.

A Russian Space Agency draft on the State Space Program from 1994 to 2000 calls for a budget of 16 Trillion Roubles. In 1994 the budget level was proposed to be 1.7 Trillion Roubles (.23% of the total expenditures of the Russian government). 30% is to be allocated quarterly each year in an attempt to ration funding so it will not be squandered all at once. Meanwhile, 40% of workers of space industry had left their jobs by 1993. Many of those still working are working shortened hours or are on unpaid summer leave.

Conversion of the defense industry is being promoted one way by the Russian government by funding of the Start-II program. SS-25 Topol ICBM's which are decommissioned from active service are being repurchased by the manufacturer with Defense Industry credits for reconfiguration as space boosters. The booster can be launched by a mobile launcher and orbit 1500 kg. payloads. An SS-25 was launched with fanfare to promote the project on June 22 and a trial launch was being scheduled for September.

★

PLANET FINDER From: Chuck Boren III

*** FIND THE PLANETS 1995 ***

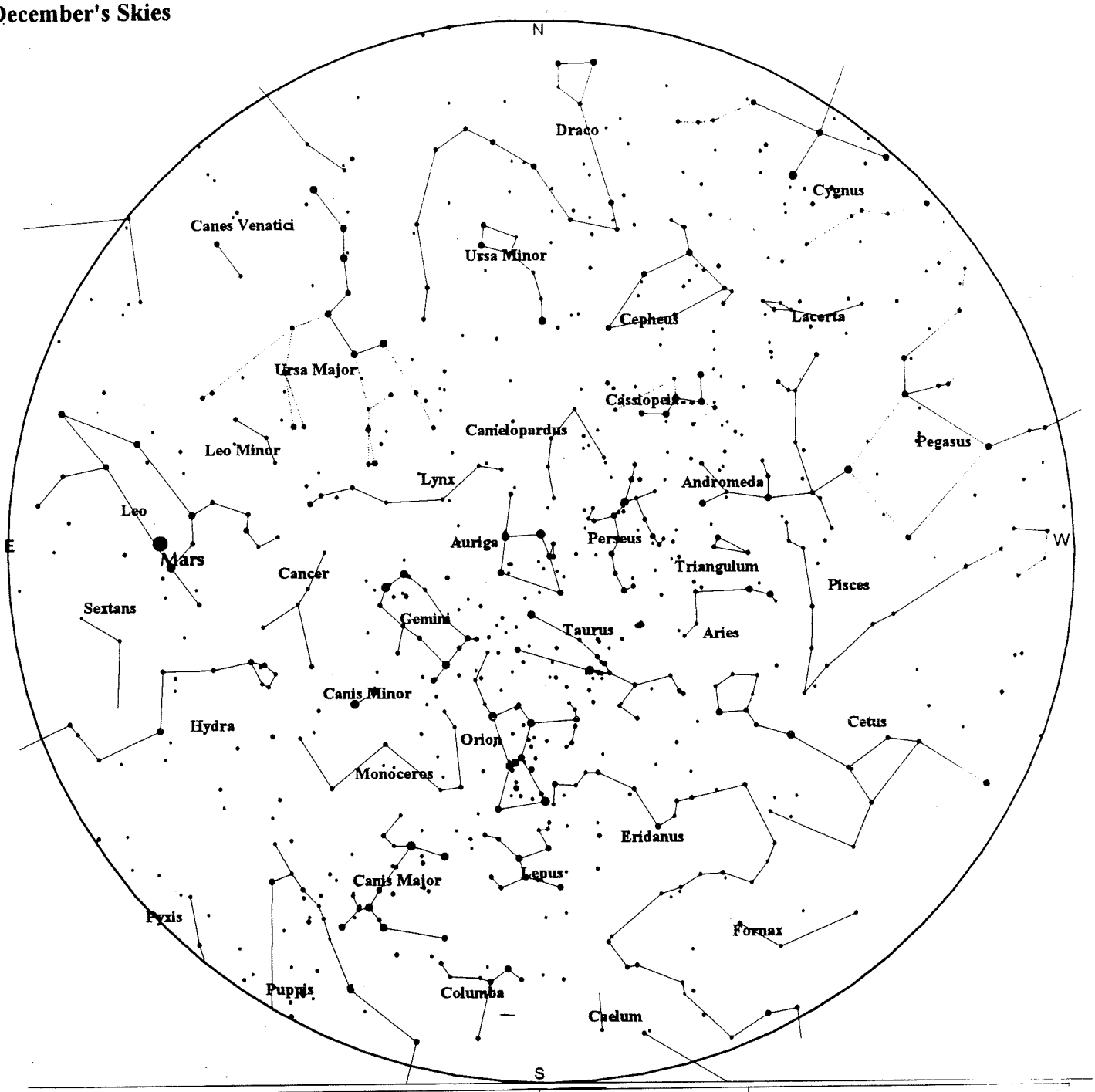
DIRECTIONS: Since the moon appears to make one trip through the ecliptic (the path of the sun) the moon can be used as a pointer to find the planets. On the dates marked below, the Moon will pass the planet heading from west to east. The locations given below tells where the planet is in relation to the Moon. The apparent diameter of the moon is 0.5 degrees.

*** YSU *** YOUNGSTOWN STATE UNIVERSITY *** YSU ***

	MERCURY	VENUS	MARS	JUPITER	SATURN
JANUARY	low in SW sky, evenings	Fri. 27 0.2 deg. S.	Thur. 19 9 deg. N	Thur. 26 1.7 deg. S.	Thur. 5 7 deg. S
FEBRUARY	Mon. 27 5 deg. S	Sun. 26 4 deg. S	Wed. 15 10 deg. N	Thur. 23 2 deg. S	Thur. 2 6 deg. S
MARCH	Thur. 30 6 deg. S	Tues. 28 6 deg. S	Tues. 14 9 deg. N	Wed. 22 2 deg. S	Wed. 29 6 deg. S
APRIL	western sky, end of month	Thur. 27 4 deg. S	Mon. 10 8 deg. N	Tues. 18 3 deg. S	Wed. 26 6 deg. S
MAY	Mon. 1 4 deg. N	Sat. 27 0.8 deg. S.	Mon. 8 7 deg. N	Tues. 16 2 deg. S	Tues. 23 6 deg. S
JUNE	Mon. 26 0.6 deg. S.	Mon. 26 3 deg. N	Mon. 5 6 deg. N	Mon. 12 2 deg. S	Mon. 19 6 deg. S
JULY	eastern sky, start of month	not visible this month.	Tues. 4 4 deg. N	Sun. 9 2 deg. S	Mon. 17 6 deg. S
AUGUST	Mon. 28 1.8 deg. N.	not visible this month.	Tues. 1 & Mon. 28 2 & 0.2 N	Fri. 4 2 deg. S	Sun 13 5 deg. S
SEPTEMBER	Mon. 25 3 deg. S	not visible this month.	Wed. 27 2 deg. S	Sat. 12 & Fri. 29 3 deg. S	Sat. 9 6 deg. S
OCTOBER	Sun. 22 4 deg. N	very low in SW sky, evenings	Thur. 26 4 deg. S	Fri. 27 4 deg. S	Fri. 6 6 deg. S
NOVEMBER	not visible this month.	Fri. 24 6 deg. S	Fri. 24 5 deg. S	Fri. 24 4 deg. S	Fri. 3 & Thur. 30 6 deg. S
DECEMBER	Sat. 23 7 deg. S	Sun. 24 7 deg. S	Sat. 23 6 deg. S	not visible this month.	Wed. 27 5 deg. S

compiled by: Richard Pirko, Ward Beecher Planetarium
data source: The 1994 Observers Handbook, The Royal
 planet95

December's Skies



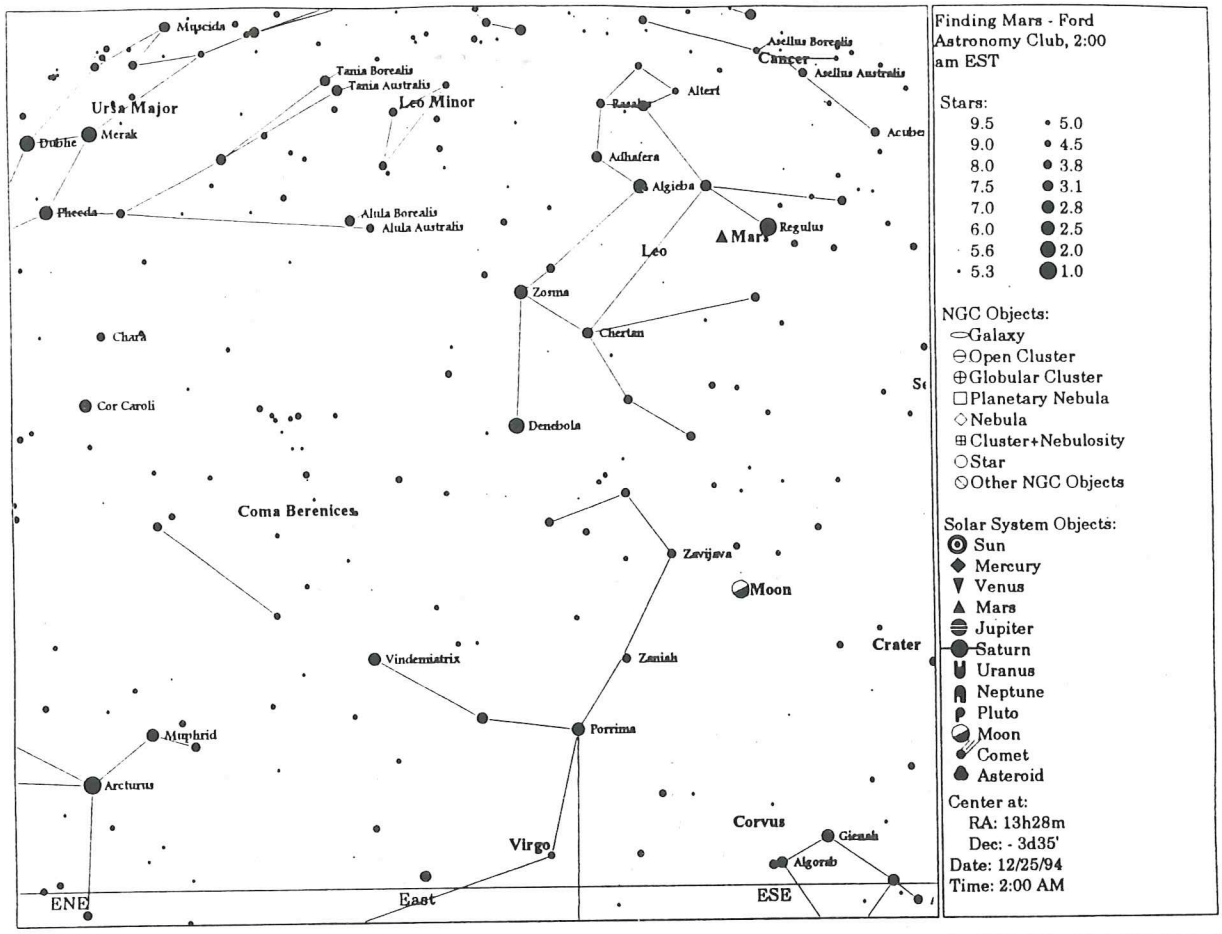
STARS	SOLAR SYSTEM			NOTES
● <1 ● 3.5	☿ Mercury	♅ Uranus	⬭ Galaxy	
● 1.5 ● 4	♀ Venus	♆ Neptune	⊕ Globular Cluster	
● 2 ● 4.5	♂ Mars	♇ Pluto	⋯ Open Cluster	
● 2.5 ● >5	♃ Jupiter	☄ Comet	✧ Planetary Nebula	
● 3	♄ Saturn	⚳ Asteroid	□ Diffuse Nebula	
			○ Other Object	

Local Time: 23:30:00 25-Dec-1994
Location: 42° 22' 0" N 83° 17' 0" W

UTC: 04:30:00 26-Dec-1994
Centre Az: 180.0° Alt: 90.0° Field: 180.0°

Sidereal Time: 05:14:39
Julian Day: 2449712.6875

Finding Mars



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