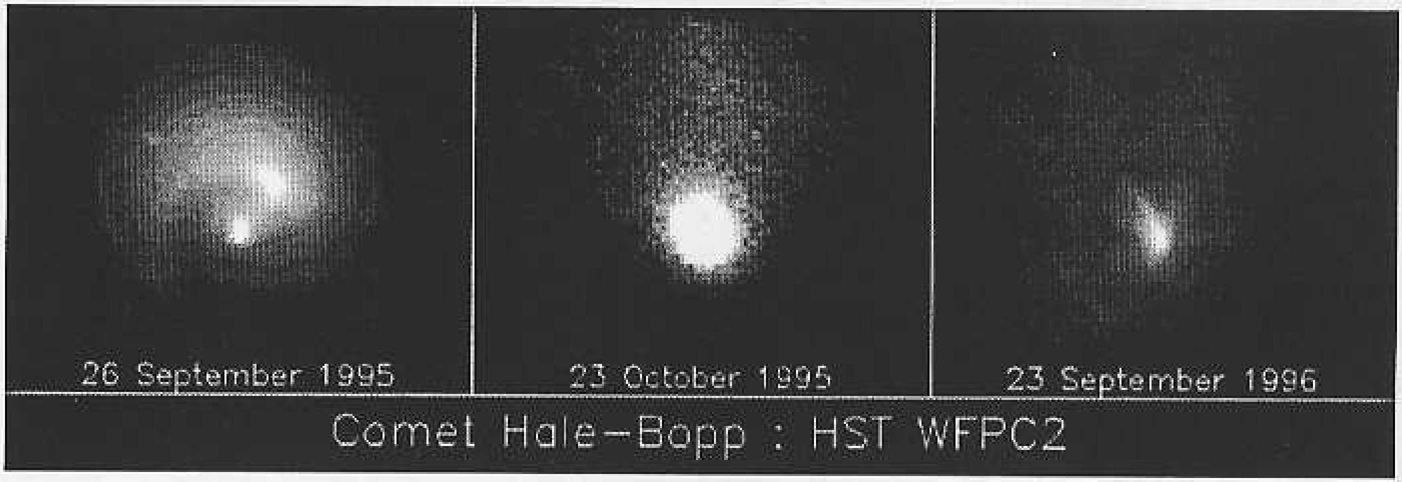
Reflections Reflections

of the University Lowbrow Astronomers

December 1996



The temporal evolution of Comet Hale-Bopp over the course of about 1 year, as seen by the Hubble Space Telescope. In the far-left frame we see the comet about 60 hours after a huge outburst of dust, and the image shows an impressive spiral structure reminescent of a water sprinkler observed from above. The middle frame shows the comet during a more quiescent phase in which hardly any structure is seen in the coma without employing a strong intensity contrast in the display. The image at the far-right shows that the comet has now taken on a "porcupine" appearance as at least five jets can be seen sprouting from the nucleus. The nucleus of the comet is located at the center of each frame, but most of the light observed is due to scattered sunlight from fine dust grains that are emitted from the nucleus and which produce the cometary "coma". Each frame above is 10 arcsec across. For the far-left frame this corresponds to 47,000 km at the comet, for the middle frame this corresponds to 49,000 km at the comet, and for the far-right frame this correponds to 21,000 km at the comet. (The comet was much closer to the Earth during the September 1996 observations.) Hal Weaver/NASA

The University Lowbrow Astronomers

is a club of Astronomy enthusiasts which meets on the third Friday of each month in the University of Michigan's Physics and Astronomy building (Dennison Hall, room 807). Meetings begin at 7:30 PM and are open to the public. Public star parties are held twice each month, weather permitting, at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinckney Road; see inside for directions) on the Saturday evenings before and after the new Moon. For more information call (313) 480-4514.

Important Dates

This Month:

Dec 7 - Public Open House at Peach Mountain Observatory
Dec 14 - Public Open House at Peach Mountain Observatory
Dec 20 - Meeting at 807 Dennison: Brian Ottum of the Lowbrows will talk on "The Christmas Star"

Next Month and Beyond:

Jan 4 - Public Open House at Peach Mountain Observatory
Jan 11 - Public Open House at Peach Mountain Observatory
Jan 17 - Meeting at 807 Dennison
Feb 1 - Public Open House at Peach Mountain Observatory
Feb 8 - Public Open House at Peach Mountain Observatory
Feb 21 - Meeting at 807 Dennison

Ice on the Moon

Michael Richmond

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http://astro.princeton.edu/~richmond/

Here's a very brief explanation of the recent announcements that there may be ice on the moon. You can read the full story in the Nov 29, 1996 issue of Science. [It can also be found on-line at www.sciencemag.org/science/scripts/display/full/274/5292/1495.html – if you can type that in without mistakes! – Ed.]

The spacecraft Clementine performed a series of experiments in April 1994, in which it pointed its antenna at the Moon (instead of an Earth station), and transmitted a 6-watt signal at 2.273 GHz (13.19 cm wavelength) with Right Circular Polarization (RCP). The waves bounced off the Moon, and were picked up by a radio antenna here on Earth. The idea was to look for special characteristics in the reflected signal, which might indicate properties of the lunar surface.

For example, some materials, with high reflectivity to radio waves and lots of small cracks or crannies, would give rise to an especially strong return signal when the radio waves were reflected exactly back whence they came; that is, when the spacecraft was *exactly* between the reflecting lunar surface and the Earth. One material with these characteristics is water ice, but there are others.

On one of its orbits around the Moon, the Clementine spacecraft was positioned exactly between the Earth and the south lunar pole (where there are areas perpetually shaded from the Sun). It had to bounce the radio signals off the surface at a very oblique angle – that is, it pointed its antenna at the "edge" of the Moon, not the portion directly beneath it. This large angle of incidence can make the results harder to interpret.

The reflection from this orbit and area yielded strong backscattering, and the received radio waves had much stronger Right Circular Polarization than Left Circular Polarization.

Reflections from other areas near the south lunar pole didn't show such properties, nor did reflections from the north lunar pole (which has a smaller area in permanent shadow).

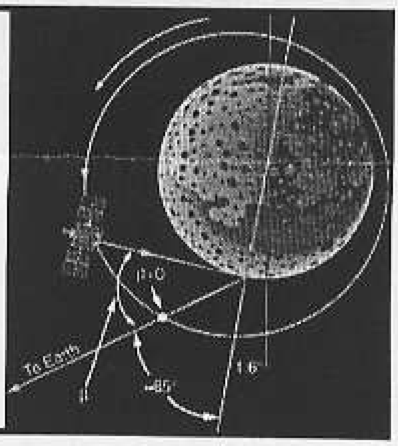
Conclusion: there *may* be ice deposits at or near the surface of permanently-shadowed craters near the south lunar pole. However, the data could be produced by other materials with similar radar-reflecting properties.

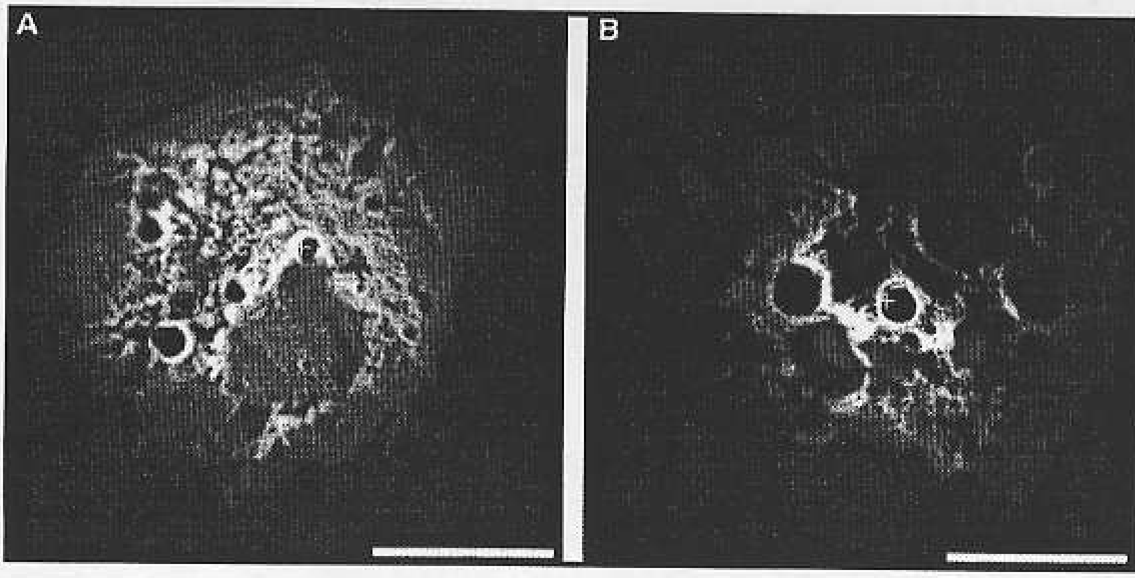
Lunar Prospector, to be launched in Oct 1997, will orbit over this area (and others), and carries a set of neutron-measuring instruments which may provide additional evidence that the material in this part of the moon is truly ice. Until then, we have to wait...

[Editor's note: Below are two of the figures from the paper, illustrating the geometry of the radar experiment and showing the north and south polar regions of the Moon. In the northern hemisphere, no large basin overlaps the polar area. The south pole, however, is located within the South Pole-Aitken basin (SPA), an impact crater over 2500 km in diameter and averaging 12 km deep near the center of the basin (29). The pole is about 200 km inside the rim crest of the SPA.

Michael is correct in pointing out that materials other than water ice can give coherent backscatter signals as was seen here; but if we choose another mineral as the cause, the question then becomes why this signal was seen *only* from the permanently-shadowed south polar basin.]

Orbital geometry of the Clementine bistatic radar experiment. The lunar polar tilt relative to the ecliptic (1.6°), the lunar tilt toward Earth (5°), and the bistatic angle β between spacecraft, lunar surface, and Earth receiver are shown.





Composite Clementine images of the lunar poles, where more than 50 separate images have been summed together over one lunar day. Areas of near permanent illumination are white and areas of near permanent darkness are black. Within 100 km of each pole, the south pole (B) shows considerable darkness (i.e. cold traps) whereas the immediate surroundings of the north pole (A) show at least an order of magnitude greater illumination, and are thus warmer. The scale bar is 100 km.

The Star-Splitter

Robert Frost

www.astro.uiuc.edu/~pmcc/1995fall/poetry/frost.star.splitter

"You know Orion always comes up sideways
Throwing a leg up over our fence of mountains,
And rising on his hands, he looks in on me
Busy outdoors by lantern-light with something
I should have done by daylight, and indeed,
After the ground is frozen, I should have done
Before it froze, and a gust flings a handful
Of waste leaves at my smoky lantern chimney
To make fun of my way of doing things,
Or else fun of Orion's having caught me.
Has a man, I should like to ask, no rights
These forces are obliged to pay respect to?"
So Brad McLaughlin mingled reckless talk
Of heavenly stars with hugger-mugger farming,
Till having failed at hugger-mugger farming
Burned his house down for the fire insurance
And spent the proceeds on a telescope
To satisfy a lifelong curiosity
About our place among the infinities.
"What do you want with one of those blame things?"
I asked him well beforehand. "Don't you get one!"
"Don't call it blamed; there isn't anything
More blameless in the sense of being less
A weapon in our human fight," he said.
"I'll have one if I sell my farm to buy it."
There where he moved the rocks to plow the ground
And plowed between the rocks he couldn't move,
Few farms changed hands; so rather than spend years
Trying to sell his farm and then not selling,
He burned his house down for the fire insurance
And bought the telescope with what it came to.
He had been heard to say by several:
"The best thing that we're put here for's to see;
The strongest thing that's given us to see with's
A telescope. Someone in every town
Seems to me owes it to the town to keep one.
In Littleton it may as well be me."
After such loose talk it was no surprise
When he did what he did and burned his house down.
Mean laughter went about the town that day
To let him know we weren't the least imposed on,
And he could wait-we'd see to him tomorrow.
But the first thing next morning we reflected
If one by one we counted people out
For the least sin, it wouldn't take us long
To get so we had no one left to live with.
For to be social is to be forgiving.
Our thief, the one who does our stealing from us,
We don't cut off from coming to church suppers,
But what we miss we go to him and ask for.
He promptly gives it back, that is if still
Uneaten, unworn out, or undisposed of.
It wouldn't do to be too hard on Brad
About his telescope. Beyond the age
Of being given one for Christmas gift,
He had to take the best way he knew how
To find himself in one. Well, all we said was
He took a strange thing to be roguish over.
Some sympathy was wasted on the house,
A good old-timer dating back along;
But a house isn't sentient; the house
Didn't feel anything. And if it did,
Why not regard it as a sacrifice,
And an old-fashioned sacrifice by fire,
Instead of a new-fashioned one at auction?
Out of a house and so out of a farm
At one stroke (of a match), Brad had to turn
To earn a living on the Concord railroad
As under-ticket-agent at a station
Where his job, when he wasn't selling tickets,
Was setting out, up track and down, not plants
As on a farm, but planets, evening stars
That varied in their hue from red to green.
He got a good glass for six hundred dollars.
His new job gave him leisure for stargazing.
Often he bid me come and have a look
Up the brass barrel, velvet black inside,
At a star quaking in the other end.
I recollect a night of broken clouds
And underfoot snow melted down to ice,
And melting further in the wind to mud.
Bradford and I had out the telescope.
We spread our two legs as we spread its three,
Pointed our thoughts the way we pointed it,
And standing at our leisure till the day broke,
Said some of the best things we ever said.

That telescope was christened the Star-Splitter,
Because it didn't do a thing but split
A star in two or three, the way you split
A globule of quicksilver in your hand
With one stroke of your finger in the middle.
It's a star-splitter if there ever was one,
And ought to do some good if splitting stars
'Sa thing to be compared with splitting wood.
We've looked and looked, but after all where are we?
Do we know any better where we are,
And how it stands between the night tonight
And a man with a smoky lantern chimney?
How different from the way it ever stood?

EUVE Discovers New Gas Component In Clusters Of Galaxies

Ron Baalke <baalke@kelvin.jpl.nasa.gov>
NASA/Jet Propulsion Laboratory

Extreme ultraviolet (EUV) observations of two massive nearby clusters of galaxies have revealed a vast cloud of unsuspected "cool" gas permeating them, a surprise mirroring the discovery some 30 years ago of a hot, X-ray emitting gas enveloping these same clusters.

Discovered by UC Berkeley's Extreme Ultraviolet Explorer satellite (EUVE), the puzzling EUV emissions could indicate the presence of a large amount of hidden matter in these clusters, says astronomer Stuart Bowyer at the University of California at Berkeley.

The findings could have a significance equal to or exceeding that of the detection of X-ray emissions by the early orbiting X-ray satellites, which eventually led astronomers to conclude that the hot cluster gas, primarily hydrogen, equaled or substantially exceeded the mass of all the visible galaxies in the cluster.

Bowyer says that the newly discovered EUV emissions are the first evidence of a large cloud of cooler matter in clusters, totalling as much as 10 trillion of our Suns. The discovery could help resolve a long-standing problem of clusters, that 80-90 percent of all their mass has gone undetected.

"The EUV emitting gas and the gas it cooled to, unless it is being constantly reheated, represents a substantial fraction of or is at least equal to the X-ray emitting gas," says Bowyer, a professor in the graduate school at UC Berkeley, former director of the Center for Extreme Ultraviolet Astrophysics and a researcher at the campus's Space Sciences Laboratory.

At the least these emissions are evidence of unknown physical processes operating in dense clusters, says Richard Lieu, formerly with UC Berkeley and now an assistant professor of physics at the University of Alabama, Huntsville. "The very existence of what we have detected is a major puzzle," he says.

Lieu, Bowyer and a team of astronomers from several other institutions report the discovery in the Nov. 22 issue of Science. Coauthors on the Coma cluster paper include Jonathan P. D. Mittaz of the Mullard Space Science Laboratory in England; astronomers Jeffrey O. Breen and Edward M. Murphy of the University of Virginia, Charlottesville; Felix J. Lockman of the National Radio Astronomy Observatory in Green Bank, West Virginia; and Chorng-Yuan Hwang of UC Berkeley's CEA.

Turning EUVE's Deep Survey telescope on the Coma cluster 300 million light years distant in the constellation Coma Berenices, the team detected EUV emissions that indicate a "cool" intracluster gas at temperatures ranging from about 800,000 Kelvin to about 2 million Kelvin (1.4 million and 3.6 million degrees Fahrenheit, respectively). This is in contrast to the much hotter 93 million Kelvin (167.4 million sF) X-ray emitting gas.

The gas cloud extends well beyond the central region of the cluster, to a diameter of at least 30 arcminutes — about 2.6 million light years across.

Last year Bowyer and Lieu reported finding evidence of a similar 500,000 Kelvin (900,000sF) gas in the Earth's nearest supercluster, the Virgo cluster some 60 million light years away. Though initially dismissed, a subsequent search through earlier ROSAT (Roentgen Satellite) observations of the cluster turned up corroborating evidence.

The discovery of a similar gas in the Coma cluster adds even more evidence for the existence of a "cooler" gas in clusters of galaxies.

"The story has just switched from, 'the data are clearly wrong,' to 'no, it's right but unexplainable'," Bowyer says. "It's now up to the theorists to explain where this gas comes from and where it's going."

Bowyer, Lieu and UC Berkeley astrophysicist Michael Lampton argue strongly against theories that have already been proposed to explain the Virgo emissions in a second article in this week's Science.

For the Virgo cluster, Bowyer, Lieu and their colleagues have calculated that the amount of EUV-emitting gas is too large to be simply the product of cooled X-ray emitting gas. They point out that at the slow rate at which Virgo's 20 million Kelvin (36 million sF) X-ray emitting gas cools off, it produces far too little gas that could emit EUV, even at the center of the cluster where the gas is so dense that it cools faster and creates a so-called "cooling flow."

"Maintenance of the EUV-emitting gas would require 35 times more cooling than that expected from the X-ray emitting gas," Bowyer says.

In the Coma cluster there is no cooling flow at the center, creating an even greater discrepancy.

If there is a large amount of cool matter in clusters, it would help clear up a major problem with these galactic groupings, that the visible mass is insufficient to keep the cluster from flying apart.

The fact that clusters don't fly apart suggests to astronomers that some invisible mass, termed cold dark matter, comprises 80-90 percent of most clusters. The debate still rages over whether this dark matter is composed of MACHOs (massive compact halo objects such as dim and dying stars) or bizarre and fanciful elementary particles called WIMPs (weakly interacting massive particles).

"We have on one hand a gravitational mass problem, because we need a lot of mass to make the cluster a bound system," Lieu says. "On the other hand, we have an EUV-emitting gas constantly cooling. Both suggest lots of cold matter, and our evidence suggests that a fair amount of it may well be in the form of normal baryonic matter.

"Perhaps all the missing mass is there in the form of ordinary matter, and we just haven't looked hard enough."

In fact, the EUV Explorer satellite saw the emissions in a new window on the universe, the extreme ultraviolet. The next step, Lieu says, is to determine whether most or all clusters of galaxies emit EUV like the Coma and Virgo clusters, and thus whether they typically are enveloped in cooler gas.

"Now we need to look at more clusters to gather statistics, to determine what the range of behavior is in this zoo," Lieu says.

Where are those Hubble pics, anyway?

Bill Keel
Astronomy Dept., University of Alabama

Someone asked on the net recently "Where the heck are all the Hubble photos I paid $17,000 for last year?" Of course, not *all* of his tax bill went to pay for HST, but if you get on the web to www.stsci.edu and look, say, for recent images of Hale-Bopp, you'll find that you don't find much.

This raises a couple of interesting points that are of more general interest about HST (I can't bring myself to call it Hubble in public because that sounds too confusing when talking about galaxies) data – 1) what does HST look at, and 2) when does it get a press release? I've been on review panels and been in on press releases, so folks may be interested in how these work.

1) What does HST observe? Whatever astronomers can talk their peers into agreeing is the most promising science they can propose. This year there are 1300+ proposals for 7 times the number of orbits in a year. There is a two-tier review system to decide which ones to let through. First, each proposal goes to one of 15 discipline-specific review panels of specialists – in galaxies, cosmology, planets, binary stars, whichever – which rank and comment on their batch of about 90 proposals. These results go to on overall committee which makes an overall recommendation to the Institute director, based on the rankings and attempts to balance the quality of proposals in various areas. There are special categories for large projects and scientifically risky but potentially very interesting observations, trying to counter the innate conservatism of almost any committee in allocating such a unique and expensive resource.

It's hard enough trying to balance the value of, say, Cepheid distances to galaxies versus searching for brown dwarfs versus deuterium abundances in the interstellar medium. Then try to fold in time-critical observations in support of Galileo and see when Hale-Bopp satisfies the sun-angle constraints for observations (and note that this is not as bad as it looks, because HST can look anywhere more than 45 degrees from the Sun even if that's 45 degrees due north or south). I get headaches just thinking about it...

2) And once the beautiful images (which don't constitute all HST data by a long shot) have been obtained, when do they get press attention? Only when everybody agrees there should be a release if they want NASA backing. That is, the principal investigator, his/her institution, the Space Telescope Science Institute, NASA HQ, and finally reporters and their editors.

There are also issues of timing (don't release on the day something else is expected at NASA, or on an election day, or when some other newsworthy and predictable event is expected); there is a natural tendency to spread out the releases as well, to improve public visibility. So there's lots of data, and lots of color pictures even, that don't get much press play because all the above weren't satisfied. A few show up in the journals, office walls, Web pages... Forrest Hamilton puts up an especially nice collection, entirely from public-domain archive data, at http://scivax.stsci.edu/~hamilton/nuggets/hst_nuggets.html which is well worth a look every week or two. I really wish the folks producing the coffee-table books of HST pictures would go beyond the standard press-release collection, because there's some utterly stunning imagery that hasn't been published outside the journals (if even there, since putting color pictures in journals is very pricey).

Hope this clears the air a little...

The Skies in Deep Space

Eric Greene <erg@america.net>
Steve Martin <martins@cadvision.com>

Tim Gillespie <tgillesp@mail.tds.net> wrote to the sci.astro news group: "Sometimes, under particularly dark skies, I try to imagine what it would be like to live on a planet circling a star just outside the galaxy, say perhaps in the outskirts of the M13 cluster. What a glorious sight our nighttime sky would be, with the galaxy in all its glory spanning the entire sky!"

But, would it really be a spectacular sight or not? Sitting at work right now I'm not able to do the calculations, but it is my suspicion that we get a much more spectacular sight of the galaxy being situated inside of it than we would thousands of light years outside of it.

If someone has a calculator and some reference material handy, perhaps that kind soul could figure out if ANY stars would be visible at all in the Galaxy to a naked eye observer situated at the distance of M13. If any are, they would have to be only the brightest of the super-giants – everything else would fade to obscurity due to the distances involved. The great clusters and nebulae we observe within our galaxy would be mere telescopic blips.

Assume a distance of 50,000 light years outside the galaxy for our observer. This is appoximately 1/40th the distance of M31. So, look at M31 with a 40x eyepiece and you will get a good idea (eliminating the light gathering abilities of your telescope) of what the Milky Way would look like from that distance. Nice, but I much perfer my seat inside the Galaxy!

As a bit more extreme example, move to half the distance to M31 so you are equally positioned between M31 and the Milky Way. Now visualize the night time sky from your planet. Andromeda will be a dim patch of light about 6° across and, looking in the other direction, you will see the Milky Way as a similar large, dim patch. Other than the possibility of M33 and the Magellanic Clouds, the rest of the sky would be an unrelieved blackness to the naked eye.

- Eric

OK! By my calculations M13, at roughly 22,000 light years from us and 45 degrees (crudely – I used a ruler on a beachball-type sky globe) from the galctic plane, is 15,500 ly from that plane. After sweating over my antique HP 10C for a few minutes, I worked out that stars at that distance would appear 13.4 magnitudes fainter than their absolute magnitude. So a sixth magnitude star would have an absolute magnitude of -7.4 – a bright supergiant. It appears that the brightest supergiants would indeed be dimly visible from M13's neighbourhood, and the closest part of the galactic vista would have a scattered sprinkling of sparklies...

- Steve

1000 Hyakutake Images

Ron Baalke <baalke@kelvin.jpl.nasa.gov>
NASA/Jet Propulsion Laboratory

I now have over 1000 images of Comet Hyakutake on my home page. I would like to thank the people who have submitted their images and made them available on the Internet. The URL of the home page is http://www.jpl.nasa.gov/comet/hyakutake/

Roger Tanner Fan Club

Don Buulky <buulky@falstaff.beer.nose.wet>

Roger Tanner – a long-time Lowbrow who moved to Arizona a few years ago – will be in the Ann Arbor area over the holidays. Friends and associates who'd like to say hello, and take a look at pictures, images, and videos of his work on NASA's Mars missions (he's working on the vision system for the next generation of Mars Rover) are welcome to come join him at the home of Kurt Hillig (7654 W. Ellsworth Rd., A^2) on Sunday, Dec. 29, from 2 PM until I get tired and kick everyone out. Call Kurt at 313/ 663-8699 – or e-mail khillig@umich.edu – for directions (and so we know how much pizza to order), either prior to Dec. 20, or on the 28th before 3 PM.

Calling All ATM's!

The Amateur Telescope Makers subgroup will hold its first meeting on Sunday, Jan. 12, 1997, at 2 PM, at the home of Kurt Hillig, 7654 W. Ellsworth Rd. Since we haven't met before, this meeting will largely be organizational – what do we want to do, what can we do for each other, when do we want to do it, etc.

Anyone with an interest in telescope making is invited to attend; this group is *not* limited to people currently building scopes, although any who are doing so (or wish to learn how) are welcome to come too. Projected subjects for discussion include optical design, mechanical design, and techniques for optical and mechanical fabrication; I expect participants will have plenty of opportunity to get their hands dirty!

Siderial Time on Your Computer

Curtis Roelle <roelle@erols.com>

An embedded Java applet is available which updates the Local Sidereal Time (LST) for anywhere on Earth in real-time. It also maintains current UTC and Julian Day. The URL where it can be found is http://www.erols.com/roelle/was/java/SiderealClock.html

All the user has to do is select a time zone and specify the longitude. The time zone is needed because the applet reads local time from the same host on which your browser is running. If your browser's host is set to PST, select PST from the time zone choice box. LST differs by Longitude, which is why Longitude is a required field.

I hope to add more time zones in the future. For now it is rather North-America-oriented. If your time zone is not one of those currently supported, you can still obtain LST for your site by doing the following:

1) change the TOD on your browser's host system to UTC.
2) select UTC from the time zone choices.

The sidereal clock may also be used to determine LST (or Julian Day) for other dates and times by entering the TOD/Date. Help is available on-line which explains how to use the applet, as well as a short tutorial on the most common systems of time.

Now you can access a sidereal clock for free from anywhere, or any observing site, in the world — provided that you have access to the WWW.

Twilight

Bill Wyatt <wyatt@cfa.harvard.edu>
Smithsonian Astrophysical Observatory

When does twilight end and night begin? There are three formally defined levels of twilight, based on the solar elevation angle:

civil	0° to -6°
nautical	-6° to -12°
astronomical	-12° to -18°

The practical definition of nautical twilight is when, at sea, you can't distinguish the horizon anymore. For astronomical twilight, it's when there is no more sunlight scattered into the night sky (although atmospheric sky lines are always present). Note that astronomical twilight never ends in midsummer for the northernmost US (Seattle, etc.), as the sun is never more than 18 degrees below the horizon.

New Mars Screen Saver Available On-Line From NASA/JPL

A new screen saver debuts today showing the "Sojourner" rover, which was recently launched on the Mars Pathfinder spacecraft, as it crisscrosses over or navigates around Martian boulders.

The screen saver display is free and available on the Internet for computer users with Windows 3.1 and '95 and Macintosh software. It can be downloaded by accessing the JPL Mars home page at http://www.jpl.nasa.gov/mars/

"The images of Mars were rendered here at JPL on our CRAY T3D parallel supercomputer," said Dr. Carl Kukkonen, manager of JPL's Supercomputing Project. "Scenes like this helped the Mars Exploration Program Office at JPL to determine the most ideal landing site for the Pathfinder mission."

The screen saver is available in the Windows 3.1, Windows '95 and Macintosh formats to computer users with any version of the "After Dark" screen saver software produced by Berkeley Systems, Inc. The screen saver was a joint effort of JPL and Berkeley Systems of Berkeley, CA, developer of After Dark screen saver software, which can be downloaded from the Internet by using the following address: http://www.berksys.com

Calendars, Handbooks – Great Literature for Sale!

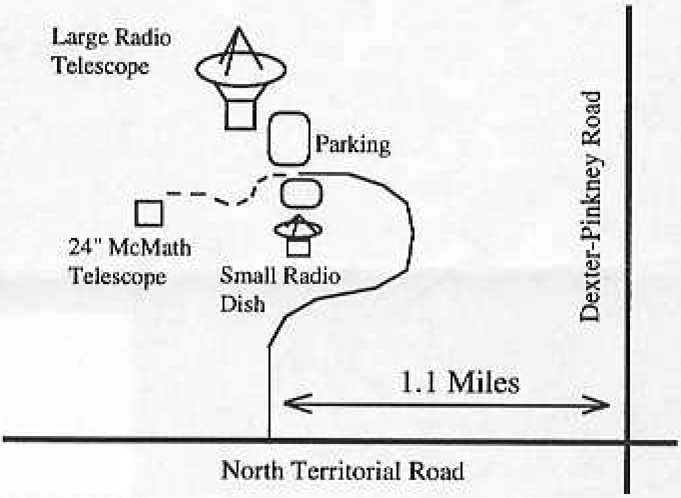
Doug Scobel, Treasurer-at-Large

The 1997 Astronomy and Space weekly desk calendars have arrived, and the 1997 RASC Observer's Handbooks should be here in time for the December meeting as well. If you ordered a copy of either, then bring in your bucks ($8.95 for the desk calendar, $18.00 for the Observer's Handbook) to pick it up. And, of course, I still have lots of the 1997 Wonders of the Universe wall calendars left, priced at $8.00 ($9.00 for non-members).

Places:

Dennison Hall, also known as the University of Michigan's Physics and Astronomy building, is located on Church Street in Ann Arbor one block north of South University Ave. The Lowbrow's monthly meetings are held in room 807. The UM parking structure on Church Street is nearby and is open to the public after 6 PM.

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



Times:

The monthly meetings of the Lowbrows are held on the third Friday of each month at 7:30 PM in 807 Dennison Hall. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.

Computer group meetings are held on the first of each month, rotating among members' houses. See the calendar on the front cover for the location of the next meeting.

Public Open House/Star Parties are held on the Saturdays before and after each new Moon, at the Peach Mountain Observatory. Star Parties may be cancelled if the sky is cloudy at sunset or the temperature is below 10°F – call 480-4514 to check on the status. Many members bring their telescopes; visitors are welcome to do likewise. Peach Mountain gets cold at night, so dress warmly – and bring insect repellant!

Membership:

Membership dues in the Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students. This entitles you to monthly issues of *Reflections* and the use the 24" McMath telescope (after training). Dues can be paid to the club treasurer, Doug Scobel, at any meeting or by mail at this address:

1426 Wedgewood Dr.
Saline, MI 48176

Magazines:

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

Sky and Telescope: $27 / year
CCD Astronomy: $20 / year
Astronomy: $20 / year
Odyssey: $16.95 / year

For more information, contact the treasurer.

Newsletter Contributions:

Members (and non-members) are encouraged to write about any astronomy-related topic in which they are interested. Images, whether photographs, sketches, or in electronic form (GIF, TIFF or JPEG) are also welcome. Call the editor (Kurt Hillig) at 663-8699(h) or 647-2867(o), or send e-mail to khillig@umich.edu, to discuss length, format, etc. Announcements and articles are due 14 days before each monthly meeting. Contributions can be mailed to:

Kurt Hillig
7654 W. Ellsworth Rd.
Ann Arbor, MI 48103

Telephone Numbers:

President:	D. C. Moons	254-9439
Vice Pres:	Mark Cray	283-6311
	Tom Pettit	878-0438
	Fred Schebor	426-2363
	Mark Vincent	663-7813
Treasurer:	Doug Scobel	429-4954
Observatory Director:	Bernard Friberg	761-1875
Newsletter:	Kurt Hillig	663-8699
Publisher:	Lorna Simmons	525-5731

Peach Mountain Keyholder:
Fred Schebor 426-2363

Visit our Home Page:

http://www.astro.lsa.umich.edu/lowbrows.html

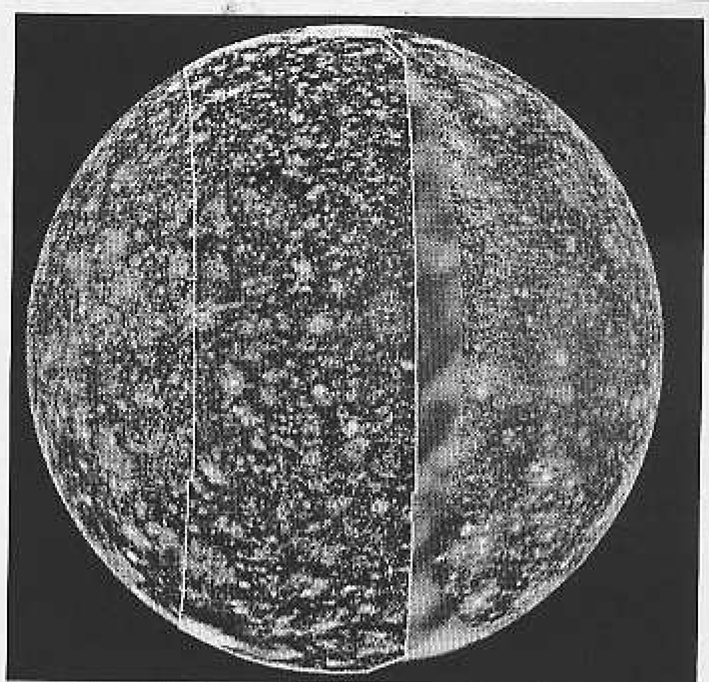
Monthly Meeting:

Brian Ottum:

The Christmas Star

Dec. 20, 1996 at 7:30 PM

Room 807 of the Dennison Building on the UM Campus



A mosaic view of Jupiter's moon Callisto, prepared from images obtained by Voyager 1 (left side, 1979), Galileo (middle, 1996), and Voyager 2 (right side, 1979). Features of interest in the Galileo data include a dark, smooth area in the north (upper third) which appears to be ejecta from a small impact crater; a fresh, sharp-rimmed crater some 90 km across named Igaluk (center left third); and a bright zone in the south polar area (bottom) which could be an impact scar.

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Check your membership expiration date on the mailing label!