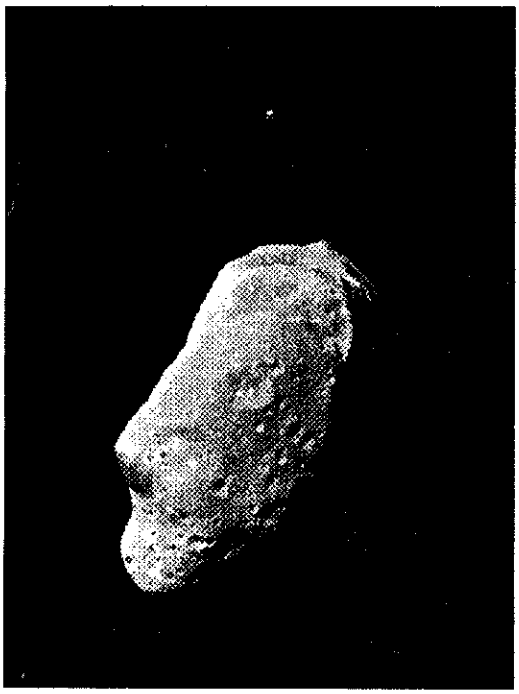
the focal point

Monthly Notices of the Atlanta Astronomy Club, Inc.

Vol. VI No. 8 — April, 1994

IN THIS ISSUE

Club Members Discover Supernova!
Details on Page 2.



Ida and Son
See Page 3

the focal point

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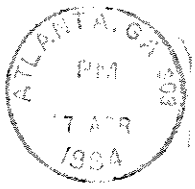
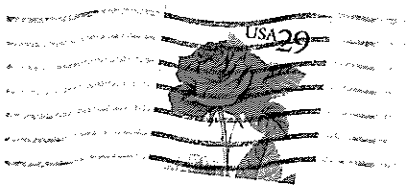




FROM:
Leonard B. Abbey, Editor
1002 Citadel Drive
Atlanta, Georgia 30324

First Class

The Atlanta Astronomy Club Inc., the South's largest and oldest astronomical society, meets at 8:00 p.m. on the third Friday of each month at Agnes Scott College's Bradley Observatory. Occasional meetings are held at other locations (check the hot line for details). Membership is open to all. Annual dues are $20 ($10 for students). Discounted subscriptions to *Astronomy* ($18), and *Sky & Telescope* ($20) magazines are available. Send dues to: **Clay McHann, Treasurer, 3450 Jones Mill Rd., #708, Norcross, Ga. 30092**

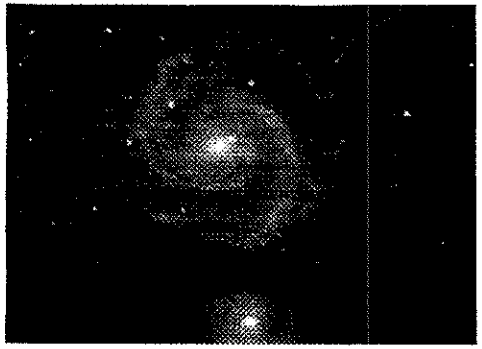
Hot Line: Timely information on the night sky and astronomy in the Atlanta area is available on a twenty-four hour basis on the Atlanta Astronomy Club hot line: 621-2661.

BBS: The Atlanta Astronomy Club operates a computer bulletin board at 455-3089. The BBS, which is free and open to the public, provides contact with both amateur and professional astronomers around the world.

9410

W. Tom Buchanan
105 Carriage Station Circle
Roswell, Georgia 30075

SUPERNOVA IN M51!



On April 1, at 11:02 p.m., Jerry Armstrong and Tim Puckett detected a faint supernova near the nucleus of M51, the Whirlpool Galaxy (seen here at the 1 o'clock position, 1/8" from the center of the nucleus). This is almost certainly the most important astronomical discovery ever made in Georgia. The discovery crowns an intensive observing program which has spanned several decades for the two amateur astronomers.

Jerry and Tim reported their find to the IAU in Cambridge, Mass. via computer. Their report beat a discovery claim by Richard Berry, another famous amateur, by only 45 minutes. A third report was received by the IAU several hours later.

The new star is located approximately 5" south, and 20" east of the galaxy's nucleus. It was approximately magnitude 13.5 at the time of discovery.

This supernova is not an ordinary one. Normally, a supernova in this galaxy would be expected to be of magnitude 8 or 9. The faintness of this one indicates that it's light is attenuated by interstellar dust and gas. It therefore presents us with a rare opportunity to analyze the interstellar medium of another galaxy for the first time. It is expected that the Hubble Space Telescope will be utilized for this purpose.

This discovery cannot be attributed to luck. Jerry and Tim have been systematically examining hundreds of galaxies for supernovae for years. They are also involved in a program of high-precision measurements of comets.

But this is not all! On the same night, and at the same time, Jerry and Tim discovered an asteroid! This discovery has also been confirmed by the IAU. After tracking the new asteroid for three months, they will have the privilege of naming it.

WHAT'S UP

	SUN				MOON				
Date	Rise	Azi	Set	Azi	Rise	Azi	Set	Azi	Age
4/15/94	7:07	77.6	20:09	282.5	10:01	64.8	-----	-----	4.6
4/16/94	7:06	77.1	20:09	283.0	10:51	65.1	0:26	295.2	5.5
4/17/94	7:04	76.7	20:10	283.4	11:45	66.7	1:13	294.1	6.5
4/18/94	7:03	76.3	20:11	283.8	12:43	69.5	1:57	291.9	7.4
4/19/94	7:02	75.9	20:12	284.3	13:43	73.6	2:39	288.3	8.4
4/20/94	7:01	75.5	20:12	284.7	14:46	78.7	3:18	283.7	9.5
4/21/94	7:00	75.0	20:13	285.1	15:51	84.6	3:56	278.3	10.6
4/22/94	6:58	74.6	20:14	285.5	16:57	91.0	4:33	272.2	11.7
4/23/94	6:57	74.2	20:15	285.9	18:06	97.7	5:11	265.7	12.8
4/24/94	6:56	73.8	20:15	286.3	19:17	103.8	5:51	259.5	14.0
4/25/94	6:55	73.4	20:16	286.7	20:29	109.1	6:34	253.7	15.2
4/26/94	6:54	73.0	20:17	287.1	21:39	113.0	7:22	249.0	16.3
4/27/94	6:53	72.6	20:18	287.5	22:47	115.1	8:15	245.8	17.5
4/28/94	6:52	72.3	20:18	287.9	23:48	115.3	9:13	244.6	18.6
4/29/94	6:51	71.9	20:19	288.3	-----	-----	10:15	245.2	19.7
4/30/94	6:50	71.5	20:20	288.6	0:42	113.7	11:18	247.5	20.7
5/1/94	6:49	71.1	20:21	289.0	1:29	110.6	12:20	251.1	21.7
5/2/94	6:48	70.7	20:22	289.4	2:09	106.4	13:21	255.7	22.7
5/3/94	6:47	70.4	20:22	289.7	2:45	101.7	14:19	260.7	23.6
5/4/94	6:46	70.0	20:23	290.1	3:18	96.5	15:15	266.1	24.6
5/5/94	6:45	69.7	20:24	290.4	3:49	91.3	16:10	271.4	25.5
5/6/94	6:44	69.3	20:25	290.8	4:19	86.0	17:04	276.7	26.4
5/7/94	6:43	69.0	20:25	291.1	4:50	81.1	17:58	281.5	27.3
5/8/94	6:42	68.6	20:26	291.5	5:21	76.4	18:52	285.9	28.1
5/9/94	6:41	68.3	20:27	291.8	5:56	72.3	19:46	289.7	29.0
5/10/94	6:40	68.0	20:28	292.1	6:33	68.9	20:40	292.6	0.4
5/11/94	6:40	67.7	20:28	292.4	7:13	66.4	21:32	294.5	1.3
5/12/94	6:39	67.3	20:29	292.7	7:58	65.1	22:23	295.2	2.2
5/13/94	6:38	67.0	20:30	293.0	8:48	64.9	23:11	294.5	3.1
5/14/94	6:37	66.7	20:31	293.3	9:41	66.1	23:56	292.7	4.1
5/15/94	6:36	66.4	20:31	293.6	10:37	68.6	-----	-----	5.0

OFFICERS AND OTHER DIGNITARIES

President:	Steve Gilbreath	409-1915
First Vice-President: (Program)	Hal Crawford	242-9995
Second Vice-President: (Observing)	Alex Langoussis	429-8384
Recording Secretary:	Terry McHann	441-9097
Corresponding Secretary:	Leonard Abbey	634-1222
Treasurer:	Clay McHann	441-9097
BBS:	Doug Chesser	457-5743
Edibles:	Terry McHann	441-9097
Facilities	Leonard Abbey	634-1222
Light Pollution:	Tom Buchanan	587-0774

OBSERVATORY REPORT

by Alex Langoussis

Now that your taxes are filed, it is time to dust off the telescope again.

This month, the New Moon weekend is the weekend of the meeting. Our scheduled observing session will be on Saturday, April 16. We will begin at dusk, and won't fold up our tents until dawn!

So come on out, and don't forget to bring this issue of the *Focal Point* with you. This month we will have an early peek at the Realm of the Galaxies. Use the Club's 20" and use your own scope. Or, if you don't have a telescope yet, come to try out the great variety of instruments which our members will bring. It will be a treat for everybody.

And don't forget, the 20" will give us a really closeup view of the supernova in M51. This telescope is the best deep sky instrument in Georgia.

BBS REPORT

by Doug Chesser

The Atlanta Astronomy Club BBS is now 1 year old. This is very good considering most BBS systems fold within the first 6 months of their existence.

BBS callers can now access the system's automatic fax system. This system contains several important Club documents including maps to Villa Rica, and back issues of the Focal Point.

Here is how it works. Upon entering the system, select "X" from the main menu. You will then see the fax menu appear. The menu allows you to select the documents you want to have faxed as well as the phone number you wish to have them faxed to. Once you have finished your BBS session, the system will pause for 45 seconds. It will then make 3 attempts to fax the document you have selected to the phone number you have specified. If the fax is successful the system will post you a message informing you that the fax was delivered.

How useful is this? For example, if you have a friend who is going to meet you at the Villa Rica observatory, but does not know the way there, you can call up the BBS, and have the system fax them the directions!

Here are our statistics, which we can all be proud of:

Total Number of Users calling within 90 days: 305
Total Messages in the system: aproximately 18,000
Total Uploads since 01/01/94: aproximately 160

SATELLITES OF MINOR PLANETS

Tom Van Flandern, Meta Research

Discovery. One of the key predictions of the exploded planet hypothesis is that most minor planets will be accompanied by debris clouds, the larger fragments of which would be classified as "minor satellites". If the thousands of objects orbiting between Mars and Jupiter did indeed originate in a planetary explosion, then satellites of minor planets must be both numerous and commonplace. Evidence of just that has accumulated over the years, but has been hotly disputed by mainstream asteroid experts ("asteroid" and "minor planet" are synonymous). This is because satellites cannot get into stable orbits under normal circumstances if the standard paradigm is correct, that minor planets or their parent bodies condensed from the primeval solar nebula. So the prediction that such satellites are abundant is indeed a decisive one for choosing between the two competing theories.

As this issue was nearing its printing deadline, the following press bulletin was released by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California:

PUBLIC INFORMATION OFFICE
JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
PASADENA, CALIF. 91109. TELEPHONE (818) 354-5011

Contact: Franklin O'Donnell

FOR IMMEDIATE RELEASE March 3, 1994

NASA's Galileo spacecraft observed what is probably a natural satellite of the asteroid Ida -- which would be the first moon of an asteroid ever sighted -- during its flyby last August 28, scientists have reported.

The object is revealed in data samples now being transmitted by the spacecraft and analyzed by scientists at the Jet Propulsion Laboratory.

Sampled data from both Galileo's solid-state imaging system and its near-infrared mapping spectrometer give indications of the object.

Because Galileo has been transmitting data back to Earth at a low rate of 40 bits per second, a complete image of the suspected moon will first become available in about three weeks.

Galileo has completed nearly 90 percent of its 3.8-billion-kilometer (2.4-billion-mile) journey to Jupiter. It will go into orbit around the giant planet after exploring the atmosphere with an instrumented probe on December 7, 1995. JPL manages the Galileo project for NASA's Office of Space Science.

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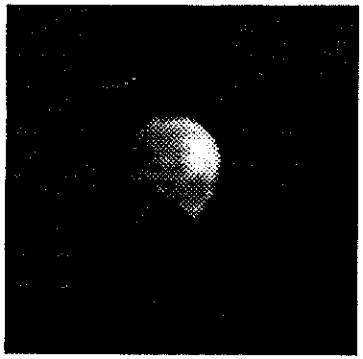
Background. In *MetaRes.Bull.* 1, 4-6 (1992), we published "First asteroid images: satellite analysis", reporting on the same spacecraft's first asteroid encounter with Gaspra in October, 1991. An earlier article predicting that the spacecraft would find satellites appeared in "Minor satellites and the Gaspra encounter", in *Asteroids, Comets, Meteors 1991*, A.W. Harris and E. Bowell, eds., Lunar & Planetary Institute, Houston, TX, 609-612 (1992). No orbiting satellites turned up in the Gaspra encounter. However, I quote here one paragraph from the preliminary analysis results of that earlier event from the *Meta Research Bulletin* (MRB) article. This same quote also appears on p. 178 of the author's book *Dark Matter, Missing Planets and New Comets*, in which chapter 8 is devoted to the history of earlier minor satellite observations.

"... Gaspra might have no moons only because of a collision event. I had said [before the spacecraft encounter], 'Even so, tidal forces prior to the collision would have operated to bring down minor satellites orbiting inside the synchronous orbit, which for Gaspra is about two mean diameters out. They should end up lying on the surface of the nucleus.' Near one edge of the image sent by the spacecraft, there is a large object about 5 km long which appears to be a physically distinct piece lying on the surface of an otherwise contiguous body. This is just the sort of object I anticipated with my remark. The proof of its origin as a moon of Gaspra could come in later photos if tracks caused by the object rolling after decaying from orbit can still be seen."

Evidence. Additional photographs of Gaspra became available when the Galileo spacecraft returned to the vicinity of the Earth on its complex journey. These photos did indeed confirm this last prediction very well. Three parallel groves lead up to the snout-shaped object. Although the origin of these peculiar surface markings is still debated, roll-marks made by the 5-km body appear to be an excellent explanation consistent with all known facts. So Gaspra might be considered as in accord with the pre-encounter prediction of minor satellites, but in a somewhat ambiguous way. It was clear that most astronomers would remain unconvinced until a spacecraft returned pictures of a satellite in the act of orbiting a minor planet right now.



A Close-up View of Ida's Moon.

The August, 1993, flyby of minor planet Ida by the Galileo spacecraft appears to have provided that confirmation. Ida is essentially a randomly selected asteroid for this purpose, since it simply happened to lie near the spacecraft's flight path to Jupiter through the main asteroid belt. It is only the second asteroid ever examined close-up by a spacecraft. The new pictures indicate it has at least one currently orbiting satellite. So little of the space around Ida has yet been examined that it may perhaps have many more. [Problems with the spacecraft antenna have prevented downloading the background on the pictures taken by the spacecraft, in order to save spacecraft and telescope time. A few single lines were downloaded from each picture to locate the asteroid image, and only that image was to be downloaded to Earth at the slow data rate of the antenna. But even in the small area of space around the asteroid sampled by these test lines, one satellite has turned up. We may expect that many additional satellites (probably dozens, possibly hundreds, many of them in orbits having the same period as the

AAC ACTIVITIES

April Meeting

In April, our meeting will be a double feature.

First, **Jerry Armstrong and Tim Puckett** will tell how they found their **supernova**. They will have multiple CCD images, and will describe the whole process. They will also display images of their new asteroid, and will describe their work with comets. If you ever wondered exactly how somebody becomes an "advanced" amateur astronomer, this is your chance!

And last, but not least, **Ken Poshedly** will present a report on this month's **Peach State Star Gaze**. He will have slides showing the instruments who attended, and their owners. The planning for PSSG '95 will begin Friday night!

As usual, we will meet at **Bradley Observatory** on the third Friday, **April 15**, at **8:00 p.m.**

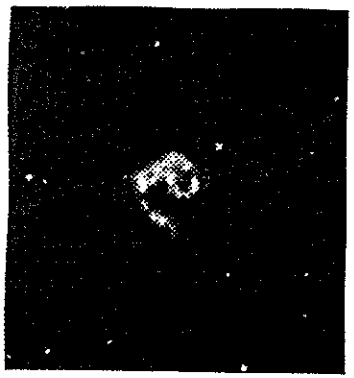
☞ NOTICE

PARKING AT BRADLEY OBSERVATORY

The house on East Hancock Street which is adjacent to the observatory driveway has a new owner, and he has planted grass on the strip of lawn which borders the driveway. We are accustomed to parking there, but that space is no longer available.

The parking lot behind the observatory building has space for 8 or 10 cars. After that lot is full, members can park on East Hancock Street, or in the parking lot near the Agnes Scott power plant on Dougherty Street. Dougherty Street is parallel to East Hancock, one block North. There is a paved, lighted path from the parking lot to the observatory. The distance to walk is just a little more than the distance of East Hancock Street to the observatory.

Members are asked to please remember to respect this reasonable request by our neighbor.



NGC 4038 The Ring Tail Galaxy.

NGC 3242 The Ghost of Jupiter. This is a very impressive planetary nebula, showing a blue-green disk almost 1' in diameter with a bright center and fuzzy edges. I saw a bright spot on the SE edge, and another but fainter brightening to its NW.

CORVUS

NGC 4038-9 The Ring Tail or Antennae Galaxy. This fascinating object is actually two interacting galaxies which have been greatly distorted by gravitational forces. A telescope shows a curving arc about 3' in length and about 2' at its widest point. Oriented N - S, it looks like a bulging crescent and is brighter on the northern end.

NGC 4361 This large planetary nebula is about 50" in diameter, and has an easily seen central star. The nebulosity is gray, and reminds me somewhat of the Owl Nebula in Ursa Major.

SEXTANS

NGC 3115 The Spindle Galaxy. This striking object is bright and moderately large in size, about 6 x 1' in extent. It has a sharply brighter core and a stellar nucleus. A very pretty object.

asteroid's rotation) of various sizes down to the limit of camera resolution would be seen if the full pictures could be downloaded. But that is not presently part of the operating plan for recovering the data from the spacecraft's tape recorder. So we must depend on chance to show additional moons that may be there.]

Conservative scientists are quick to point out that one satellite of one minor planet does not prove that minor satellites are "numerous and commonplace", as the exploded planet hypothesis predicts. Indeed, imaging-team leader Michael Belton is quoted by *Sky & Telescope* magazine as cautioning that there's a remote chance that a small, previously undetected asteroid just happened to be whizzing past Ida at just that moment. But the probability of this may be compared with the probability that, during your one-hour visit to New York or Los Angeles, the city is completely destroyed by the impact of an asteroid from space.

Therefore, I suspect that those with a good sense of the laws of probability must realize that finding a moon of an asteroid during only the second spacecraft encounter with one implies that minor satellites are at least not rare. When this discovery is combined with earlier occultation and radar data suggesting that the majority of asteroids examined have companions (at least coalesced ones), it is perhaps not too soon to anticipate that this critical test is turning out in favor of the exploded planet hypothesis, and against the hypothesis of origin of minor planets by condensation from the solar nebula. [The latest radar results showing the contact-binary nature of asteroid Castilia (1989 PB) are reported by R. Hudson and S. Ostro, *Science* 263, 940-943 (1994).]

It might be added that, in addition to all the other evidence for the exploded planet hypothesis (see chapter 11 of *Dark Matter*, ...), the Galileo spacecraft also detected evidence of a magnetic field during its flyby of Ida. According to JPL's press release about that finding, "Before Galileo's Gaspra encounter in October 1991, small asteroids generally were not expected to possess their own magnetic fields, though some meteorites – believed to be fragments of asteroids – have measurable fields." This is because small bodies such as asteroids, even up to the size of Earth's Moon, are unlikely to have the high temperatures and pressures in their interiors generally associated with planetary magnetic fields.

Moreover, both Gaspra and Ida were believed to be mainly stony, rather than iron as in the magnetic meteorites. So finding magnetic fields there came as quite a surprise. Yet, if the asteroids are fragments of a major planet, it would be no surprise that each fragment preserved a fossilized magnetic field from its parent planet, frozen in place during the billions of years it spent inside that planet.

Implications. Why can't abundant satellites exist in the standard model? Suppose the satellites come from outside the sphere of influence of the parent asteroid. Then gravitational capture is impossible for several reasons. In the two-body problem, gravitational capture is impossible under any circumstances, as long as gravity is the only force acting. If a third body intervenes, then temporary captures are possible, but escape back to a solar orbit is inevitable, usually after only one or a few revolutions as a satellite.

In both cases of external origin, a stable capture might occur if a non-gravitational force acts too. But all known non-gravitational forces acting on asteroids except collisions are negligible in strength compared to gravitation, and have apparently always been so. Moreover, to be effective, any such non-gravitational force would have to be quite strong because the mean relative velocity between any two asteroids, +/- 5 km/s, would have to be reduced to typical satellite orbital velocities of just a few meters per second, a thousand times smaller. Yet the hypothetical force would then have to cease operating to prevent causing decay of the orbit of the satellite down to the surface of its parent. No

known forces can have either this strength or behavior.

But perhaps asteroid moons originate through collisions or the breakup of the parent asteroid. The high relative velocity between asteroids mitigates against fragments from a collision leaving at less than escape velocity, which is also just a few m/s for a typical asteroid. But the more important problem is the lack of angular momentum (sideways velocity) available from a collision or breakup. In short, this means that any fragment originating at the surface of an asteroid, if it does not escape the asteroid's sphere of influence altogether, must enter an elongated elliptical orbit whose trajectory again intersects the same surface point. Thus it must fall back onto the parent after a single revolution.

Moreover, since all collisional fragments move more-or-less radially away from the center of their parent body, secondary collisions cannot provide transverse velocity sufficient to enter a stable orbit.

But even if some unlikely combination of events managed to lift the periapsis point in the satellite orbit above the surface of its parent, so that it did not collide with the parent after one revolution, that low periapsis orbit would still decay down to the surface again through the action of tidal forces in a dynamically short time, small compared to a million years. To be stable, a satellite orbit must lie almost entirely at or above the altitude of the synchronous orbit, where satellite orbital period equals rotational spin period of the parent asteroid. That altitude typically lies a few radii above the parent asteroid.

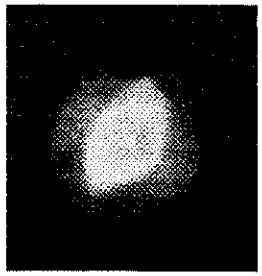
The bottom line is that creating stable satellites in the standard model requires freakish circumstances of extremely low probability. Abundant satellites are simply not possible with that mode of origin. And that is why earlier observational evidence for satellites has been so readily dismissed by mainstream asteroid experts, despite its apparent reliability.

By contrast, abundant satellites are unavoidable if asteroids originated in the explosion of a far larger parent planet. The key difference is that such satellites were always inside of the gravitational sphere of influence of their parent asteroids. They did not have to come from outside and get captured. The explosion of a major planet fills space densely with debris of all sizes and masses fleeing the explosion with a wide range of fragment velocities. Immediately after the explosion, the fragments' own spheres of influence are severely limited by the strong gravitational field of their still-nearby parent planet. But as they get farther away, the influence of the parent planet gets weaker, allowing the gravitational spheres of influence of each fragment to enlarge. This enlarging continues until a new limit is set by the Sun as the fragments enter their permanent solar orbits.

During this enlarging period for the spheres of influence of fragments, considerable debris of all sizes will become trapped inside each such sphere of influence. Some of that debris will tidally decay, and be found coalesced with the parent minor planet or lying on its surface. Some of the debris will escape through tidal or collisional forces, forming streams of objects traveling in closely similar solar orbits, very much like the "families" and "jet streams" of asteroids that we observe. But much of the debris near each large original fragment will remain gravitationally bound to it and in orbit around it. These comprise the moons of the fragment that are predicted to exist abundantly by the hypothesis of an explosion origin.

The Future. Additional details about Ida and its satellite should become available later in March. And we might hope that there will be a new plan to download the "background" portion of at least some of the images in the hope of finding additional satellites. Beyond that possibility, we can look forward to the encounter of the spacecraft Clementine with near-Earth asteroid Geographos in a few months. According to another JPL press release,

center, and seemingly connected to M51 by a bridge of stars.



NGC 3242 "The Ghost of Jupiter."

M63 The Sunflower galaxy. This is a large, bright galaxy, about 10 X 5', extended E-W. The bright center is surrounded by a halo which fades gradually to the edges. Long exposure photography shows an amazingly intricate spiral structure.

M94 Another large and bright galaxy. It is about 8 - 10' in diameter and roughly circular. It is very bright, with a large core and a fainter surrounding envelope. On a superb night in the mountains of New Mexico, I was able to detect its delicate spiral structure at the edges.

M106 This large and bright galaxy is about 12 X 5' with a bright oval core and a fainter surrounding halo. At times in good seeing, faint spiral structure can be seen in this galaxy.

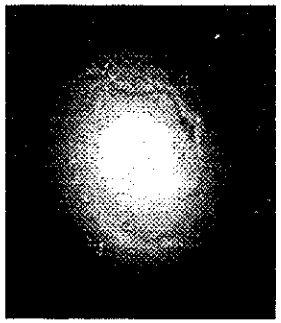
NGC 4631 This is one of the gems to be discovered by those pursuing the Herschel objects. This remarkable galaxy is large, about 13 X 2', extended E - W, with a star seemingly imbedded above its center. It is relatively bright, with mottling and streaks very reminiscent of M82 in Ursa Major.

NGC 4656 Another fine object. This peculiar galaxy is about 10 X 2', extended NE - SW. The southeast side is very faint, but the northeastern side is curled to the east as it tapers to a point. An off-center central bulge gives this galaxy an overall comma shape.

HYDRA

Hydra is both the largest and longest of all the constellations, spanning almost 7 hours of Right Ascension, and covering over 1300 square degrees. The attendant constellations of Corvus, Crater, and Sextans seem to ride on the back of Hydra as it winds across the sky. While on the whole this is a rather sparse region of the sky containing primarily faint and distant galaxies, there are three Messier objects and several fine Herschel objects in the area, making the hunt worthwhile.

M48 This is a fine open cluster over one-half of a degree in diameter, and easily seen in binoculars. It is composed primarily of fairly bright stars, loosely concentrated to the center. I estimated about 75 stars in the area.



M94 Spiral Galaxy in Canes Venaciti

M68 This rather bright globular cluster is about 8 - 10' in diameter and is very compact, showing a bright, granulated core and many stars resolved around its edges.

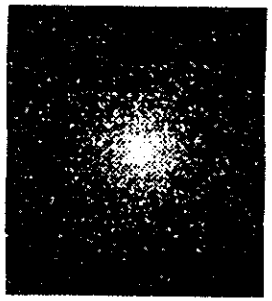
M83 This is one of the finest examples of a face on barred spiral galaxies in the sky. It is large, about 10' in diameter, with an obvious central bar and spiral arms which seem to go all the way around the galaxy. Often photographed by amateurs, this is a real gem of the night sky.

CONSTELLATIONS OF THE MONTH
CANES VENATICI AND THE HYDRA REGION

by Rick Raasch, Dallas

CANES VENATICI

With the coming of warmer weather, the Realm of the Galaxies is now coming into view. As the winter Milky Way sets in the west, the obscuring clouds of dust and gas set with it, giving us a relatively unobstructed view into deepest space. Here we find some of the finest and most difficult objects in the sky: galaxies. Galaxies require special techniques such as averted vision and shaking the telescope tube to coax

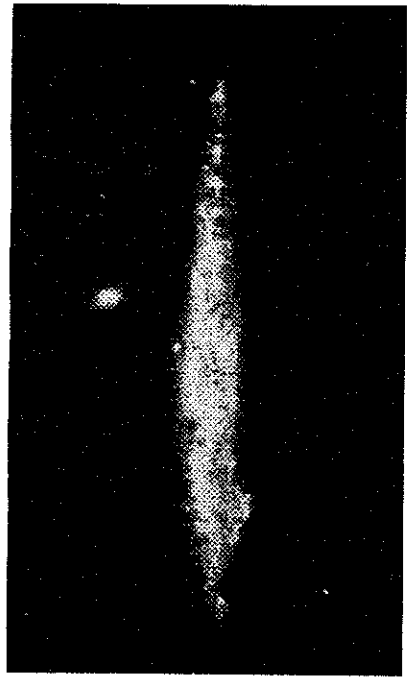


M3 A Rich Globular in Canes Venatici

detail out of them. Patience and practice will reward the persistent observer with details unseen by more casual observers.

Canes Venatici lies between the constellations of Ursa Major and Coma Berenices. While it has only two stars brighter than the fifth magnitude, it is rich in galaxies and contains the fine globular cluster, M3. Most of the galaxies in this area are outliers of the Coma Berenices Galaxy Cluster. Many are small and faint, but there are also some real showpieces in this constellation.

M3 This pretty globular cluster is about 12 - 15' in diameter and handles magnification rather well. There are many stars



NGC 4631 Galaxy in
Canes Venatici

arranged in curving chains resolved at its edges. The center is very dense, and was not resolved in my scope, which showed a granulated center.

M51 The Whirlpool Galaxy. This is probably the finest example of a face on spiral galaxy in the northern hemisphere. It is about 10 - 15' in diameter, with a bright center and rather easily seen spiral arms. Just a few arcminutes to the northeast is its companion galaxy, NGC 5195. This object is small, about 3 X 2', with a brighter

"Clementine is scheduled to reach Geographos on August 31, after which time more than 2,000 images will be recorded and stored on board in the solid-state memory for later playback to Earth. The cigar-shaped asteroid measures about 1.5 km by 4 km, and its orbit is inclined about 16 degrees to Earth's ecliptic plane. The spacecraft will pass within 100 km of Geographos, when it will be 8 million km from Earth." Asteroid Geographos holds unusual interest in part because of its odd shape. It may turn out to be the result of the tidal coalescence of several smaller asteroids, formerly orbiting one another.

Another related event is the widely publicized collision of Comet Shoemaker-Levy 9 with Jupiter late this July. The comet was discovered last year after it had "broken up" into at least 21 fragments arranged in a line along the comet's orbit. Because of this unique appearance, it was dubbed the "string of pearls" comet. Subsequent orbit analysis showed two things: (1) The comet was in a temporary orbit around Jupiter, and would collide with Jupiter on its next revolution. (2) On its previous revolution, the comet had come so close to Jupiter that it passed inside the so-called "Roche limit", inside of which a fluid body would be disrupted by tidal forces.

However, for the expected strength of cometary materials, these tidal forces were not strong enough to produce the breakup. This is additional evidence that the fragments were not part of one nucleus, but rather were orbiting satellites before the breakup. The distance of closest approach to Jupiter was close enough to cause satellites orbiting the nucleus to escape into the comet's orbit around Jupiter. Small differences in period then caused them to spread out in a line. This behavior neatly explains certain other solar system mysteries as well, such as the origin of long crater chains seen on the surfaces of some of Jupiter's satellites, and even on our own Moon.

Other References. Additional details about the stability and lifetimes of minor satellites, tidal forces, satellite orbital speeds, spheres of influence, and collision probabilities, may be found in "Satellites of Asteroids", T.C. Van Flandern, E.F. Tedesco and R.P. Binzel, in *Asteroids*, T. Gehrels, ed., U. of Ariz. Press, Tucson, 443-465 (1979). Early stellar occultation evidence for minor satellites may be found in "Minor planets: the discovery of minor satellites", R.P. Binzel and T.C. Van Flandern, *Science* 203, 903-905 (1979); with technical comments on the article debated in "Minor planet satellites", *Science* 211, 297-298 (1981). A review article by the author appears in "Satellites of minor planets: a new frontier for celestial mechanics", *Cel.Mech.* 22, 79-80 (1980). Finally, the connection with comets appears in "Do comets have satellites?", *Icarus* 47, 480-486 (1981).

Most existing prior evidence for asteroid moons was collected through the International Occultation Timing Association (IOTA)'s efforts at the initiative of astronomer David Dunham. Dunham also reported the first asteroid moon recognized for what it was to the American Astronomical Society following a discovery observation by observer Paul Maley in 1977. See chapter 8 of *Dark Matter,...* for more details.

Conclusions. The following paragraph is quoted from chapter 20 of *Dark Matter, ...* on the Scientific Method: "The logical deductions from a theory or model are its 'predictions.' They must be compared with reality at every opportunity. It is of paramount importance for any hypothesis which purports to be of value that it be 'falsifiable'; that is, that it be able to make predictions which if false invalidate the theory. Predictions that support a hypothesis if true, but do not contradict the hypothesis if the opposite (or nothing at all) happens, are generally of low value. For a hypothesis to gain acceptance, it must predict things seemingly of low probability that will invalidate the theory if the predictions are wrong. The convincing power of the predictions will be proportional to how much at risk the theory is placed by them. This is why it is usually a sign of a bad

theory if it must be 'patched' as a result of a bad prediction, or even a prediction it simply failed to make at all."

In the conclusion to the cited MRB article, and to chapter 8 of *Dark Matter*, ..., I also discuss the importance of tests of a theory that are unlikely to happen by chance, and of falsifiability. The words I used there, written well before this discovery, say what now needs to be said: "To be useful, a hypothesis must be falsifiable. I have agreed that, if the first three minor planets examined with sufficient resolution (including a least one C-type asteroid over 50 km diameter) have no moons, then the hypothesis of abundant asteroid satellites may be considered falsified, with corresponding implications for theories of asteroid origin. I hope that my colleagues will be equally forthcoming about the implications for asteroid origins if abundant satellites are found."

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STAR HOPPING

by George F. Chambers, London

Star hopping is a commonly used method to get around the night sky. Here are a few handy rough measures that might help: With your hand at arms-length your little finger covers about 1 degree of sky, three fingers cover 5 degrees, your fist covers 10 degrees, if you spread your fingers wide, the distance between your index and little fingers will be about 15 degrees. You can check these rough measurements against the Big Dipper. The top of the cup is 10 degrees across. It's 25 degrees from the tip of the handle to tip of the cup. The cup is 5 degrees deep.

Stepping off with fields of view is another handy method almost everyone uses sooner or later. A question that needs to be answered before this method can be used is: what is the angular field of view for the telescope and eyepiece I am using? I first used the method I am going to describe over 25 years ago. It is mentioned in the January, 1993, issue of *Sky and Telescope*. It really works!

A star on or near the celestial equator moves westward at the rate of 15 degrees every hour or 1 degree every 4 minutes. To find the field of view of your telescope with any given eyepiece, or the field of view of your finder, use the following procedure. If you have an equatorial mount, set the scope up and align it with the pole just as you would for an evening's observing. Turn the scope to point at a right angle to the polar axis. It will now be pointed along the celestial equator. Find any convenient star near the equator and position it at the western edge of the field of view. Note the time. Let the star drift to the east side. Note the time. Divide the time in minutes that it took the star to drift across the field by 4 to get the number of degrees in the angular field of view! For instance: If it takes 6 minutes for a star to drift across the field, the angular field of view is 6/4 =1.5 degrees. If you have an altazimuth mount you will need to use a star chart to find a star along the celestial equator. This method works with any type of telescope and any combination of eyepieces.

INTERNET...

MARS OBSERVER'S LAST GASP

Would it be possible to visually locate the Mars Observer, based on its last reported location and Keplerian orbital parameters? I realize that the error in position approximation increases as time marches on, and that there could be quite a large area of space to search. If it is possible, is anyone aware of an effort to visually locate the Mars Observer, in order to verify the findings of the Failure Investigation?

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RON BAALKE (JPL) REPLIES

There is no telescope that has the power or resolution to spot a spacecraft at Mars. There were actually multiple scenarios identified for the Mars Observer failure. One of them is simply that the transmitter never came back on, but the spacecraft is OK otherwise. If this is the case, the spacecraft can receive commands from Earth, but can't send anything back. To test out this theory, there will be one last attempt in May to command the Mars Balloon Relay on and try to detect the signal using the Arecibo antenna.

Ron Baalke, JPL
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AND DAVE THOLEN ADDS

Actually, the observability of Mars Observer from Earth has been investigated. The geometry isn't favorable for some time, but it should be possible eventually, assuming the spacecraft is largely intact. It's frustrating, because when it makes a close approach to the Earth, the solar elongation is small. When the solar elongation gets to a respectable value, the distance is too great. But within the next few years, it should reach about magnitude 25, which is possible to detect with Earth-based telescopes, though by no means easy.

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OVERHEARDONTHE INTERNET

A HORROR STORY

Greetings

I work at the Ohio State University in the Physics Department. Here in Columbus we have a science museum called COSI, the Center of Science and Industry. Ever since I was a child I've loved to go there, and especially see the planetarium. My brother and I would bug our parents to take us every 2 months (which was when they changed the shows). However, the last couple of times I went were rather bad experiences for me. There was an article in *Sky and Telescope* last year called "Planetariums and the Bottom Line." I recently read this article, and it's prompted me to tell this story.

Last August I went to COSI and sat through the show. I don't know who the guy was that gave the talk, but he was about as clueless a person as I've ever seen talk about the sky. He was playing with the fun little special effect projectors and saying the most inane things. It was all I could do to keep from walking out. There were two things he said (out of many) that stuck in my mind. He talked about "shooting stars AND meteors" as if they were two different things. I suspect he had heard about the Perseids and thought we'd like to know about them. As near as I can tell, his definition of meteor was a large fireball. The meteor shower projector was on while he talked about shooting stars, and when he mentioned meteors, he used the bolide flash. At no point did he explain what caused these things to happen. The other thing he did was turn on the galaxy projector to show the "Milky Way." There on the dome was a spiral galaxy, slowly rotating. So far so good. Then he said, We live in the spiral arm on the left-hand side." I have no idea where he got that one from.

This I could have chalked up to a volunteer put into the show before he was ready, but then a couple of months ago I went back and saw a different guy give the show. From what he said he had been doing these shows for a long time. This guy told us about the comet that had *recently* struck Jupiter. I assume he means comet Shoemaker-Levy which isn't due to hit Jupiter yet for a few months. Then he talked about the phases of the moon and put on the dome an image of the moon. As we watched, it waned and waxed back to full. The man then said that the phases of the moon are caused by the EARTH'S shadow falling on it. I could have died.

I'd be interested in hearing some discussion about this. Are many of you professional planetaria people? What do you think? Perhaps the most frustrating thing about this is that I have tried to get a job at COSI many times. My degree is in Physics and Math Education, and I have a strong background in astronomy. I couldn't for the life of me get in there, even into a job with crappy pay, but here are these guys who DO work there who wouldn't know a black hole from a hole in the ground.

Sigh.

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IS IT TIME TO RE-ALUMINIZE?

by Jack Kramer, Libertyville, Illinois

All users of telescopes that employ mirrors eventually face the need for re-aluminizing the optical surfaces. Those of us with scopes of the Newtonian design have to face this more frequently because our mirror surfaces are more exposed to the elements than are those in a closed Schmidt-Cassegrain system. While today's coatings are surprisingly rugged, they will deteriorate from the scratches that occur with handling, the abrasive nature of dust that inevitably settles on the mirror, and the wear of repeated washings of the mirror. In addition, any dew or condensation that forms on the mirror also contains some acids that gradually degrade the coating.

By careful cleaning of your mirrors at reasonable intervals, you can prolong the life of the coating; I found that I have to clean my mirrors with dishwashing detergent and distilled water about twice a year. Most experts say it's best to tolerate a small amount of dust on the mirror rather than to wipe it away, because the abrasive nature of some dust particles will cause more scratching as you try to remove them. Blowing the dust off with your breath is probably a better idea. Wash the mirror when the dust gets really noticeable.

When is it time to re-aluminize?

Despite our best efforts to care for the mirror, there comes a time when the reflective property of the coating has deteriorated to the point that performance of the telescope is seriously compromised. But generally this is such a gradual process that you're not really aware of it. How can you tell when "it's time"? I recently faced this issue with my seven-year-old ten-inch mirror; and what I learned in the process may be of some help to you. Other than for a few minor scratches at the edge of the mirror, it appeared to be in good shape. There were no blotches or hazy spots; after a washing it always looked bright and clean. Yet other observers were usually surprised that I had been able to go seven years without recoating, and this was just the usual commercial coating.

But there were tip-offs that things could be better. Bright stars always had a halo around them. Most often, this is the result of light scattered by dust on the mirror, but this occurred even after washing the mirror. Also, when I compared objects seen in my scope with the same objects seen in other scopes of the same size, they seemed a bit duller in my scope. Surprisingly, I was still able to catch objects fainter than 14th magnitude on exceptional nights, so the deterioration hadn't yet become severe. But logic seemed to say that re-aluminizing might improve the view nonetheless. Obviously, it also makes sense to have the secondary mirror recoated at the same time.

What kind of coating?

There are a number of different firms that do aluminizing work; some also provide "enhanced" aluminum coatings which typically have reflectivities of 95 - 96% versus 86 - 89% for normal aluminum coatings. Enhanced coatings cost more than *twice* as much.

A couple of years ago, I began thinking about the eventual need to recoat, so I asked other experienced observers their opinions about enhanced coatings. The consensus was that the improvement due to enhanced coating is somewhat noticeable, but it's questionable whether this improvement is worth the additional cost. The clincher was the general observation that enhanced coatings deteriorate faster than the regular coatings - within a relatively short time, you're no better off with an enhanced coating.

The following is a quote from issue #46 of *Telescope Making* magazine.

> "Enhanced coatings consist of a base layer of aluminum or silver overcoated with several layers of materials with varying refractive indices and thicknesses whose combination causes constructive interference of the reflected light, raising the reflectivity of the original metallic film. ...Some coatings enhance only a specific portion of the spectrum. ...Silver-based enhanced coatings tend to tarnish even if they're overcoated because overcoatings tend to be porous. ...Furthermore, enhanced coatings tend to be expensive and must be protected from acid dew that will degrade reflectivity and cause much scattering. ...Is the extra 10% light worth the added expense? It's hard to say, particularly considering that smog, acid dew and adverse atmospheric conditions may force you to recoat every several years."

Regular aluminized mirrors are generally overcoated to protect the soft aluminum from scratching, especially the very fine scratches ("sleeks") that are an almost unavoidable result of cleaning. Most overcoatings are silicon monoxide (SiO). Magnesium fluoride (MgF_2) is sometimes used, but it isn't as mar-resistant as SiO. (The Hubble Space Telescope's mirrors were overcoated with MgF_2 for better transmission in the ultraviolet end of the spectrum, rather than for its value as an overcoat.)

Doing it!

Where's the best place to have this done? After checking around, it seems we have one of the best places right in our back yard, so to speak. The P. A. Clausing firm has long touted its *Beral* coatings...and they're located in Skokie, Illinois. Moreover, a number of commercial telescope makers use Clausing for their coatings. (When I went there, they were coating several very large mirrors for Galaxy Optics.) For convenience sake, this certainly was better than boxing up the mirrors and shipping them across the country. The *Beral* coating is an alloy that's harder than aluminum, so Clausing does not overcoat the mirrors. They indicated that overcoating would provide a somewhat harder finish than *Beral* by itself, but that with appropriate care, the mirror should not have to be recoated more frequently than an aluminized and overcoated mirror. The experience of others indicates it's suitably durable, and in fact, it has a slightly higher reflectivity (90%) than regular aluminum. Incidentally, one point brought out in *Telescope Making* was that it's impossible to guarantee an exact reflectivity; conditions vary slightly in each coating run, so shops advertise a range of reflectivities. One way you can improve the odds of getting a better job is to remove any paint or adhesive on your mirrors before sending them for recoating. Residue from such chemicals will cause outgassing during the process, resulting in a less than optimum deposition of coating.

Results

In about a week I had my mirrors back. Was it worth it? It's hard to tell the difference simply based on how different objects appear – no two nights are exactly the same and it's impossible to test the "before" and "after" side-by-side. But my general impression is that stars now appear somewhat more "sparkling", and bright stars definitely have less of the scattered light glow around them. It *was* worth having the mirror re-coated.

This article is reprinted, with permission, from *NightTimes*, the monthly publication of the Lake County Astronomical Society, Libertyville, Illinois.

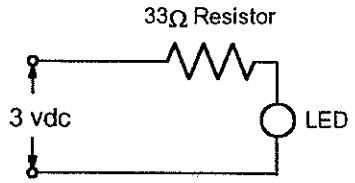
LED STAR LIGHTS

by Kevin Gill, Cave Creek, Arizona

Everyone knows that one's night vision, once obtained, is precious to the astronomer. Hence the use of red light for required seeing around the observation site. The purer the red the less destructive it is to one's night vision. This was usually accomplished by painting the flashlight bulb with red nail polish producing varying results. Over the last few years the use of LED (light emitting diode) lights has become popular and with good reason. The red is very pure and the power consumption is low thus extending battery life to its maximum. However the $20-$30 price tag has not been overly attractive.

Well, after searching electronics and hardware stores I was able to build a few different configurations for $3 to $8 each. The difference in cost was directly rated to the intensity of the light.

The general procedure is to take a standard flashlight and replace the standard incandescent bulb with a red LED and resistor circuit (shown below).



Circuit Diagram for the LED Light.

Radio Shack sells a variety of LED's ranging from 5 to 5000 mcd (millicandelas – a measure of brightness) that should fill all your observing needs – with 500 mcd being the minimum for outdoor use.

A LED will only light when current is applied in the correct direction. The long lead is positive.

The best light I was able to obtain was from Radio Shack called Slider, by Phillips, $1.99 on sale. It has a large efficient reflector, a handy on/off switch and best of all, soldered wire leads to the bulb. These connections made it a snap to add the resistor instead of having to deal with those funky spring clip arrangements on most lights. Simply remove the bulb and super glue or epoxy (or both) the LED in place, solder the connections and you have a pure red star light for a low price that will last.

Slider Flashlight	$2.00
2000 mcd LED	1.69
100 ohm resistor	0.15

If you need more light they have a 5000 mcd for $4.99

The slider lite is 4.5 volts. below are the resistor values for various voltage configurations.

3 vdc	33 Ω OR 47 Ω	1/4 watt
4.5 vdc	100 Ω	1/4 watt
6 vdc	150 Ω	1/4 watt
9 vdc	270 Ω	1/4 watt
12 vdc	390 Ω	1/2 watt

Other possibilities are LED's over your setting circles or eyepiece rack powered by a common battery located on your mount or tripod; and variable resistors (potentiometers) added to the circuit to adjust the brightness. Inexpensive pure red light at your disposal. Use your imagination.