

of a few very faint galaxies which lie behind the cluster.

Those of you who are itching to go after galaxies have a few bright ones to satisfy your appetite. In Hydra is the "Spindle" galaxy, NGC 3115, located 3.2 degrees east and a half north of Gamma Sextantis. Small telescope users will see it at very low power as a small oval fuzzy patch, with larger instruments revealing the narrow points of light off each end that give the galaxy its name. Another interesting galaxy is NGC 2683, an edge-on spiral located five degrees west and a half south of Alpha Lyncis. This object can be seen in a four inch as a small fuzzy needle of light, with larger apertures making it much easier to see and adding hints of dark detail to one side of the center.



# THE *Prairie Astronomer*

## Hubble Hubris: A Case of "Certified" Blindness

*Russ Alberts sent this month's main story concerning the Hubble Telescope. The article was written by M. Mitchell Waldrop and originally appeared in the December 7, 1990 issue of Science magazine. Russ mentioned that he gets quite a few questions concerning the Hubble when he works at the Hyde Observatory, and that his article might help answer some of those questions.*

The Hubble Space Telescope's devastating optical flaw was the result of sloppiness all around, concludes the final report of NASA's official investigation panel. There was sloppiness in the agency's supervision of its optical contractor, the Perkin-Elmer corporation of Danbury, Connecticut (now Hughes-Danbury Optical Systems). There was sloppiness in Perkin-Elmer's management of its own Optical Operations Division, where the telescope 2.4-meter mirror was polished in 1980-1981. And there was sloppiness especially in the optical division itself, a "closed shop" where the polishing team operated with disdain for paperwork and outside interference while ignoring at least three separate warning signs that might have allowed them to catch and fix the error.

"The story is not a happy one," says panel chairman and JPL director Lew Allen, who presented the report on 27 November at a NASA press conference. As widely reported this fall, the Allen committee confirmed that the culprit was a device called the reflective null corrector, which the Perkin-Elmer opticians periodically used to test the mirror as they polished it. By illuminating the partially polished surface with laser light and capturing the reflections, the corrector was supposed to produce a map of the bumps and irregularities that needed more work. In reality, however, it contained a certain crucial lens that was 1.308 millimeters out of position. The opticians therefore ended up polishing the mirror very, very precisely to an incorrect shape, producing a massive optical flaw known as spherical aberration. And as a result, every star now seen by Hubble is enveloped in a halo of fuzz.

However, says Allen, knowing how the error happened doesn't explain the real tragedy: the fact that Perkin-Elmer's optical team managed to dismiss the

## Welcome!!!

We have a new member from western Nebraska: James Gancarz. James lives north of North Platte and observes from the pristine skies of the sandhills. He enjoys deep-sky and variable star observing, and presently uses a four-inch Schmidt-Cassegrain telescope. **Welcome Jim!!!!!!**

### The Prairie Astronomer

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First Class Mail

Next Meeting February 26, 1991

# MAGELLAN STATUS REPORT

FEBRUARY 21, 1991 (9:00 AM)  
From the Compuserve Information Service

1. The Magellan spacecraft and its radar system are performing normally.
2. The offpoint of the solar panels for about 5 minutes at the beginning and end of each mapping pass has reduced the thermal effects of sunlight reflecting off the solar panels on to the spacecraft bus. The gyro temperatures have leveled off at 68.8xC and Battery #1 is peaking at about 23.4xC. The resulting depth of battery discharge is about 12 percent.
3. A decision was made yesterday afternoon to continue the solar panel offpoint and shortened mapping strategy through the remainder of mapping sequence M1051. That is, the earliest change to this strategy would be in the M1058 command sequence next Tuesday.
4. On 28 February next Thursday, Magellan begins a period of periapsis occultations, when a portion of the low end of each orbit passes through the shadow of Venus. This will help to cool the spacecraft as the length of time in the shadow increases.

## MAGELLAN COMPLETES MAPPING OF VENUS HIGHLAND REGION

At least four competing theories about the nature of Aphrodite Terra, a continent-sized highland on Venus, are being tested by new Magellan data, a scientist at NASA's Jet Propulsion Laboratory, Pasadena, Calif., said Thursday.

The Magellan spacecraft, which began imaging the surface of the planet last Sept. 15, has mapped more than 58 percent of Venus.

Aphrodite Terra, the largest of the highland regions on Venus, extends nearly two-thirds of the way around the planet. Magellan has completed mapping of the region, but the process of producing image mosaics lags behind actual data acquisition, said Project Scientist Dr. Steve Saunders. Still, scientists have been able to study radar images of the western portion of Aphrodite, called Ovda Regio.

Earlier data produced by the Pioneer Venus Radar Mapper indicated that the regional topography may be similar to Earth's continents, Saunders said. The various theories are based on the Pioneer data and other earlier radar imagery, as well as topography and gravity data.

"All of the leading proponents of competing ideas for the nature of Venusian continents are part of the Magellan science team and this leads to lively debates during the science analysis meetings," he said.

The first hypothesis is the "ancient continent" model which holds that Aphrodite formed from lighter rock that crystallized early and literally floated on the dense mantle of Venus. There are similar formations on Earth and on the moon.

A second theory is called the "spreading ridge" model. This compares the topography of Aphrodite to that of mid-ocean ridges on Earth where new crust is being formed as the continents drift apart.

Another hypothesis advocates the "hot spot" model which says the equatorial highlands were pushed up by hot spots similar to the ones that lie beneath the island of Hawaii. Hot spots are regions of mantle that tend to rise, producing broad domes frequently resulting in huge

volcanoes.

The fourth hypothesis is that western Aphrodite is a region of "mantle downwelling." That means a downwelling plume of colder, more dense mantle material causes the surface crust to compress and thicken. The thicker region stands higher than the surroundings.

"The study of Aphrodite will be extremely important for understanding the origin of continental regions of Venus," Saunders said, "and may help us better understand our own planet."

Referring to the predicted models for the formation of Aphrodite, he added, "Someone should have predicted that none of the early hypotheses would be easily confirmed. Nature, once again, demonstrates that she is far more imaginative than we, and has provided a surface full of surprises."

Magellan's primary mission cycle of 243 days, one Venus rotation, ends May 15, at which time more than 80 percent of the surface will have been mapped.



*This is a radar image taken by the Magellan craft of the Ishtar region on Venus. The image was uploaded to Compuserve by Lenny Abbey.*

# President's Message

by Dave Knisely

In recent years, Amateur Astronomy has been deluged with new innovations and gadgets which are revolutionizing the hobby in the technical sense. This revolution is not without its price, as the hardware making many of these advances possible tends to be rather expensive. It seems the basic telescope has turned into a mechanized or computerized monster which threatens to make Amateur Astronomy into a hobby for the rich elite. Where are the inexpensive scopes? I remember the Criterion RV-6 Newtonian fondly, with its emphasis on basics and its low price. I recall it showing fainter stars and giving better contrast than an eight-inch Schmidt-Cassegrain costing almost three times as much. Does anyone make a scope like that anymore? Looking through the ads in various magazines, it appears that telescopes are coming in only two types: the high performance expensive ones, and the cheap dime-store junk that pervades most discount stores and catalogs.

There is a way out of this for the cost-conscious amateur: build your own telescope. It isn't as difficult to construct a basic Newtonian as it used to be. Many small companies still offer finished parts and optics at low prices, allowing the amateur to customize his own instrument and save a bundle of money. True, the instrument won't have digital computerized setting circles, CCDs, or a pretty paint job, but it will open the door to wondrous observing opportunities. And if you really want image quality, you can still order mirror kits and grind a mirror which will outperform much of the commercial optics on the market today. Several people in our club have wanted a guide for a simple home-built Newtonian, and to this end, I have produced the basic plans for my own ten inch pipe-mount equatorial \$450 telescope for anyone who wants them. I will try to bring them to the meeting. For those who want to be led by the hand, Richard Berry has written a fairly good book, *HOMEBUILT TELESCOPES*, which will give the beginner a start towards instrument construction without all the headaches. Remember, before you think about buying a fancy commercial instrument, consider building the simple Newtonian. You will be glad you did!

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**Editor's Note:** I didn't have any response to the 'question and answer' column that was proposed in last month's newsletter. BUT, I'm still hoping that those of you with questions just sitting there on the tip of your tongue WILL send something my way in March. Also, I am in the process of getting permission to reprint an informative series of articles entitled "A Planetary Grand Tour" written by Carolyn Collins Petersen, and avid amateur astronomer who frequents the Astronomy Forum on Compuserve. If permission is granted, the series will begin next month.

inverse null was known to be slightly imperfect and the fact that the reflective null was "certified" led them to discount the result.

A final warning sign appeared after the polishing of the Hubble mirror was completed, as the opticians were checking the mirror's overall curvature with yet a third null corrector, the refractive null. Once again, the test pattern said spherical aberration. And once again the results were ignored in favor of the "certified" device.

The panel could find no evidence that anyone outside Perkin-Elmer's Optical Operations Division heard a word about any of this. "The impermeability of [the division] seems astounding," says the report. For example, the polishing team kept NASA's quality assurance representatives off the shop floor during crucial operations, lest they get in the way. Moreover, none of the team members ever seems to have asked the advice of the people who developed the reflective null corrector. Nor did they consult with the company's in-house expert on making large telescope mirrors. These specialists were on the team that designed the mirror-polishing facility and that wrote the winning proposal to NASA. But when it came to actually making the mirror-well, that was the operation's division's turf.

In the final analysis, though, the report lays full blame for the Hubble fiasco with NASA and Perkin-Elmer management-"100% each," says Allen. Officials at both organizations allowed themselves to be overwhelmed by the massive cost overruns and schedule slippages in other parts of the project. As a result, they neglected the mirror work, which seemed to be going relatively well, and failed to enforce their won quality assurance procedures.

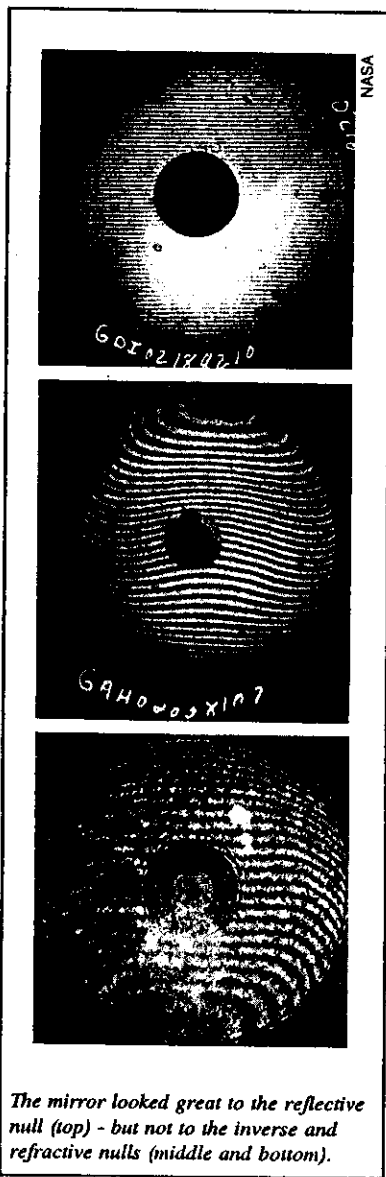
The panel did find one piece of good news, say Allen: Perkin-Elmer/Hughes-Danbury seems to have cleaned up its act enormously in the past 10 years. The panel found that internal communications are now apparently excellent-which is a relief to NASA, since the agency had commissioned the company to build a Hubble-scale x-ray satellite known as AXAF before the space telescope's problem was discovered.

The company's new-found efficiency doesn't do much for Hubble, however. NASA space science chief Lennard Fish estimates that devising optical corrections for Hubble's aberration will cost the taxpayer some \$40 million to \$50 million. When reporters asked him at the press conference whether NASA would take legal action against Hughes-Danbury, he called that option "premature"-but did not rule it out.

warning signs that would have allowed them to correct the error before it was too late.

The first indication of trouble appeared as the polishing team was assembling the null corrector. As they tried to move the errant lens into position, they found that the lens' adjustment screws wouldn't turn far enough. The report concludes that the opticians were probably taking incorrect readings from a high-precision measuring rod. But at the time, they did not try to find out what was wrong. Instead they simply added some 1.3 millimeter tick spacers to extend the lens' range of motion. Once they were done, they henceforth treated this null corrector as being "certified" correct. (The panel was unable to find any documentation defining what "certified" meant.)

Another warning sign appeared shortly thereafter, as the opticians were doing a double check on the alignment of the reflective null before starting to work on the mirror itself. To perform the check, they beamed laser light at the reflective null with a second device known as an inverse null corrector-and produced a test pattern that shouted spherical aberration. The report cites testimony from several of the polishing team members that they did express concerns about these test results. And yet, as the team leaders admitted, the fact that the



*The mirror looked great to the reflective null (top) - but not to the inverse and refractive nulls (middle and bottom).*

## Observing Chairman's Report

by Dave Knisely



THE NEXT SCHEDULED STAR PARTIES WILL BE HELD ON MARCH 8TH AND 15TH AT THE ATLAS SITE. Many of the bright Messier objects in the late winter sky are open star clusters. If you look 3.75 degrees north and two east of Theta Canis Majoris, you will find M50, a large and fairly rich group that is easy to resolve in small apertures. A six inch will show over 100 stars in the cluster, and larger instruments will add many faint background stars. About four degrees south and a half east of Sirius is the bright cluster M41, visible to the naked eye under good conditions. A 60mm refractor will reveal about 20 bright stars in this group, with an eight inch adding color to the stars.

In Puppis are a number of interesting open star clusters, with the most notable being the naked eye pair M46 and M47. M47 can be found about four degrees south and one west of Alpha Monocerotis, and contains 20 to 30 bright stars, making it an easy target for small telescope users. M46 lies a degree to the east and a bit south of M47, and contains many more stars, although its members are fainter than those of M47. A six inch will reveal over 50 stars arrayed evenly over a half degree field. On the north edge of the cluster is the faint planetary nebula NGC 2438, which can be seen in a six inch as a small faint circular puff of light with a darker center. Larger instruments make it look a bit like a small version of the Ring Nebula in Lyra. Also in Puppis is M93, a rich group of faint stars located about a degree north and one degree west of Xi Puppis. This group has several nice star chains in the middle of the cluster, and is a real winner in a six inch.

In Hydra is the interesting planetary nebula, NGC 3242, located 1.75 degrees south and a third west of Mu Hydrae. Small apertures will show it as a fuzzy 9th magnitude star, while large apertures will reveal some internal structure. An eight inch at high power shows a bluish elliptical inner shell and faint central condensation plus a circular diffuse outer shell that overleaps the inner one. Also in Hydra is the open star cluster M48, located two degrees south and three west of 30 Mon. It is large and fairly rich, but its stars are not terribly bright, making it a difficult target in small telescopes. A ten inch will show 80 to 90 member stars arrayed in a rectangular group nearly a degree across, with a curved star chain near the center.

For binocular users, now is the time to be viewing the Beehive cluster, M44 in central Cancer. The planet Jupiter is now just west of the group, making the field at low power very pretty. Large telescope users may even catch a glimpse

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