Star Stuff

The Ford Amateur Astronomy Club Newsletter

Volume 4, Number 5 — September 1995

HUBBLE FINDS COMPLEX STRUCTURES IN RADIO GALAXIES

Probing some of the most distant and energetic galaxies in the universe, NASA's Hubble Space Telescope has uncovered surprisingly varied and intricate structures of stars and gas that suggest the processes powering these so-called radio galaxies are surprisingly more complex than previously thought.

The Hubble observations, made by a team of astronomers at Cambridge University, England, should shed light on the nature of active galaxies that might be powered by immense black holes at their cores, and more generally, on galactic evolution. The radio galaxies observed are so far away they existed when the universe was half its present age, and the light is only now reaching us. The bizarre, never-before-seen details may be a combination of light from massive star forming regions, small satellite dwarf galaxies, and bow shocks caused by jets of hot gas blasted out of the galaxy's core by a suspected black hole.

The observations were made by Professor Malcolm Longair and Philip Best of the Cavendish Laboratory, Cambridge University, and Huub Rottgering of Leiden Observatory, The Netherlands, who have published images of three radio galaxies (3C368, 3C324 and 3C265) in the August 1 issue of the Monthly Notices of the Royal Astronomical Society. The team is analyzing a sample of 28 radio galaxies that have been imaged by Hubble in visible light, by the Very Large Array Radio Interferometer (an array of 27 separate radio antennas) at radio wavelengths, and by the UK Infrared Telescope.

A radio galaxy emits powerful radio waves along two opposite directions pointing out from the galaxy's core. The radio lobes usually extend far beyond the host galaxy. The suspected powerhouse behind the radio emission is a one-billion solar mass black hole in a galaxy's core. Gaseous jets, traveling at nearly the speed of light, blast out along the rotation axis of the spinning black hole. These jets bore through space like a narrow stream of water from a garden hose nozzle plowing through sand. When they are finally stopped by the intergalactic medium, a huge amount of energy is released in the form of radio waves.

Previous ground-based observations since 1987 have shown that, in visible light, radio galaxies have an unusual elongated structure — unlike the classic spiral and elliptical shapes in normal galaxies — that align to the twin lobe of radio emissions that are the trademark of such active galaxies. In the Hubble views, these shapes break up into a string of bright knots that might be regions where new stars are forming, or could be glowing clouds of gas. In one galaxy, the knots align to the axis of the jet, while in another case they do not, and instead cluster around the galaxy like smaller "satellite" galaxies.

One explanation for the alignment between the invisible jets and optical structures is that the jets trigger the formation of stars along their paths. However, some of the galaxies emit highly polarized light. Since this type of light is not produced by stars, other processes must be at work. A possible explanation is that the light from the galaxy's hidden active nucleus is scattered in our direction by dust or electrons.

Longair, Best and Rottgering propose that the remarkable structures seen in the Hubble images are different manifestations of activity associated with radio galaxies. They conclude at least two mechanisms responsible for the alignment effect. They also note that the period during which there is strong radio emission is quite short relative to the total lifetime of a galaxy, so different processes may dominate as the radio source ages. They are planning further observations to determine the relative importance of the different effects.

HUBBLE OBSERVES RADIO GALAXIES

These Hubble Space Telescope images, combined with radio maps produced by the Very Large Array Radio Interferometer (blue contour lines), show surprisingly varied and intricate structures of gas and stars that suggest the mechanisms powering radio galaxies are more complex than thought previously. The bizarre, never before seen detail may be a combination of light from massive star forming regions, small satellite dwarf galaxies, and bow shocks caused by jets of hot gas blasted out of the galaxies' cores by suspected black holes.

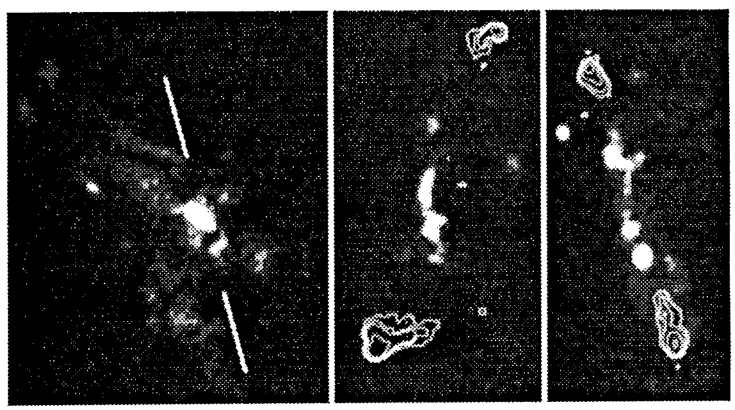

PHOTO RELEASE NO.: STScI-PRC95-30, August 7, 1995.

[LEFT] - 3C265. Hubble resolves numerous bright star clusters or dwarf "satellite" galaxies surrounding a bright central compact structure. The line corresponds to the axis of the galaxy's radio emissions, which unlike other radio galaxies, is in a different direction from the optical region. The star forming regions might result from a collision between galaxies. The jet that produces the radio emissions might have further intensified star formation.

[CENTER] - 3C324. A number of small interacting components are distributed roughly along the radio axis in this source. Comparison of the Hubble image with that from the United Kingdom Infrared Telescope suggests the central regions of this galaxy are obscured by a large dust lane.

[RIGHT] - 3C368. One of the best studied radio galaxies, this image is composed of a very smooth cigar-shaped emission region closely aligned with the radio axis, upon which is superimposed a string of bright knots that might be stars or dust. This suggests that a jet of high speed gas, presumably ejected from a black hole at the core of the galaxy, might be triggering star formation along its path. ✪

PALOMAR SURVEY REVEALS PEAK IN QUASAR FORMATION

From Ron Baalke (baalke@kelvin.jpl.nasa.gov)

PASADENA-Astronomers have discovered direct evidence that most quasars came into existence during the same era, when the universe was still in its infancy. This discovery will help scientists use quasars, the most luminous objects in the sky, as tools for studying the universe back to a time when it was less than a billion years old. "This survey allows scientists to investigate for the first time the era of quasar formation," said Maarten Schmidt, a Caltech astronomer and a coauthor of the study.

Using data from the recently completed quasar search known as the Palomar Transit Grism Survey, Schmidt, Donald P. Schneider of Penn State, and James Gunn of Princeton University published their discovery in the July 1995 issue of the Astronomical Journal. (A grism is a transmission grating mounted on a clear, wedge-shaped piece of glass (prism).)

The survey shows that the space density of quasars—the number of quasars in a given volume of space—reaches a maximum for those with redshifts between 1.7 and 2.7, and declines steeply for quasars with higher redshifts. "This maximum means there was a peak in the rate of quasar formation between 1.9 and 3.0 billion years after the Big Bang," Gunn said, "and a much lower rate earlier in the history of the universe."

A typical quasar emits 100 times more energy than our home galaxy, the Milky Way. This makes them the most luminous and also some of the most distant known objects in the universe. Because light from quasars takes billions of years to reach the earth, scientists see them as they were billions of years ago. Therefore quasars are important to astronomers as one of the best probes available for studying the conditions present in the early universe. Astronomers first identified quasars in 1960 as starlike counterparts to strong sources of radio waves, but were initially unable to determine the nature of the objects. In February 1963, Maarten Schmidt made a breakthrough. "I recognized that the pattern of spectral lines in one particularly bright quasar was due to hydrogen, but that the location of the lines was redshifted," Schmidt said. "This indicated that the object was moving away from the earth at a very high velocity."

Redshifting is an effect seen in rapidly receding sources of light, where the spectral lines of such sources move toward longer wavelengths, or toward the red end of the visible spectrum. The larger the redshift, the more the light is shifted toward red, and the greater the distance to the source. The small size of quasars is as astonishing as their luminosity. Studies of the variability of quasars show that their brightness can change on time scales of days, or sometimes just a few hours, which implies that their physical size is not much larger than our solar system. Because of quasars' extraordinary brightness and small size, astronomers suspect that they are probably powered by matter spiraling into a supermassive black hole. But just how quasars form and whether black holes really power them remain a puzzle.

The Palomar Transit Grism Survey was undertaken with the goal of finding a large number of high-redshift quasars so that scientists could study the evolution of these objects back to a time when the universe was less than a billion years old. The survey began in 1985 using a special electronic camera designed by James Gunn that was mounted on the 200-inch Hale Telescope at Palomar Observatory. Finding a large number of quasars was like looking for needles in a haystack and required special software to separate the quasars from superficially similar foreground objects. "For every high-redshift quasar that we found, we recorded and sorted through thousands of nearby objects," Schneider said. The Palomar Transit Grism Survey succeeded in identifying 90 quasars with redshifts between 2.75 and 4.75, with a typical luminosity more than a trillion times that of our sun. Analysis of the survey data has revealed that between redshifts of 2.7 and 4.7, the space density of luminous quasars declines by a factor of seven. That is, for quasars with redshifts greater than 2.7, the higher the redshift, the fewer quasars there are in a given volume of space.

Previous studies have shown that the space density of quasars increases dramatically—by a factor of 100 or more—in the range of redshifts between 0 and 2.0. These results, combined with other studies of quasars with intermediate redshifts, show that the space density of quasars exhibits a sharp peak at a redshift between 1.7 and 2.7, indicating the bulk of quasar formation must have occurred around 2.5 billion years after the Big Bang. This result will help astronomers refine their theories by placing constraints both on models of galaxy and quasar formation, and on ideas about the mechanism that supplies quasars with their tremendous energy. ✪

STAR STUFF
Monthly Publication of the Ford Amateur Astronomy Club

Star Stuff Newsletter
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1995 CLUB OFFICERS

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Secretary:	Harry Kindt	313-835-1831
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GENERAL MEETINGS

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

OBSERVING SITE

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

OBSERVING HOTLINE NUMBER - (313) 39-05456

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

MEMBERSHIP AND DUES

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

Annual Individual/Family	$20.00
Lifetime Membership	$100.00

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

NEWSLETTER STAFF

Editor:	Paul Mrozek (pmrozek@pms064.pms.ford.com) (PROFS = pmrozek)	313-33-73619
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NEWSLETTER SUBSCRIPTION

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

SEPTEMBER 1995

SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4 Labor Day	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23 Fall Equinox
24	25	26	27	28 FAAC Meeting	29	30

MEETING ANNOUNCEMENT

The Ford Amateur Astronomy Club (FAAC) holds regular general meetings on the fourth Thursday of each month, except November and December. Our next meeting will be **Thursday, September 28, at 5:00 p.m.** The program for the meeting has not been determined at this time.

The FAAC meets in the Ford Motor Credit Company (FMCC) building, conference room 1491, located on the lower floor on the east side. FMCC is the low building immediately northeast of (but not attached to) Ford World Headquarters in Dearborn.

The FMCC building is secured with a card entry system. The easiest way to enter the building for meetings is to park in the northeast lot (Employee Lot 7) and enter through the lower northeast door or lower east door. At 5:00 pm no one seems to have much trouble getting in because many people are leaving around that time. At the east door you can dial 0911 on the security phone and say that you are here to attend a Ford club meeting, and security will admit you. You may, of course, find your way into the building any way you see fit, but direction signs will only be posted fromthe lower northeast and lower east doors.

MEETING MINUTES 8/24/95

by Harry A. Kindt (Sec'y FAAC)
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The meeting was called to order at 5:10 pm by our president Chuck Boren. There were 30 members and guests present.

The treasurers report was read and accepted. Al Czajkowski reported on the discounts available too club members. These discounts included subscriptions to Astronomy and Sky & Telescope magazines, and products advertised in those publications. 1996 Calendars will soon be available at considerable savings to club members.

Bob MacFarland reported on the creation of a committee to formulate a educational program for use by club members too "bring Astronomy to the masses". A meeting is scheduled for September 7, 1995 at 5:00 pm in the Management Dining room of the Product Development Center building. If you would like to become a member of this committee, please contact Bob, or bring your ideas too the meeting on the 7th of September. You can get in touch with Bob at 33-7975, for further information.

Tim Klepaczyk entertained the club with an interesting lecture on "The Wonders of the Southern Skies". On his recent trip to Peru, to see some of the ancient Inca ruins, he had the opportunity to view the celestial sphere from "South of the equator perspective". He showed the club members GIF and BMP images of a lot of the celestial wonders of the Southern skies. Thanks Tim, good job! The meeting was adjourned at 6:30 pm.

SEPTEMBER TRIVIA

by Harry A. Kindt (73521.1710@compuserve.com)

Sep 01	1979	Pioneer 11 (US) made first flyby of Saturn.
	1752	Gregorian Calendar adopted by Britain
Sep 03	1976	Viking 2 (US) soft landed on Mars.
Sep 05	1977	Voyager 1 (US), launched.
	1984	US Space Shuttle Discovery ended its inaugural flight.
Sep 07	1914	Born, James Van Allen
	1944	First German V-2 rocket hit Britain
Sep 09	1934	First rocket to reach 700 mph, launched
	1975	Viking 2 (US), launched.
Sep 12	1959	Luna 2 (USSR), 1st unmanned craft to land on Moon, launched.
	1970	Luna 16(USSR), 1st unmanned craft to go to Moon and back, launched.
Sep 15	1976	Soyuz 22 (USSR), launched.
	1897	Ariane-3 (ESA), launched.
Sep 16	1186	Conjunction of all planets in Libra (sunrise).
Sep 17	1764	Born, John Goodricke, German astronomer.
	1978	Pegasus 1 (US) broke up and fell to Earth.
Sep 18	1819	Born, Jean Foucault, French inventor of the gyroscope.
	1977	Cosmos 954 (Soviet), launched
	1980	Soyuz 38 (USSR), launched.
Sep 19	1980	Titan 11 missile explosion (Damascus, Arkansas).
Sep 23	1846	Neptune discovered (Johann Gottfried Galle).
Sep 24	1989	Pope John Paul II. declared that Galileo was right after all.
Sep 26	1868	August Ferdinand Mobius, German astronomer and mathematician, died.
Sep 27	1973	Soyuz 12 (USSR), launched.
Sep 28	1953	Edwin Powell Hubble, astronomer, died.
	1962	Alouette (Canada), first Canadian satellite, launched.
Sep 29	1977	Salyut 6 (USSR), launched.
	1988	Discovery, first flight since Challenger explosion, launched.
Sep 30	1880	Orion Nebula first photographed.

Source: OTD (v2.02) - Phone: 508-851-6204, Email: softcons@world.std.com

SEPTEMBER 1995 EVENTS

The following August 1995 events come from the 7/29/95 edition of "Space Calendar." This Calendar is compiled and maintained by Ron Baalke (baalke@kelvin.jpl.nasa.gov). Note that launch dates are subject to change.

Sep 01	Soyuz TM-22 Launch (Russian)
Sep 02	First Quarter Moon (5:03 am EDT)
Sep 06	Progress M-30 Launch (Russian)
Sep 08	Full Moon (11:37 pm EDT)
Sep 13	Telstar 402R Ariane 4 Launch
Sep 15	AsiaSat 2 Long March Launch (China)
Sep 16	Last Quarter Moon (5:09 pm EDT)
Sep 19	Infrared Space Observatory (ISO) Ariane 4 Launch
Sep 20	RADARSAT/SURFSAT-1 Delta-2 Launch (Canada)
Sep 21	STS-73, Columbia, Spacelab USML-2
	Autumnal Equinox (8:13 am EDT)
	Luch-1 Proton-K Launch (Russian)
Sep 24	New Moon (12:55 pm EDT)
Sep 29	Ulysses, End of 2nd Solar Passage (70.05 degrees latitude)
	SWAS (Submillimeter Wave Astronomy Sat.) XL Pegasus Launch
Sep 30	Ulysses, End of Primary Mission

SEPTEMBER STAR PARTIES

from Doug Bock (DougBock@aol.com, dbock1 (PROFS))

What:	**Fall Star Party**
When:	September 16, 1995.
2:00	Starting time, -dusk- games
4:30	Fire up the barbecue
dusk	Start observing
Where:	Northern Cross Observatory 6383 Hartland Rd. Fenton, MI 48430 Phone: 810-750-0273

Cadillac Weekend Star Party
September 22-25, 1995.
Head up Thursday night if you wish.

Doug Bock's property west of Cadillac. Let me know if you are going. Phone: 810-750-0273

WEATHER AND ASTRONOMY

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

The Greenhouse Effect, undoubtably you have heard of it by now: The inexorable warm up of the planet Earth due to the emission of man-made Carbon Dioxide and other gases. While I am no expert on this subject, I have an all-around knowledge of what it is, and why it is so hard to say whether or not we are actually undergoing greenhouse warming. Here is a general rundown of the Greenhouse Effect, with the astronomer in mind.

As you know, the planet Venus is enshrouded by clouds. Venus is also very, very hot by our standards, with temperatures of many hundreds of degrees fahrenheight by the most conservative estimates.. The two are not coincidental! Have you ever noticed on a night when you are observing the stars, that the temperature tends to be cooler, than when it is cloudy? This "sealing in" of the heat, is a temporary "Greenhouse Effect". It happens all the time. Sunlight, or shortwave radiation, comes in during the day, but in our example, is trapped by the clouds at night, so that the ground is not able to "see" the sky, and thus radiate away the daytime heat back to space as "longwave" radiation. This is exactly how a greenhouse operates.. the sunlight comes in as shortwave radiation, but the GLASS inhibits the long wave radiation from returning to space.

On Venus, the bright cloud deck of the day is able to allow just enough brightness in to warm the planet, but the clouds and gases trap in the heat on a permanent basis. On Earth, man-made gases have the same effect as the glass walls and ceiling of a greenhouse: They do not let the long-wave radiation return to space. The higher the carbon dioxide level, the more difficult it should be for the heat of the day(s) to escape out, leaving some to suggest that we will eventually follow Venus down the road to planetary doom. It probably isn't quite as serious as that, firstly, and obviously because we are further from the Sun. Nonetheless, the Greenhouse effect, if it came to full fruition, could be devastating to the Earth in many related ways, not directly from the warm-up itself.

The biggest quarrel in the Meteorological community of all time has to be whether or not we have already begun Greenhouse warming. You might think it would be obvious, but the problem is that there is already a swing in temperature globally from time to time that is natural. In fact, while we ARE currently as warm as the Earth has ever been to our knowledge, it has happened before, and may just be part of a normal cycle. The Greenhouse Effect will not really be able to be detected for sure until AFTER it has happened, almost by definition. That is to say, we have to look back in time to see a significant period of warming that is uncharacteristic of any normal swing in climate. If we do not know that the Greenhouse Effect is here until after the fact, then also by definition, logic implies we can't really wait until we are sure it is here to try to stop it from getting out of hand!

A larger number of scientists and climatologists now believe that we are entering a significant "Greenhouse" warming because a) It is already a very warm period in Earth's climatological history B) new, sophisticated computer models are PREDICTING a major warmup due to the excess Carbon Dioxide, of up to 8 degrees fahrenheight in the next 30 years (globally). But of course, even the computer models disagree, some pointing to a much lower number.

What would really happen though, if there WAS a bit of a warmup, to some.. it seems almost enticing... Well, it is not so much the direct effects of a warmup, as the indirect ones. For instance, the polar ice caps would melt just enough to bring on a very significant rise in sea level... enough to flood some low lying cities around the world. (New Orleans, La., USA, as an example is already below sea level) Also, Hurricane and Typhoon frequency would undoubtably rise from the warm ocean, which helps create them in the first place. Thus, the areas that are already oceanfront, and vulnerable to sea level increases, are now also potentially threatened by Hurricanes, which could bring that seawater onshore even further, and more frequently.

Other indirect effects of a "greenhouse" warmup include climate shifting so that many species of animals and especially trees will be totally relocated, or threatened. Also, this shifting around could bring devastating areas of drought and/or heat (many predict the Midwestern United States would suffer) to established agricultural areas around the world. On the bright side, both man, and nature have adapted well to gradual climate shifts before. Even if there is an overall trend "upward" in temperature, we may have time to adjust to the change. Also, based on some predictions in the 1960s, we could have already been much warmer, globally, than it is today.

Meanwhile, Mother Nature seems to have a way of compensating for swings in climate. It is quite possible that a series of volcanic eruptions, for instance, could substantially halt a major global warming at the same time that man begins to use less fossil fuel in the future, thus putting a lid on the Greenhouse effect. (Volcanic eruptions spew particles into the Stratisphere where they are trapped for years, to the detriment of astronomers. However, this "cloud" acts to prevent incident solar radiation more than keeping the heaet locked in, thus it cools the Earth. In the most extreme instance, this could cause a dramatic cooling of the Earth)

So, overall, the debate revolving around the Greenhouse controversy boils down to more of the questions such as: "how bad is Greenhouse warming?" rather than: "is Greenhouse warming for real?" My opinion is that this matter should be taken very seriously, because a cure "better late than never", may just not be enough!

ASTRO TRIVIA

by Paul Mrozek
pmrozek@pms064.pms.ford.com, or pmrozek (PROFS)

Q: What is a Bishop's ring?
A: A Bishop's ring occurs around the Sun, usually with a reddish outer edge. It is mainly due to dust particles in the air, and can be seen after volcanic eruptions and forest fires. Dust in the upper atmosphere can also result in a bluish-looking Moon. This phenomenon was widely observed in 1950, due to Canadian forest fires. In astronomy, the term "blue Moon" refers to the second full Moon in a single calendar month. [1]

Q: What is a light echo?
A: A light echo is the burst of light from a supernova or a nova reflected by neighboring interstellar clouds. The resulting ring expands over time. [2]

Q: Does a halo around the Moon indicate an approaching storm?
A: A ring around the moon does not always indicate approaching precipitation, but two time out of three it will start to fall within 12 to 18 hours (especially if the barometric pressure is falling). Moreover, the brighter the ring, the greater the odds and the shorter the time for precipitation. The very high ice crystals that cause these halos are a forerunner of an approaching low pressure system. [1]

Q: What is a galactic halo?
A: A galactic halo is a roughly spherical region around a spiral galaxy. In addition to the disc, the region contains the ancient stars and globular clusters that indicate the size of the galaxy before much of it collapsed to a disc. These stars and clusters do not have any systematic motion, but instead travel in randomly oriented orbits. The galactic halo also contains the outer regions of the galactic magnetic field and very hot gas that emits X-rays. This gas rises into the halo, cools, and then falls back to the disk in a so-called galactic fountain. [3]

Q: What is heliacal rising and setting?
A: Heliacal rising or setting occurse when a star or planet rises just before or sets at the time of sunrise. Aplanet at its heliacal rising time has an elongation close to zero (conjunction). Elongation is the angle between a celestial object and the Sun measured with respect to the Earth. Heliacal risings and settings have a strong astrological significance. For example, the ancient Egyptians thought the heliacal rising of Sirius cause the flooding of the Nile and the "dog days of summer." [3]

References:
[1] The Handy Science Answer Book by the Carnegie Library of Pittsburgh
[2] The Penguin Dictionary of Astronomy by Jaqueline Mitton
[3] Oxford Illustrated Encyclopedia of the Universe by Archie Roy

ASTRONOMY WORKSHOP

The following article is reprinted from ASTRONET, issue 18, July 15, 1995. For more information, please contact resource@rahul.net.

TWO-STAR POLAR ALIGNMENT
by Truman Kohman (tk11+@ANDREW.CMU.EDU)

Recent discussions of methods for polar alignment of telescopes, including situations when Polaris is not visible, prompt me to dust off and revise a previous posting on this subject. For locating celestial objects in a telescope by their equatorial coordinates and for long-exposure astrophotography, an accurate polar alignment is necessary. I find most satisfactory one of several "two-star methods", which were described in an article in *Sky and Telescope* for 1976 February, pages 135-139.

It is assumed that the telescope has circles marked for right ascension and declination and a drive motor for the proper hemisphere. It is also assumed that the declination circle reads exactly 90° when the optical axis is parallel to the polar axis. This can be checked, and if necessary adjusted, as follows. Set the telescope so that the declination circle reads 90°. By moving the mount bring Polaris (or other high-declination star) into the center of the field of view. Rotate the upper part of the mount with the telescope around the polar axis. Ideally, the star should remain in the center of the field. If it does not, but moves in an arc of a circle, it is likely that the declination circle or its indicator is out of adjustment. Offset the telescope a little from 90° and repeat the test. Continue this one way or the other until the star remains stationary, or describes a circle of smallest radius (indicating that the optical and declination axes, andor the declination and polar axes, are not exactly perpendicular). Reset the declination circle or the indicator to read 90°. If this is not possible, note the offset from 90° and apply this correction mentally (noting the direction) to all declination readings. (The size of the residual circle will show roughly the imprecision of settings using the circles.)

Method A is the general two-star method, using any high-declination and low-declination pair. It can be used in either the Northern or Southern Hemisphere. In the Northern Hemisphere it is useful when Polaris is obstructed from view. Method B, the Polaris two-star method, is specifically for the Northern Hemisphere, and is the method of choice when Polaris is visible. An analogous method using Sigma Octantis can be used in the Southern Hemisphere. Method C is a simplified Polaris method. Method D is a simplified Southern Hemisphere method.

In Methods A and B, the mounting is aligned roughly; the telescope is pointed at the low-declination star, and the right ascension circle is set; the telescope is set for both coordinates of the high-declination star, and the mounting is adjusted to point the telescope at that star; and the process is repeated cyclically until little change is necessary. With experience, two cycles suffice. In Method C, the telescope it pointed at a low-declination star close to the hour circle of Polaris (Hamal and Arcturus are most convenient). Then it is swung around the declination axis to the declination of Polaris (on the right side of the pole), and the mount is moved to bring Polaris into the center of the field. This is repeated cyclically as needed. In Method D, a low-declination star and a high-declination star in the Southern Hemisphere lying close to a common hour circle are used in a similar fashion.

It helps if the mounting provides for turning the right-ascension circle by the motor along with the telescope. Then it is simple to set the circles by the right ascension and declination of the object, which should then appear in a low-power eyepiece. This is quite gratifying! If the right-ascension circle is stationary, a mental correction for the elapsed time is satisfactory for short times, and from time to time the circle can be reset using any low-declination star. It is assumed that the declination and polar axes, and the optical and declination axes, are precisely perpendicular. This is often not the case with inexpensive mounts (and sometimes even with expensive ones). Then an object far from both alignment stars may be out of the field. One should then reset the right ascension axis and note the declination offset using a bright star in the neighborhood of the sought object.

Some telescope mountings come with an auxiliary scope fixed parallel to the polar axis designed for aligning with the North Celestial Pole by proper offset from Polaris. I have used a similar device attached to a hinged camera platform in the Southern Hemisphere by memorizing the position of the South Celestial Pole relative to Sigma Octantis and fainter nearby stars. Finally, some computer-driven mounts enable a two-star alignment with any orientation of the axes, even altazimuth. Of course, the setting circles are then not useful as such. However, for astrophotography a real polar alignment is necessary; otherwise the camera will rotate relative to the stars during exposures. Fortunately, the two-star methods work well with no additional equipment. Coordinates of suitable stars can be found in a current Astronomical Almanac or Observer's Handbook, or any star catalog giving 2000.0 coordinates, which will be adequate through 2010.

THE STAR STUFF CATALOG

Conducted by Greg Burnett (gburnett (PROFS), or gburnett@ford.com)

Each month another interesting astronomical object is added to the Star Stuff Catalog. Entries include favorite observing targets, objects of current interest, and objects with long-standing scientific or cultural significance. Readers are encouraged to submit write-ups on their favorite objects for inclusion in the Star Stuff Catalog. This month we add the fourth catalog entry, the famous double star Castor....

SSC 4: Castor (RA 4h 34.6m DEC +31o 53' (2000))

Castor is possibly the most famous double star known to northern observers (with the possible exception of Albireo). The two bright components visible in small telescopes, Castor A and Castor B, are magnitude 1.99 and 2.85, respectively. Their period of revolution is about 400 years; current estimates disagree on the exact figure. The actual distance between them averages about 8.4 billion miles (90 Astronomical Units), a bit more than the diameter of our Solar System. The apparent separation reached a minimum of 1.8 arc-seconds in 1965, and has been slowly increasing since then. It is presently almost 4 arc-seconds. A third component, Castor C (also known as YY Geminorum), appears at a distance of 73 arc-seconds, and shines at magnitude 9.1. It's orbital motion is very slow, with estimates of its period being in excess of 10,000 years. Castor is about 45 light-years away, and is receding from us at a speed of about 3 miles per second.

Each component of Castor is actually a double star in its own right, bringing the total number of components in the system to six. Castor A is composed of two nearly identical main sequence A-type stars, separated by about 4 million miles. They revolve around each other with a period of 9.2 days. Each of the two stars is about twice the diameter of our Sun and twelve times as bright. Castor B is also a matched pair of A-type stars, each about 1.5 the diameter of the Sun and six times as luminous. They revolve in just 2.9 days. Castor C consists of two K-type red dwarf stars less than two million miles apart. They whirl around each other in just 19-1/2 hours. Since the Earth happens to be positioned in their orbital plane, we see them as an eclipsing binary that varies from magnitude 9.1 to 9.6. The three component of Castor are known as spectroscopic binaries, because we cannot see their duplicity directly; it is inferred from the periodic changes in their spectrums.

Castor was the first star to be recognized as a true physical binary, which demonstrated gravity at work somewhere other than near Earth or within our Solar System. It is thought that G.D. Cassini first resolved Castor in 1678. Sir William Herschel was the first to profess Castor as a gravitationally bound binary system in 1803, although the possibility of such objects had been suggested earlier. In the years since then, the study of binary stars has provided a wealth of knowledge about the relationship between the masses of stars and their spectral types and luminosities. Analysis of binary orbital motion is the only direct source of stellar mass information.

Castor, along with Pollux, form the bright "twins" pair in the constellation Gemini. They have figured prominently in both Greek and Roman mythology since ancient times. Consistently symbolizing brotherly love, they have appeared in various forms on coins dating to as early as the third century B.C. The twins were also regarded as the protectors of sailors, and were associated with the phenomenon of "St. Elmo's fire" that sometimes appeared on the rigging of ships.

Although not particularly difficult, Castor is a fine double star for amateur observers. It is easy to find, bright, and serves well to show novices a "classic" binary. It revolves rapidly enough that an amateur can observe changes in it appearance over periods less than a lifetime, something that can be said of relatively few double stars. This fact alone would make Castor worthy of study.

COMET OF THE CENTURY?

from the European Southern Observatory

A very unusual comet was discovered last month, on its way from the outer reaches of the solar system towards the Sun. Although it is still situated beyond the orbit of Jupiter, it is so bright that it can be observed in even small telescopes. It has been named 'Hale-Bopp' after the discoverers and is already of great interest to cometary astronomers.

Discovery circumstances.

The comet was discovered on 23 July 1995, nearly simultaneously by two American amateur astronomers, Alan Hale of Cloudcroft (New Mexico) and Thomas Bopp of Glendale (Arizona). Although the chronology is slightly uncertain, it appears that Hale first saw it some 10—20 minutes before Bopp, at 06:10 - 06:15 UT on that day. In any case, he informed the IAU Central Bureau for Astronomical Telegrams (CBAT) in Cambridge about his discovery by email already at 06:50 UT, while Bopp's message was filed more than 2 hours later, after he had driven back to his home, 140 km from where he had been observing. Upon receipt of these messages, Brian Marsden at the CBAT assigned the designation '1995 O1' (indicating that it is the first comet found in the second half of July 1995). After further sightings had been made by other observers, and according to the venerable astronomical tradition, the new object was named after the discoverers.

The magnitude, reported as 10.5 by Hale, is not unusual for a comet that is discovered within one or two hundred million kilometres from the Earth. It corresponds to a brightness that is about 60 times fainter than what can be seen with the naked eye and according to the statistics, a few comets with this brightness are normally discovered every year. However, some astronomers early remarked that the comet appeared to be moving rather slowly in the sky, indicating that it were possibly situated farther away.

A near-parabolic orbit with perihelion passage in April 1997.

Within less than three days after the announcement of the discovery, more than 60 accurate positions had been measured, many by advanced amateur astronomers equipped with modern CCD-detectors and the appropriate computer programs. On this basis, Dan Green of the CBAT published a first, highly uncertain parabolic orbit. To some surprise, it showed that the comet was located at a heliocentric distance of no less than 1,000 million km, well beyond the orbit of Jupiter! It was immediately obvious that it must therefore be intrinsically very bright. Indeed, it was about 250 times brighter than Comet Halley was at the same distance in late 1987!

During the next few days, observers all over the world obtained additional positions which allowed Brian Marsden to calculate a more accurate orbit. Thus, it also became possible to trace the comet's motion backwards in time with some confidence. As a result, Robert McNaught at Siding Spring Observatory (Australia) soon found a possible image of Comet Hale-Bopp on a photographic plate obtained in late April 1993, i.e. more than two years before the discovery. The estimated magnitude of this object was about 18. It has not yet been possible to establish with absolute certainty that this image is indeed of Comet Hale-Bopp, which was at that time nearly 2,000 million km from the Sun, but if the identification is correct, this would again indicate a most unusual brightness at this enormous distance [1].

Subsequent orbital calculations depend heavily on this assumption and for that reason, there is still some uncertainty about the comet's true orbit. When the 1993 position is included in the computations, it appears that Comet Hale-Bopp moves in a near-parabolic orbit with a revolution time of about 3000 years [2]. According to this orbit, it will pass about 120 million km from Jupiter in April 1996, and it will approach the Sun to about 140 million km when it passes perihelion in early April 1997. At the time of perihelion, the comet's geocentric distance will be about 200 million km and the elongation about 45 degrees. It will actually by 'circumpolar' in Northern Europe and therefore well observable all night from there.

Why is Comet Hale-Bopp now so bright ?

One possible cause for the unusual brightness of Comet Hale-Bopp at its present location, more than 200 million km outside the orbit of Jupiter, is that it possesses a very large nucleus, that is the 'dirty snowball' of dust and ice at the centre of a comet. The larger the diameter of the nucleus, the more sunlight will be reflected from its surface and the brighter will it appear. A corresponding estimate indicates that the diameter of its nucleus would be nearly 100 km, as compared to about 10 km for Comet Halley.

However, it is also important to consider that - due to the heating action of the sunlight on its surface - the nucleus of a comet that is not too far from the Sun will emit dust particles of which many assemble as a cloud around it (the 'dust coma'). These particles are moved outwards by the pressure of gas molecules emanating from the melting ice(s) in the nucleus. That this is indeed the case for Comet Hale-Bopp can be clearly seen on the first high-resolution images from ESO which confirm the presence of a dense dust cloud around the nucleus. It is in fact likely that most of the light observed from the central condensation in the comet's head is sunlight reflected from the particles in this cloud. The nucleus is probably completely hidden from view inside this cloud and we do not see it at all.

When we cannot observe the nucleus of a comet directly, we can only judge its size indirectly from the amount of dust it produces; a larger dust production will normally correspond to a larger nucleus. However, a temporarily high dust production rate during an outburst from the nucleus will lead to an overestimate of its size. In this case, the comet's brightness will begin to fade after a while, as the dust particles ejected during the outburst slowly disperse into space. A main goal of future observations is therefore to decide whether or not Comet Hale-Bopp has just undergone an outburst. For this, the brightness of the central condensation and the size and shape of the dust cloud must be carefully monitored as long as possible. In this connection, the relatively bright pre-discovery images from April 1993 and May 1995 (see above) seem to argue against a recent outburst.

How bright will the comet be at perihelion ?

The main question now asked from many sides is obviously how bright the comet will be when it passes perihelion in 1997. Will it, as some headlines have already stated, become the 'comet of the century, if not of the millennium'? From the above, it is clear that no firm prediction can be made before we have learned whether the present brightness is 'stable' or whether it undergoes important variations which indicate that there has been a recent outburst. Astronomers are therefore very reluctant to express themselves on this point until further observations become available.

However, if the comet did not undergo a recent outburst and the nucleus is indeed as large as the current brightness would appear to indicate, then the comet may possibly become very bright at perihelion. Experience has shown that the evolution of a comet's brightness as it approaches the Sun in general depends on its orbital type. Comets with periods of a few hundreds to some thousands of years - which have therefore already been close to the Sun one or more times - brighten by the inverse-fourth, or even higher, power of the heliocentric distance and are often brighter and more spectacular after perihelion. Comets in almost-parabolic orbits with much longer periods (many of which make their first passage near the Sun) brighten more slowly, e.g., by the inverse cube of heliocentric distance. If the orbital period is near 3000 years, this comet would belong to the first category and the extrapolation indicates that the brightness near perihelion in April 1997 could then reach magnitude -1.5. This means that Comet Hale-Bopp would become almost as bright as Jupiter [3].

What is even more exciting, the comet would stay this bright during several weeks and be visible from the Northern hemisphere during many hours each night. It will even be above the horizon all night for observers located north of geographic latitude 45 degrees. Thus, in addition to providing a wonderful opportunity to astronomers for learning more about comets, Hale-Bopp may become an object of great public interest. This is especially so, because it is now almost 20 years since a comet has been this bright. The last one (Comet 1976 VI - which was discovered at ESO) attained this magnitude during a few days in early March 1976.

Notes

[1] Another relatively bright pre-discovery image (magnitude 11.7) has since been identified on a photograph taken on May 23, 1995, by Terry Dickinson. Moreover, Robert McNaught found another Schmidt plate from Siding Spring, obtained on September 1, 1991, which shows the sky region where the comet was located at that time, but no image can be seen. The ESO collection has also been checked and no such plates were found.

[2] According to Brian Marsden, a computation based only on approximately 500 positions that were obtained between the discovery date and August 22, still allows orbits with much longer periods.

[3] If the 1993 observation does not belong and Comet Hale-Bopp is instead in a long-period orbit, the predicted magnitude would still be near 0.

HOW MANY VISIBLE STARS?

from California Institute of Technology, Office of Media Relations

Q: How many stars can a person see at night with the naked eye?
A: Under ideal conditions, about 3,000 stars should be visible at night with the unaided eye, but many factors can reduce this number. In the best of circumstances, about 6,000 stars are bright enough to be visible to the naked eye. But of course, only half of these are visible at any one time; no one can see the stars below the horizon.

A full moon reduces the number of stars that are visible. The sunlight reflected from the moon's surface brightens the entire sky and obscures the fainter stars. A similar problem is created by the artificial lights of towns and cities. That's why the telescopes on Mount Wilson near Los Angeles aren't able to see as well as they might; city lights brighten the sky and mask the faintest stars. Certain atmospheric conditions can also make stars more difficult to see. Smoke from fires, dust kicked up by wind, and high humidity all make stars harder to see. And of course clouds block them out altogether. So for the best viewing, go out on a dry, clear, calm, moonless night far from the city, and you should be able to see nearly all 3,000 visible stars. ✪

STELLAR PHYSICS BY STARLIGHT

by Buddy Nelson (buddynelson@lmsc.lockheed.com)

PALO ALTO, California, May 30, 1995 — The hot, tenuous outer atmosphere of a star, the corona, is best seen as the pearly white striations streaming away from our own sun during a total eclipse. It has been commonly assumed that stellar coronae are optically thin, that is, that they are so tenuous that all particles of light (photons) emitted at the surface of the star, or in the atmosphere above it, pass right through the stellar outer atmosphere without interaction. Recent spectrographic observations in the extreme ultraviolet (EUV), however, have led a Lockheed Martin scientist and his colleagues to question that assumption, and to suggest the presence of matter in the coronae that causes scattering of some photons.

So the starlight we see when we look at a star may not be all that has been emitted. NASA's Extreme Ultraviolet Explorer looks at the EUV spectrum of stars, doing so at a spectral resolution that allows astronomers to see regions of continuum emission and spectral lines separately. "As you look at these spectra, you try to explain them by computing theoretical spectra from plasma of a given temperature, and you say how much of any given temperature do I need to explain this total observed spectrum?" explains astrophysicist Karel Schrijver of the Lockheed Martin Palo Alto Research Lab. "And we just couldn't get it to fit. It turned out that the emission in some of the strongest lines was always too weak compared to the continuum emission. So we could not match the entire spectrum simultaneously."

Dr. Schrijver and his colleagues thus began to construct a theoretical model that would explain their observations. "We came to the conclusion that we had to get rid of some of the photons in the spectral lines. A possible explanation is that we were seeing an effect of something in between the source region and us. Something in the stellar atmosphere that was scattering the light." In the hot plasma of the stellar coronae, some photons rising from the surface were possibly being absorbed in collisions with atoms moving electrons into higher orbits. "Eventually those electrons will fall again to a lower orbit and the photons will be re-emitted," continues Schrijver. "But what will happen is that they'll be emitted in another direction, and will go somewhere else. But somewhere in the atmosphere there'll be something emitted to us. It behaves like a street light in fog. The denser the fog becomes, the fuzzier the ball becomes, but the amount of light is still the same because you are not losing any."

So for the model to match their observations, the researchers had to invent a mechanism by which photons were disappearing. "One way of doing that is: As photons are scattered, some will be scattered down in the direction of the stellar surface. When they hit the surface they are destroyed, because they are absorbed and not re-emitted due to the many collisions there. In the process, the plasma would be warmed up slightly. The net result would be a loss of photons in the spectral lines. If that is what happens, we would expect a lower ratio between line strength and continuum strength. And that's exactly what we were seeing." If astronomers confirm and accept the theory of optical thickness in stellar coronae, they will have a new diagnostic tool for looking at other stars. They will be able to observe and draw conclusions about matter in stellar atmospheres that is hardly emitting. Measuring the ratio between spectral line strength and continuum strength can also serve to infer the existence of hot tenuous stellar winds. There is much to learn from the darkness in the atmospheres of the stars. ✪

RETURN TO NEW MEXICO

by Greg Burnett

You really give something away when you leave New Mexico, not the least of which are dry-heat days and air you can actually see through at night. When the Beechcraft 1900 lifted off the runway at Clovis Municipal airport, the morning sun was still below the horizon. A bit earlier, in the dawn twilight, a crop duster had taken off from the taxiway, unfettered by airport protocol. But, since this was an "airline," we had aligned ourselves on the runway centerline, and made a proper departure. Now, climbing toward 18,000 feet, the sun was just peeking over a few low clouds in the east. These planes are a joy to folks who like to fly, and a terror for those who don't. All of the fourteen seats are both "window" and "aisle," and the pilots perform their work in full view of the paying clientele. The leg to Albuquerque, first of three, would take only 45 minutes or so.

As the high plains slid by below, the last ten days replayed in my mind.... The three-day drive from home, in my son's car, bearing the typical load of college regalia: stereo, computer, clothes, and a styrofoam head (doesn't every college student have one of these?). The battle with the recalcitrant air conditioner; the final diagnosis was simple freeze-up, cured by intermittent defrosting ("Time for...THE PROCEDURE!!!"). Spending the second night in Oklahoma City, recent witness to extremes of disaster and heroism. Checking the son into his college dormitory, home for the next year at least, seeing on his face and feeling with him the odd mix of uncertainty and anticipation of major changes coming down. Registration for classes; ah, to be young again, and to stand in line!

But any trip to The Land of Enchantment would be wasted if not for a bit of astronomy! There had been only two opportunities to use the trusty Pronto (now "properly stowed under the seat in front of me"). The first was at the monthly meeting of the Clovis Amateur Astronomy Club. This determined band of observers, represented that evening by four intrepid souls, meets monthly at the local community college. Since this meeting was more-or-less lacking a formal program, and since I more-or-less had a telescope, we repaired outside as soon as darkness fell. In spite of the glare from parking lot lighting, we were able to observe Jupiter, Mars, M13, Mizar, Albireo, and finally Saturn, sans rings. The friendly conversation and sharing of experiences was a welcome tonic so far from home. My thanks to Bob Reithel and the club for their hospitality.

A couple days later, all of the college administrivia taken care of, the Pronto was once again called into service, this time in my sister's back yard. The dry air and dark skies of this area allowed the small scope to perform at its best. Star-hopping from Cygnus through Vulpecula, the Dumbell, M27, was easy, it's distinctive shape visible even at low power. Then to the coathanger cluster. Next, Sagitta yielded M71 and several doubles. Farther to the east, M15 in Pegasus hinted at resolution, even in the small aperture scope. Turning north, a sweep through Cassiopeia turned up the Owl cluster by surprise; I can never remember where it is. Reluctantly I packed in, anticipating the long day of traveling I was just now beginning. A plunging descent into Albuquerque, a two-hour layover, then the flight back into the humidity of the midwest...If I hadn't been heading home, I would have turned around and gone back. As the last few irrigation circles passed from view, I assured myself this wouldn't be the last trip to the high plains. ✪

STAR STUFF CLASSIFIEDS

STATISTICALLY SPEAKING

Location(Dearborn, MI): 42°22'00" N, 83°17'00" W, 180 meters elevation
Local Time = Universal Time - 4.00 hours (Eeastern Daylight Standard Time)

Abbreviations used in reports:

FM Full Moon	FQ First Qtr Moon	LQ Last Qtr Moon	NM New Moon
MR Moon Rise	MS Moon Set	SR Sunrise	SS Sunset

Calendar Report for September 1995

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	Lunar Events FQ: 5:05 Sept 02 FM: 23:36 Sept 08 LQ: 17:10 Sept 16 NM: 12:55 Sept 24				1 SR: 6:58 SS: 20:08 MR: 13:56 MS: None	2 SR: 6:59 SS: 20:06 MR: 14:59 MS: None
3 SR: 7:00 SS: 20:04 MR: 15:57 MS: 0:54	4 SR: 7:01 SS: 20:03 MR: 16:50 MS: 1:55	5 SR: 7:02 SS: 20:01 MR: 17:37 MS: 3:01	6 SR: 7:03 SS: 19:59 MR: 18:18 MS: 4:10	7 SR: 7:04 SS: 19:58 MR: 18:56 MS: 5:20	8 SR: 7:05 SS: 19:56 MR: 19:30 MS: 6:30	9 SR: 7:06 SS: 19:54 MR: 20:02 MS: 7:38
10 SR: 7:07 SS: 19:52 MR: 20:34 MS: 8:44	11 SR: 7:08 SS: 19:51 MR: 21:06 MS: 9:49	12 SR: 7:09 SS: 19:49 MR: 21:40 MS: 10:51	13 SR: 7:10 SS: 19:47 MR: 22:17 MS: 11:51	14 SR: 7:12 SS: 19:45 MR: 22:56 MS: 12:48	15 SR: 7:13 SS: 19:43 MR: 23:39 MS: 13:42	16 SR: 7:14 SS: 19:42 MR: None MS: 14:32
17 SR: 7:15 SS: 19:40 MR: 0:26 MS: 15:18	18 SR: 7:16 SS: 19:38 MR: 1:17 MS: 16:00	19 SR: 7:17 SS: 19:36 MR: 2:11 MS: 16:38	20 SR: 7:18 SS: 19:35 MR: 3:08 MS: 17:13	21 SR: 7:19 SS: 19:33 MR: 4:08 MS: 17:46	22 SR: 7:20 SS: 19:31 MR: 5:09 MS: 18:17	23 SR: 7:21 SS: 19:29 MR: 6:12 MS: 18:48
24 SR: 7:22 SS: 19:28 MR: 7:17 MS: 19:20	25 SR: 7:23 SS: 19:26 MR: 8:24 MS: 19:54	26 SR: 7:24 SS: 19:24 MR: 9:31 MS: 20:31	27 SR: 7:25 SS: 19:22 MR: 10:40 MS: 21:12	28 SR: 7:26 SS: 19:21 MR: 11:47 MS: 21:58	29 SR: 7:28 SS: 19:19 MR: 12:52 MS: 22:51	30 SR: 7:29 SS: 19:17 MR: 13:53 MS: 23:50

Planet View Info Report for September 1995

Date	Rise	Set	RA	Dec	Elongation	Ill Fr	DIST(AU)
Mercury							
9/ 1/1995	9:14	20:57	12h11m46s	-2°42'00"	25°41'48"	0.673	1.07090
9/ 8/1995	9:29	20:42	12h39m28s	-6°48'01"	26°56'34"	0.578	0.97043
9/15/1995	9:32	20:22	12h59m54s	-9°56'08"	26°06'56"	0.454	0.86215
9/22/1995	9:17	19:57	13h08m36s	-11°26'23"	21°58'13"	0.287	0.75452
9/29/1995	8:34	19:24	12h59m23s	-10°11'47"	12°42'58"	0.095	0.67195
Venus							
9/ 1/1995	7:13	20:21	10h52m30s	8°42'04"	3°20'05"	0.998	1.72455
9/ 8/1995	7:30	20:13	11h24m45s	5°19'19"	5°07'10"	0.996	1.71786
9/15/1995	7:47	20:04	11h56m38s	1°49'02"	6°56'34"	0.993	1.70873
9/22/1995	8:05	19:55	12h28m23s	-1°44'40"	8°46'04"	0.989	1.69725
9/29/1995	8:22	19:47	13h00m16s	-5°17'35"	10°34'57"	0.984	1.68346
Mars							
9/ 1/1995	11:04	21:53	13h35m46s	-10°07'08"	47°46'05"	0.937	2.02249
9/ 8/1995	11:01	21:37	13h53m08s	-11°50'17"	45°35'03"	0.941	2.05402
9/15/1995	10:57	21:20	14h10m59s	-13°30'36"	43°26'30"	0.945	2.08353
9/22/1995	10:54	21:05	14h29m20s	-15°07'17"	41°20'09"	0.949	2.11108
9/29/1995	10:52	20:50	14h48m12s	-16°39'26"	39°15'57"	0.953	2.13667
Jupiter							
9/ 1/1995	14:30	23:52	16h20m04s	-20°56'00"	88°39'17"	0.991	5.23235
9/ 8/1995	14:06	23:27	16h22m51s	-21°03'55"	82°32'17"	0.991	5.33910
9/15/1995	13:42	23:02	16h26m10s	-21°12'44"	76°31'10"	0.991	5.44435
9/22/1995	13:19	22:38	16h29m57s	-21°22'19"	70°35'09"	0.992	5.54699
9/29/1995	12:57	22:14	16h34m13s	-21°32'24"	64°43'45"	0.993	5.64590
Saturn							
9/ 1/1995	20:41	8:10	23h34m17s	-5°18'28"	165°55'44"	1.000	8.65635
9/ 8/1995	20:12	7:40	23h32m22s	-5°31'30"	173°01'26"	1.000	8.63550
9/15/1995	19:43	7:10	23h30m24s	-5°44'36"	177°32'14"	1.000	8.62934
9/22/1995	19:15	6:39	23h28m25s	-5°57'27"	171°32'17"	1.000	8.63805
9/29/1995	18:46	6:09	23h26m30s	-6°09'42"	164°18'50"	1.000	8.66162
Uranus							
9/ 1/1995	18:07	3:30	19h56m48s	-21°18'21"	138°54'59"	1.000	18.95754
9/ 8/1995	17:39	3:02	19h56m04s	-21°20'15"	131°57'51"	1.000	19.04257
9/15/1995	17:11	2:33	19h55m29s	-21°21'44"	125°01'20"	1.000	19.13717
9/22/1995	16:43	2:05	19h55m03s	-21°22'47"	118°05'16"	0.999	19.24007
9/29/1995	16:16	1:38	19h54m47s	-21°23'23"	111°09'50"	0.999	19.34980
Neptune							
9/ 1/1995	17:48	3:14	19h39m17s	-20°55'45"	134°58'10"	1.000	29.44620
9/ 8/1995	17:20	2:46	19h38m50s	-20°57'01"	128°04'49"	1.000	29.53596
9/15/1995	16:53	2:18	19h38m28s	-20°58'03"	121°11'26"	1.000	29.63452
9/22/1995	16:25	1:50	19h38m12s	-20°58'52"	114°17'47"	1.000	29.74057
9/29/1995	15:57	1:23	19h38m03s	-20°59'25"	107°23'59"	1.000	29.85260
Pluto							
9/ 1/1995	13:08	0:27	15h54m44s	-6°44'24"	80°08'04"	1.000	30.01055
9/ 8/1995	12:41	23:55	15h55m05s	-6°49'09"	73°38'35"	1.000	30.12350

Planet/Moon Apsides/Conjunction/Opposition Report for September 1995

9/ 2/1995 Mercury @ Aphelion	Distance from Sun: 0.47 AU		
9/ 4/1994 Moon @ Perigee	Hour = 21	Distance from Earth: 367908 km
9/14/1995 Saturn @ Opposition	Hour = 3	
9/17/1995 Moon @ Apogee	Hour = 2	Distance from Earth: 404265 km

Meteor Showers Report for September 1995

Date	Meteor Shower	ZHR	RA	DEC	Illum. Frac.	Longitude
9/ 8/1995	Piscids	10	0h36m	7°	1.00	166°
9/20/1995	Piscids	5	0h24m	0°	0.16	178°

SKY & TEL. NEWS BULLETIN

from the editors of SKY & TELESCOPE magazine

MONSTER BOLIDE SEEN

The U.S. Air Force announced that military satellites recorded a brilliant meteor on July 7th with a peak brightness of magnitude -20.2 — 1,000 times brighter than the full Moon. The daylight bolide exploded in the atmosphere above Lancaster, Pennsylvania, at 17:33:37 Universal Time, and there is at least one eyewitness report from the Washington area, 150 km to the southwest. Air Force analysts say the meteoroid struck the atmosphere at 14 km per second and, given certain assumptions about how much kinetic energy was converted to light, its estimated mass was at least 1,300 kg. A solid stone that massive would have been about 1 meter across. Satellites have been recording airbursts of this magnitude for two decades, and they actually occur surprisingly often — dozens of times per year.

A NAKED-EYE COMET

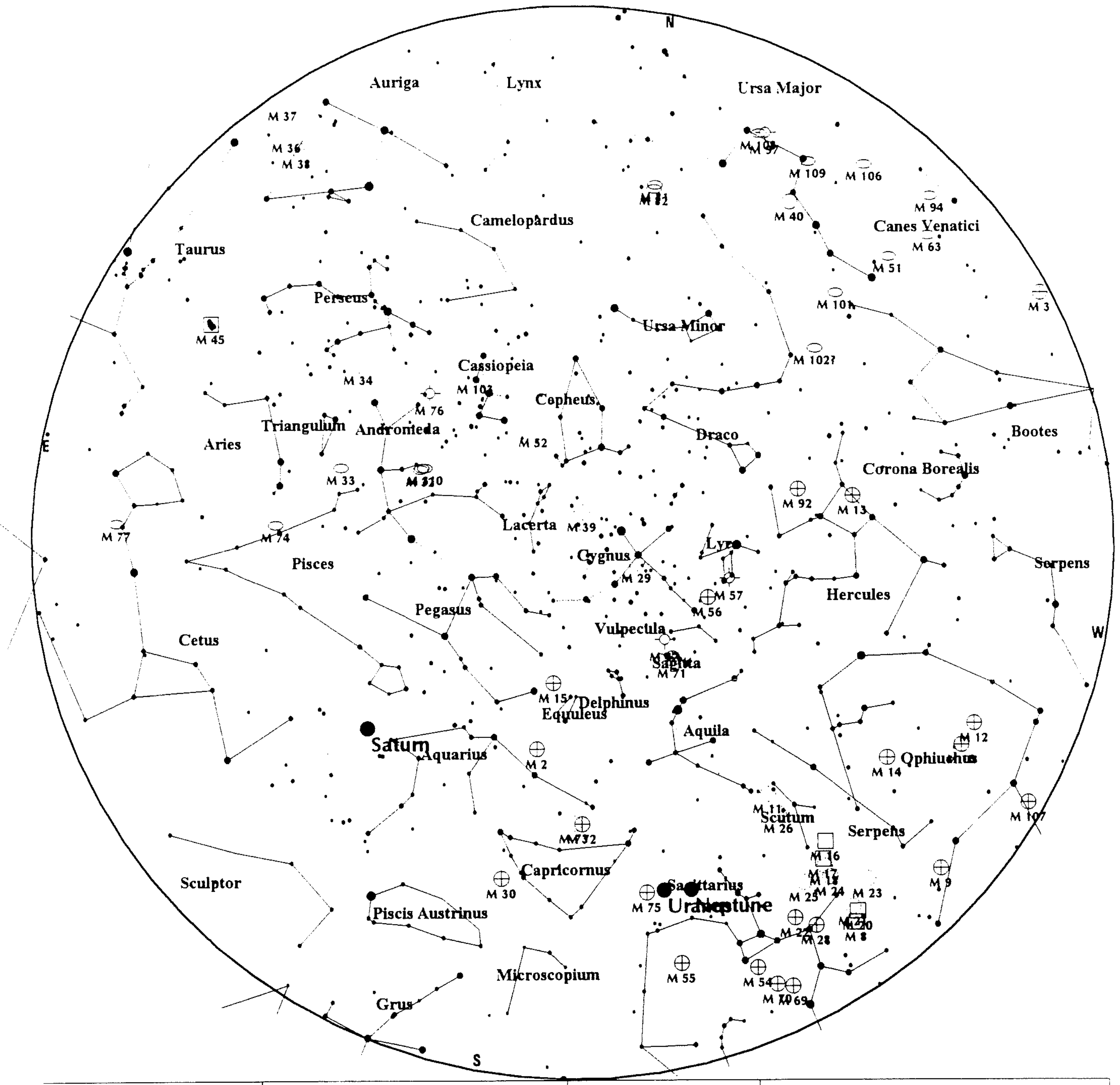
After a long drought it seems that comets are suddenly breaking out all over. On August 17th, the veteran Australian observer William Bradfield discovered a new comet in the constellation Crater. This is Bradfield's 17th comet and, unless someone else chimes in quickly, all of them have been discovered by him alone. 1995 Q 1, as this one is designated for now, has a tail more than 1 degree long. In announcing the discovery, Brian Marsden added that the European Southern Observatory in Chile has photographed the comet with its 1-meter Schmidt telescope. The image showed "two wavy tails," up to 3 degrees long. From their mountaintop site in Chile, observers could see the comet with the unaided eye. Its position at 0h Universal Time on August 18th was right ascension 11h 01.5m, -13d 27' (2000.0 coordinates). That means the comet currently is visible only from the Southern Hemisphere, but it's moving northeastward about 1 degree per day.

Comet Bradfield's orbit indicates that the comet will reach perihelion on August 31st and continue to move closer to the Sun in angular elongation through September 10th, making it temporarily unobservable from either the Southern or Northern Hemisphere. Then it should slowly emerge into the morning sky for observers in midnorthern latitudes. It won't become visible in truly dark skies (that is, just before dawn) until early October as it moves from Leo toward Ursa Major. By then it will probably have faded to about 8th magnitude, but it could still be an interesting sight in binoculars or a small telescope if it still has its tail. Unfortunately for observers on Earth, this comet has entered the inner solar system at a time when it is basically behind the Sun from our vantage point.

F.A.A.C. CLUB LOGO

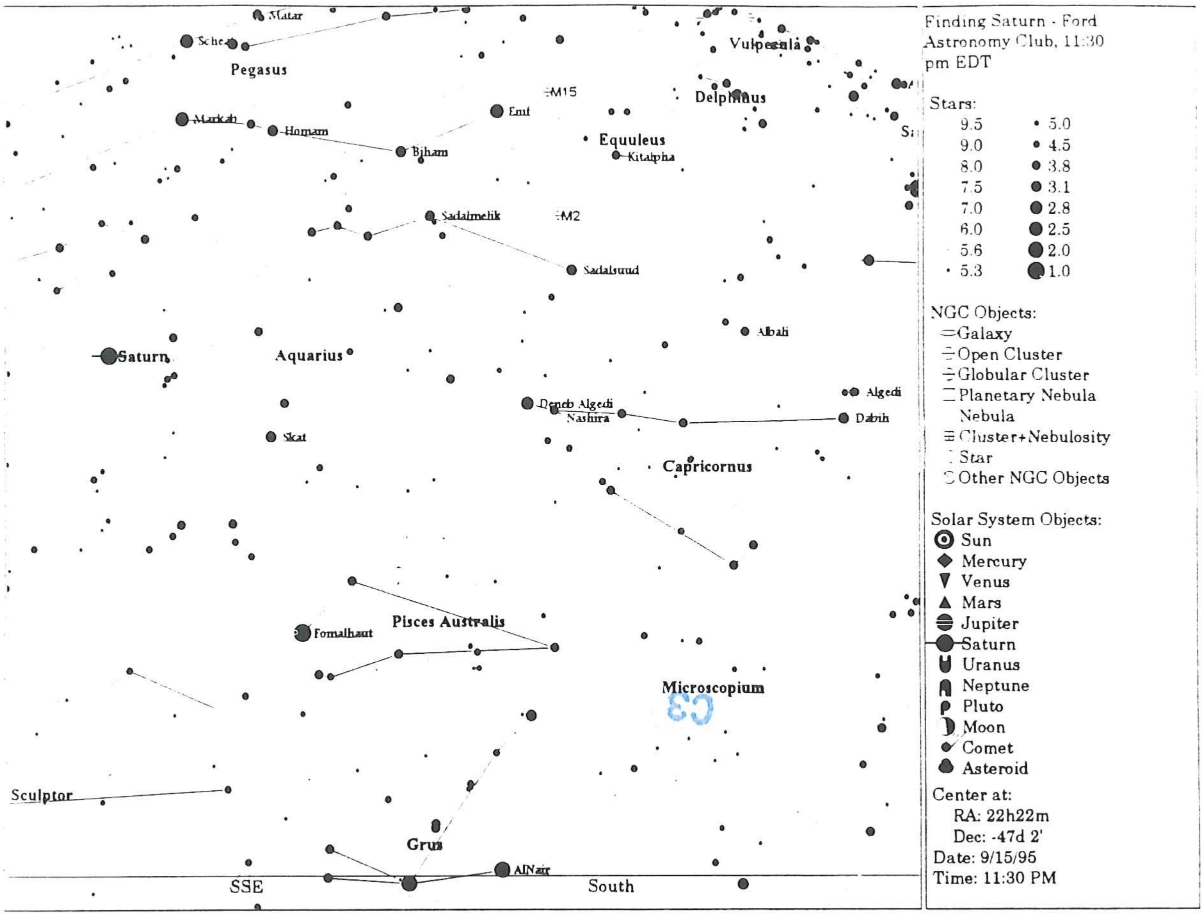
Congratulations are due to Judy Doelker for her design of our new club logo. Look for the logo on our Island Lake Star Party t-shirts. .

SEPTEMBER'S SKIES



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

Local Time: 23:30:00 15-Sep-1995	UTC: 03:29:59 16-Sep-1995	Sidereal Time: 21:35:20
Location: 42° 22' 0" N 83° 17' 0" W	Centre Az: 191.3° Alt: 90.0° Field: 180.0°	Julian Day: 2449976.6458



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