San Francisco Amateur Astronomers

The Randall Museum
199 Museum Way, San Francisco 94114

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BULLETIN FOR JULY 1990

Date:	WEDNESDAY, JULY 18
Time:	8:00 PM
Place:	Auditorium, THE RANDALL MUSEUM
Speaker:	John Hewitt Lawrence Hall of Science
Topic:	AMATEUR ASTRONOMERS AND THE HST

John Hewitt has been in the news recently as one of the amateur astronomers awarded time on the Hubble Space Telescope. His proposal for detecting clouds of comets around stars other than the Sun takes advantage of the HST's unique capabilities.

At present there is no evidence for the cloud of comets proposed by Jan van Oort. The Space Telescope, together with a fortuitous nova outburst, could provide the needed proof. An intrinsically bright nova would create a light pulse, which would cause some of the water in its cloud of comets to photo-dissociate into hydrogen and OH radicals. These radicals would fluoresce in the ultravoiolet light of the nova in a way which would be undetectable from Earth, but which the HST's wide-field planetary camera is well suited to record.

John went to Cape Canaveral for the launch of the HST and was able to go behind the scenes and experience the excitement of countdown first hand. He will speak to us at our July meeting about his experiment and his recent adventures in Florida.

In his capacity as a staff member with the Astronomy & Physics Education Dept. of Berkely's Lawrence Hall of Science, Mr. Hewitt presents a wide range of programs for schools and the public. He is active in the Eastbay Astronomical Society and the Valley of the Moon Astronomical Society, and serves as treasurer of the Astronomical Association of Northern California.

NEXT STAR PARTY AT ROCK SPRINGS - JULY 21

The club's next star party at Rock Springs on Mount Tamalpais is on Saturday, July 21, beginning at sunset. You won't want to miss the talk by Dr. Walt Terris of San Francisco State and the Morrison Planetarium, entitled "Stories from the Stars: the Loves of Zeus", starting at 8:30 in the nearby Mountain Theater. Afterwards, help us explore and admire the beauties of the Summer Milky Way with naked eye, binoculars or a telescope.

LICK FIELD TRIP SELLING OUT FAST

The 50 available spots for the field trip and star party at Lick Observatory on August 25 are going fast. By the time you read this, the trip may be completely sold out. If you want to go and haven't signed up yet, call Chelle Beard (878-4965 evenings) as soon as possible. Cost of the trip is $5 to cover food and refreshments.

VOLUNTEERS NEEDED FOR ANNUAL PICNIC SEPTEMBER 15

The annual SFAA picnic is scheduled for September 15, the evening of our monthly star party, at Bootjack Camp near our observing site on Mount Tamalpais. We need volunteers to serve on the following committees: Set-Up, Cooking and Clean-Up. If you can help out, please call Bob Levenson at 468-3592.

ANNUAL DUES INCREASE IN AUGUST

After considerable discussion over the last few months, the Board of Directors voted on June 13 to raise dues to $20 per year, effective August 1, to cover actual and anticipated increases in club expenses. We think it's still a very good deal. Membership dues include the monthly Bulletin and admission to club activities such as lectures by well-known amateur and professional astronomers at the monthly meetings, star parties and field trips, and the annual picnic and dinner.

In addition, club members may subscribe to Sky & Telescope, Astronomy, Deep Sky and Telescope Making magazines (any or all) at greatly-reduced rates. For more information, contact Chelle Beard, 32 Penhurst Avenue, Daly City 94015.

BULLETIN CONTRIBUTIONS

The SFAA Bulletin is a forum in which club members may share their ideas and experiences in astronomy. We encourage you to participate and welcome your letters to the editor, announcements and articles on astronomical topics. Please send them to: SFAA Bulletin, C/O Jim Shields, 190 Chilton Avenue, San Francisco 94131. Deadline is the 18th of the month.

THE "ROOTS" OF ASTRONOMY

Joel W. Goodman

We tend to take modern astronomy for granted, with the wealth of information accumulated during its "golden age", the twentieth century. But how many of us ever give a thought to the earlier eras of our hobby, when it was just a stumbling infant taking its first awkward steps? This came to mind when I was at Fiddletown last month, "crater-hopping" the third quarter moon. Many prominent lunar craters are named after ancient Greeks who lived 1500-2000 years before Galileo, and my thoughts turned to what they had done to merit such distinction.

Our knowledge of the origins of astronomy go back to about 3000 B.C., when Egypt and China adopted the 365-day year. The Great Pyramid of Cheops was built in Egypt at about that time, with its main passage oriented to the north pole. The Chinese of that period recorded descriptions of comets and eclipses, but the record is fragmentary and, of course, the science of astronomy was very primitive. True astronomy, as we might call it, really began in Greece almost 2.5 millenia later with a succession of philosophers and mathematicians that spanned about 8 centuries, beginning with Thales of Miletus, who was born in 624 B.C., and ending with Ptolemy of Alexandria, who died about 180 A.D. Human thought made remarkable progress during that period, after which there followed a "dark age" of about 1400 years until Nikolai Copernicus came upon the scene.

Thales may have been first to realize that the earth is round rather than flat, but his original writings have unfortunately been lost and this conclusion is therefore based on the writings of others. It was the great philosopher Aristotle, one of the most brilliant minds in recorded history, who made the first reasoned arguments for a round earth in the 4th century B.C. Aristotle pointed out that the altitude of stars changed with the latitude of the observer, which was incompatible with a flat earth. He also noticed that the earth's shadow on the moon during lunar eclipses was curved rather than straight, again arguing for a round earth.

Despite Aristotle's brilliance, he clung to a geocentric model of the universe. So influential was he that had he made the giant leap from that mindset the science of astronomy and our concept of the universe would have been revolutionized almost 2000 years before Copernicus.

The next major step was taken by Eratosthenes of Cyrene, who ingeniously determined the earth's circumference with remarkable accuracy. Eratosthenes commandeered the premier scientific library of the time, located at Alexandria in Egypt. He learned from the books available to him that at the summer solstice, the longest day in northern latitudes, the sun was directly overhead at noon in Syene, a town about 500 miles from Alexandria. However, at that exact time the sun was about 7 degrees from the zenith in Alexandria. Since 7 degrees is about 1/50th of a circle, Eratosthenes reasoned that the earth's circumference must be 50 times the distance from Alexandria to Syene. He deduced a figure of 24,850 miles, astonishly close to our best contemporary measurements. Eratosthenes certainly deserves to be immortalized by the prominent crater named for him at the foot of the lunar Appenines.

The first detailed star catalog was compiled by Hipparchus in the first century B.C. His original records have been lost, but they were reproduced by Ptolemy, to whom we owe most of our knowledge of Greek astronomy. Ptolemy wrote a wonderful historical account summarizing the ideas and achievements of his predecessors, which is widely known by its Arab title of the *Almagest*. Although the idea that the earth is at the center of the universe is commonly attributed to Ptolemy, he refined rather than originated it. Being an excellent mathematician, Ptolemy realized that planetary motion could not be explained by perfectly circular orbits about a central earth. He thus developed a complex system of "epicycles" to explain planetary motion, which remained the accepted model for 1400 years despite obvious irregularities.

The decline of ancient Greece heralded a long and dismal scientific dormancy. The great library at Alexandria, a hallmark of culture and enlightenment, was destroyed in 640 A.D. Further progress would wait for nearly a millenium.

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READ ANY GOOD BOOKS LATELY?

* Those of us who enjoy the beauty of the Ring Nebula in Lyra will also enjoy a new book that has just come out, entitled "Planetary Nebulae". It deals with those small, seemingly insignificant balls of hazy light, likened by the early observers to the faint, distant outer planets, and thus named by them planetary nebulae. Written by Steven J. Hynes, and published by Willmann-Bell, it is at long last a practical guide and handbook on the subject, aimed at amateurs like ourselves. It includes not only 253 finder charts but a catalog of 1,340 objects as well. Noteworthy therein is an acknowledgement of the aid and assistance of our own Steve Gottlieb to the author.--Gordon Ridley

* If you've ever dabbled with cosmology, and don't mind a little innocent gossip now and then, you're sure to enjoy "Lonely Hearts of the Cosmos" by Dennis Overbye (Harper Collins, 1991). It's an easy and entertaining introduction to the personalities and rivalries of the major players in cosmology during the second half of the 20th century, from Allan Sandage to Stephen Hawking. There's just enough physics to give us a taste for what they're arguing about. I liked the book because it raises more questions than it answers. It portrays science as an ongoing social endeavor in which today's gospel is quite likely to become tomorrow's embarrassment.--Jim Shields

Tackling the Corona Borealis Galaxy Cluster

by Steve Gottlieb

One by one, deep sky objects traditionally listed as severe challenges or even flatly unobservable have become standard fare at today's star parties. Nebulae such as the Veil, Eagle, Rosette, Pelican, California and even the Horsehead have succumbed to modern equipment such as the narrow bandpass Oxygen 111 and Hydrogen Beta filters and large transportable optics. Many Palomar globulars and Abell planetaries-very low surface brightness objects discovered photographically in the 1950's were once considered totally beyond visual detection. Yet 50% of these modern discoveries have proved to be within the grasp of large Dobsonians operating in dark skies. Want some challenging galaxies? Look for the dwarf galaxy Leo I very near Regulus, or the heavenly reddened Maffei I discovered in 1968. The latter is virtually invisible on the blue POSS print yet I've observed it with my 13" from the Fiddletown observing site.

Still, one well-known deep-sky object has resisted any large scale amateur observation-the Corona Borealis Galaxy Cluster (Abell 2065). I was first introduced to this remarkably rich cluster by an intriguing photograph in Burnham's *Celestial Handbook* which shows a field filled with small galaxies among two "bright" milky way stars. Their diminutive sizes and extreme faintness (the brightest members shine at mag 16.5!) a result of a truly staggering distance of nearly 1.5 billion light years. This distant cluster seemed way beyond the reach of my meager 8" and 13" scopes and this was confirmed in the *Webb Society Handbook* on Galaxy Clusters which claims it is "undetectable in 16" reflectors even under good sky conditions." A short report and sketch is given by Ron Buta who described Abell 2065 as "very difficult in the 36 inch" although he identified 16 members. So, this object was put on indefinite hold as far as my observing lists go, and over the years I've rarely heard this cluster mentioned in observing articles though both the *Sky Atlas 2000.0* and the *Uranometria 2000.0* both plot it as if it were standard observing fare. Nevertheless, as the more distant Abell clusters have passed through the eyepiece field of my 17.5" I've wondered about the observability of the Corona Borealis cluster.

Two years ago I had the opportunity to spend the better part of a week observing at the San Francisco Field Campus at the Sierra Buttes at an elevation of 7200' in conjunction with their Observational Astronomy class. After being thrilled at the deep sky sights in my 17.5" (the naked-eye threshold was close to 7.0), I knew that the following year I wanted to return and see if Abell 2065 could be conquered.

So, armed with the finder sketches in the Webb Society Handbook, a photocopy of the relevant POSS print and an article by Jeff Corder on the cluster which appeared in the *Webb Society Quarterly Journal*, I arrived at the class last year with high hopes. With careful starhopping I located the field and identified the two mag 11 and 12 stars which are displayed prominently on the Webb Society field sketch. Although no galaxies stood out with any certainty, I saw fleeting images of some extremely faint nebulous images very near the mag 12 star. Jim Shields was able to confirm that indeed several cluster members were visible.

I probably spent a good hour straining at my visual threshold to positively identify members which were barely non-stellar and visible with averted vision only. At the end I had logged 6 definite members in the central core and felt immensely satisfied just to have glimpsed a galaxy cluster at such a mind boggling distance. For those wanting to pursue Abell 2065, I discovered an interesting fact. The brightest cluster member is actually not plotted on the Webb Society chart at all, but is located about 20' SSW of the central core just northeast of a mag 9.0 star. As none of the cluster members are listed in any of the traditional galaxy catalogues, I've used the Goodwin numbering system found in the Webb Society Handbook. Positions given are for epoch 2000.0 though keep in mind that the 5 Goodwin galaxies will easily fit within a 10' circle.

Corona Borealis Galaxy Cluster (Abell 2065), August 3, 1989 at the Sierra Buttes

Goodwin	RA	Dec	Mag	Description
–	15.21.9	+2725	~16	17.5:EF/VF, ES/VS, R, located 2'NE *9.0 SAO 083789, brightest in cluster.
#1	15.22.4	+2743	~16	17.5:EF, ES, visible almost continuously w/averted, located 1.5'ENE of *12, similar in brightness to #2.
#6	15.22.4	+2744.5	~16.5	17.5:EEF, ES, R, between 2*11/12, only glimpsed for moments.
#2	15.22.5	+2742.5	~16	17.5:EF, ES, R, close double w/#3 off north side, cleanly resolved for moments, 2.5'E of *12, similar to #1.
#3	15.22.5	+2743	~16.5	17.5:EEF, ES, R, close double w/#2 off south side, 2.5'E of *12.
#4	15.22.7	+2740.5	~16	17.5: EF, ES, almost round, *14 1.5'NE, forms equilateral triangle to south of 2*11/12 in core of cluster.

SUN COLUMN

Eppler Nowell

Last time I enumerated our reasons for recording sunspots by sketching them rather than by photographing them. Now I think it's appropriate to talk a little about the sunspots themselves – what and where they are.

Sunspots are the centers of huge tangles of magnetic fields. Because they are 2000° cooler than their surroundings, they appear as dark blemishes on the photosphere of the Sun, the bright face of the Sun which is several hundred miles below the Sun's atmosphere. These spots usually group themselves in clumps, but some travel alone. Each of these areas is numberd and classified according to its size, polarity, and configuration – whether the spots are gathered tightly or loosely.

The least active spots show as tiny dots which are probably about the size of North America. As the spots grow (many of them do), you'll see large black areas (the umbra) surrounded by a wide gray boundary (the penumbra.) The more complicated regions will show two black umbrae – one with a positive charge and the other, negative – both surrounded by the penumbra. A few become much larger and more complicated still, with small spots sprinkled about and white bridges developing across some of the large umbrae. If these regions are three to four times the size of the Earth, they are naked-eye-visible. This is to say, you can see these tremendous ones, as did the ancient Chinese, through a good blanket of fog. (Remember; don't ever attempt to look at the Sun without a good filter!)

You will notice a couple of interesting effects that the tremendous curvature of the Sun's surface has upon your view. Because of the great depth of the Sun's atmosphere, the rim (limb) of the Sun appears much darker than does the center. If a large spot is close to rotating onto the disk from the back side of the Sun, there will often be some very bright, crooked string-like formations called "faculae" – an exciting tip-off that something big may be about to appear. The second important effect of this huge bulging surface is that the penumbrae closest to the center of the Sun appears to change its width as the spot crosses from East to West. This observation led to the realization that the umbra of a spot is located several hundred miles below the surface of the Sun.

The spots appear to travel from East to West in parallel tracks; actually, the spots are stationary but are being carried across the face of the Sun as it makes its 28-day (about) rotation. Some telescopes reverse left to right so that if you find that over the period of a few days the spots are crossing from right to left, don't be alarmed. Your telescope is merely reversing the image; the Sun is still O.K. Other telescope systems will turn the image upside-down, but this isn't going to effect your observations in any way.

Next time we'll talk a little more about the position and the varying numbers of these spots during a Sunspot Cycle.

'Til then, have fun.

COMET COMMENTS

06-07-90

By Don Machholz

One new comet has been discovered recently, it may become fairly bright in our summer sky. Comet Austin continues to dim in our evening sky. A third object, Periodic Comet Honda-Mrkos-Pajdusakova passes to within 27 million miles from earth in late July, then it continues to brighten in the morning sky as it nears its Sept. 12 perihelion.

Comet Levy (1990c): David Levy discovered this, his sixth comet, on the morning of May 20. At magnitude ten, it was near the north side of the Great Square of Pegesus. David was using his 16" reflector, and had been searching for 60 hours since his previous find last August.

A very preliminary orbit (IAU Cir. 5023) shows the comet closest the sun at 0.94 AU in early November. It should brighten over the next few months as it passes through opposition and into our evening sky.

EPHEMERIDES

DATE (UT)	RA (1950)	DEC	RA (2000)	DEC	ELONG	SKY	MAG
			Comet Austin ($1989c_1$)				
06-23	15h42.2m	-34°01'	15h45.4m	-34°10'	148°	E	8.9
06-28	15h32.2m	-34°42'	15h35.4m	-34°52'	142°	E	9.4
07-03	15h25.7m	-35°09'	15h28.9m	-35°19'	135°	E	9.9
07-08	15h21.8m	-35°29'	15h24.9m	-35°40'	130°	E	10.3
07-13	15h19.7m	-35°45'	15h22.9m	-35°55'	125°	E	10.7
07-18	15h19.1m	-35°58'	15h22.3m	-36°09'	121°	E	11.0
07-23	15h19.7m	-36°10'	15h22.8m	-36°21'	116°	E	11.3
07-28	15h21.1m	-36°21'	15h24.3m	-36°32'	112°	E	11.6
08-02	15h23.3m	-36°32'	15h26.5m	-36°43'	108°	E	11.9
08-07	15h26.1m	-36°43'	15h29.3m	-36°54'	104°	E	12.2
08-12	15h29.4m	-36°55'	15h32.6m	-37°05'	100°	E	12.4
			Comet Levy (1990c)				
06-23	00h07.1m	+29°12'	00h09.6m	+29°29'	78°	M	9.2
06-28	00h07.2m	+29°24'	00h09.8m	+29°40'	82°	M	9.0
07-03	00h06.6m	+29°33'	00h09.1m	+29°49'	87°	M	8.8
07-08	00h05.0m	+29°38'	00h07.6m	+29°55'	91°	M	8.5
07-13	00h02.4m	+29°39'	00h05.0m	+29°56'	96°	M	8.2
07-18	23h58.9m	+29°33'	00h00.9m	+29°50'	101°	M	7.9
07-23	23h52.6m	+29°18'	23h55.1m	+29°34'	106°	M	7.6
07-28	23h44.6m	+28°48'	23h47.1m	+29°05'	112°	M	7.3
08-02	23h33.8m	+27°58'	23h36.2m	+28°14'	119°	M	6.9
08-07	23h19.2m	+26°37'	23h21.7m	+26°53'	126°	M	6.5
08-12	22h59.9m	+24°28'	23h02.3m	+24°44'	134°	M	6.1
			Periodic Comet Honda-Mrkos-Pajdusakova				
07-03	23h12.7m	-11°05'	23h15.3m	-10°48'	115°	M	11.9
07-08	23h35.2m	-09°44'	23h37.8m	-09°28'	114°	M	11.3
07-13	00h03.8m	-07°57'	00h06.3m	-07°40'	112°	M	10.8
07-18	00h40.8m	-05°28'	00h43.4m	-05°11'	107°	M	10.2
07-23	01h29.5m	-02°01'	01h32.0m	-01°45'	99°	M	9.6
07-28	02h31.3m	+02°29'	02h33.9m	+02°42'	88°	M	9.1
08-02	03h42.7m	+07°23'	03h45.4m	+07°32'	74°	M	8.7
08-07	04h53.6m	+11°28'	04h56.3m	+11°33'	61°	M	8.5
08-12	05h54.3m	+14°05'	05h57.2m	+14°05'	51°	M	8.4

SEEKING COMETS

In what part of the celestial sphere are comets found? A plotting of the 51 comets visually found between 1975 and 1989 shows that discoverers avoid neither the Milky Way or the galaxy-ridden areas of the sky. The Southern Hemisphere is well-represented, half the comets are found south of +5 degrees. In the diagram below each discovery is indicated by an "X", while two finds in the same section is given an "O".

DISCOVERY POSITIONS OF COMETS PLOTTED IN R.A. AND DEC.

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                    RIGHT ASCENSION IN HOURS
        00  02  04  06  08  10  12  14  16  18  20  22  24
D   +80  +   +   +   +   +   +   +   +   +   +   +   +   +  +80
E                                   X
C   +60  +   +   +   +   +   +   +   +   +   +   +   +   +  +60
L                      X                       X
I   +40  + XX+   +   +   +   + X +   +   +   X X +   +   +  +40
N                                X   X  O X      X
A   +20  + X +   +   +   +   +   X   +X  +   +   +  X+   +  +20
T        X     X              X     X  X   X   X
I    00  +   +   + X +   +O  +   +   +   +X  +   +   +   +   00
O                                                    X X
N   -20  + X +   X   +X  +   + X +   X   +   +   + X +   +  -20
             X                                     X   X
I   -40  +   +   X X +   +   + X X   +   XX  +   +   +   +  -40
N                                        X    X     X
    -60  + X +   +   +   +   +   +   +   +   +   + X +   +  -60
D
E   -80  +   +   +   +   +   +   +   +   +   +   +   +   +  -80
G.      00  02  04  06  08  10  12  14  16  18  20  22  24
                    RIGHT ASCENSION IN HOURS
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The two discoveries closest each other are by William Bradfield, comets 1979l and 1980t. Their positions were 1.2 degrees apart, one being found 51 weeks after the other, in southern Scorpius.

Four comets have been found in the constellation Bootes: all of them in the last three years. Three comets have been found in the constellation Hydra.

In each of these constellations two comets were visually found between the years 1975-89:

Andromeda	Aquarius	Corona Borealis	Draco
Ophiuchus	Pisces	Scorpius	Usra Major

...and 28 other constellations have had one comet find each.

Don Machholz (408) 448-7077

ABRAMS PLANETARIUM

SKY CALENDAR JULY 1990

An aid to enjoying the changing sky

CURRENT SKY INFORMATION:
Call (517) 332-STAR

Use this scale to measure angular distances between objects on diagrams below.
0° 10° 20°

Morning: Venus in July closes from 32° to 24° W of Sun. Watch it go 4° N of Aldebaran July 3, 1.3° N of Zeta Tauri (Bull's S horn) on July 15, and closely N of Eta and Mu Gem July 22-24. **Mars** goes 21° E in July, crossing from Pisces into Aries. **Jupiter is 12° W of** Sun on July 31 and just emerging; see July 15, 30.

Evening twilight: Mercury on July 16 is 20° W (lower right) of Regulus. Don't miss event described on July 28.

Three planets visible nearly all night, all retrograding in Sagittarius: Saturn, E of Teapot, goes 2¼° W in July and is **best planet for telescopes.** Its rings extend 42" at midmonth and tilt 23.3° from edge-on. By month's end its rings open slightly to cover poles again until late November. **Use binoculars or telescope at low power to "star hop" to Uranus and Neptune. Refer to chart of their starfield on March *Sky Calendar*.** To find **Uranus,** locate the 5th-mag globular cluster M22, a small fuzzy patch 2.4° NE of 3rd-mag λ (Lambda) Sgr, top of the Teapot. Next, find the 5.6-mag star 24 Sgr, 2° NE of λ and 0.6° WSW of M22. Uranus and 24 Sgr are of same brightness. As July begins, Uranus is 0.5° N and slightly W of 24 Sgr. Uranus goes 1.1° W in July and will pass 1.8° due N of λ Sgr on Aug 4. To find **Neptune:** Locate a pair of 5th-mag stars, ν^1 and ν^2 Sgr, 14' apart and 3.6° N of 2nd-mag σ (Sigma) Sgr, brightest star in the handle of the Teapot. ν^1 is the eastern (left) star of pair. Next, locate 3.5-mag ξ^2 Sgr, 1.7° NNE of ν^1. Then find 6th-mag 33 Sgr within 1.4° N of ν^1 ν^2 and 0.9° W of ξ^2. Another 6th-mag star, 1.4° S of ξ^2 and 0.8° E of ν^1, completes a rough rectangle with ξ^2, 33, and ν^1 ν^2. In July, Neptune is the brightest object within the "rectangle". On July 1 the 7.9-mag planet is near its east side, and on August 1 is on its west side, connecting ν^1 and 33.

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 **Evening:** Face SSW. •Spica Moon	**2** Mercury at superior conjunction, beyond Sun.	**3** **Morning:** Venus 4° N of Aldebaran. Pleiades, Hyades, Venus, • β Tauri, Aldebaran, ζ Tau, ENE	**4** **Evening:** Antares, Moon On what date will Moon again pass Antares? Look up Moon's sidereal period. SSE	**5** Neptune at opposition. Wait a week to look for it; then sky will be dark and moonless at end of evening twilight. **12** **Thursday morning:** Pleiades, Hyades, • β Tauri, Aldebaran, Venus, • ζ Tauri, ENE, E	**6** **Friday through Sunday evenings, July 6-8:** Friday 6, Full Moon Sat 7, Saturn •, Sunday 8, ESE, SE, TEAPOT **13** Now through July 25, sky is very dark and moonless as evening twilight ends; excellent for viewing Uranus, Neptune, Milky Way, and deep-sky objects.	**7** **Saturday July 7, all night:** Moon approaches Saturn. See July 7, evening, and July 8, morning. **14** **Evening:** Saturn at opposition, visible all night. •Saturn, TEAPOT, SE
8 **Saturday through Monday mornings, July 7-9:** Monday 9 •Saturn Sunday 8 Handle of *Teapot* • Saturday 7	**9** **Magnitudes of Planets:** Venus −3.9 Jupiter −1.8 Saturn +0.1 Mars +0.3 to 0.0 Mercury (July 13-31) −0.9 to 0.0 Uranus 5.6 Neptune 7.9	**10** **Planets at Dawn:** **Venus,** rising near start of morning twilight, is prominent in ENE at dawn. **Mars** is well up in ESE to SE. **Saturn,** in SW, sets in twilight latter half of month. **Jupiter** emerges; see July 30.	**11** **Planets at Dusk:** **Saturn,** in SE, rises in twilight first two weeks; see diagrams July 6-9, 14. **Mercury** very low WNW midmonth onward; lower right of Regulus through July 28.			
15 Jupiter in conjunction, behind Sun and not visible. **Morning:** Moon at Last Quarter in SE •Mars	**16** **Morning:** Moon in ESE •Mars	**17** **Morning:** Face east. Moon Pleiades Hyades Aldebaran •	**18** **Morning:** Pleiades Moon Hyades Aldebaran •	**19** **July 19, morning:** β • Moon, Aldebaran • ζ Tauri Venus ENE, E	**20** **July 20, morning:** β Tauri • Venus Moon Castor, ENE	**21** **30 minutes before sunrise:** Venus Using binoculars, try for very old Moon ENE **21** New Moon 10:54 p.m. EDT. **Solar eclipse:** See below.
22 **15 minutes after sunset:** Using binoculars, try for Moon, 22 hours old from E Coast, and about 25 hours old from West. •Mercury Very young Moon, WNW	**23** **Evening:** Regulus • Mercury W, Moon, WNW	**24** **Evening:** Moon, Regulus •, Mercury W, WNW	**25** **Wednesday July 25, evening:** Moon Mercury W, Regulus •	**26** **Thursday July 26, evening:** Mercury W, Regulus •	**27** **Evenings:** •Spica Saturday July 28 Friday July 27 SW	**28** **Evening:** Mercury & Regulus form close "double star", 20' apart from E Coast, 9' from W Coast, 2' from Hawaii. Mercury is the brighter. Use binoculars. W, Regulus, WNW, • Mercury
29 **Predawn:** Broad maximum of Delta Aquarid meteor shower. **Evening:** Moon just past First Quarter. **Evening:** Mercury has overtaken Regulus. W, Mercury, WNW, •Regulus	**30** **Morning:** Fifteen days have passed since Jupiter's conjunction with the Sun. Can you see Jupiter this morning? See 2nd diagram to right.	**31** **Tuesday evening:** Antares •, Moon 27 days have passed since July 4, and Moon is nearly around to Antares again. S	**Monday July 30, morning:** Look for Jupiter within 14° lower left of Venus, and 1° closer to it each day. Don't miss their spectacular conjunction on August 12 & 13. ORION, •Castor, Venus, Betelgeuse, Rigel, • Pollux, ENE, E, ESE		**Total solar eclipse on July 21-22** (date is July 22 west of International Date Line): Path of totality crosses southern Finland, Arctic coast of USSR, Aleutian Islands. Partial eclipse in progress at sunset on July 21 from Hawaii, Washington, Oregon, parts of California, Nevada, Idaho, Montana, and extreme NW parts of Wyoming and Utah. From Alaska and NW Canada, greatest eclipse occurs during afternoon hours.	

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ISSN 0733-6314

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