NORTHERN LIGHTS

NORTH CENTRAL REGION

*Published quarterly in January, April, July and October
*Subscriptions $2.50 per year
*Send all inquiries to Ray Wendt, Editor, 4834 N. 70th St., Milwaukee, WI 53218

VOLUME XVII | APRIL 1988 | NUMBER 2

AL/ALPO Convention Announced, Call For Papers

In just under six months, between July 27th and 30th, the annual convention of the Astronomical League and the Association of Lunar and Planetary Observers will be held. The convention is being hosted by the Omaha Astronomical Society and will be meeting at the Iowa Western Community College in Council Bluffs, Iowa, just across the Missouri River from Omaha, Nebraska. General correspondence regarding the convention should be sent to:

Mr. George Allen
3390 South 130th Street
Omaha, NE 68144.

The program committee for the 1988 Astronomical League-ALPO national convention is soliciting papers and speakers for the convention's paper sessions. Those wishing to give a talk should contact the papers chairman as soon as possible and, at the same time, enclose an abstract of their paper. These abstracts will not be returned. Amateur papers will be limited to a 20 minute time limit which will include a question and answer period. Authors of accepted papers will be notified as soon as final selections are made and given a place on the program. In addition, it will be the speakers' responsibility to provide us with camera-ready copies of their papers on or before the date of the convention for inclusion in the convention "Proceedings". Remember, papers do not have to be completed in order to submit an abstract. There are only a limited number of openings, so please reply soon. Send correspondence to:

Jerry M. Sherlin
Papers Chairman ALCON '88
1001 South Cornelia Street
Sioux City, IA 51106.

Dawes Limit Understood

---Tom Quinn

A star is a matehmatical point, subtending an angle of 1/20 of one second of arc or less. No telescope can show such a tiny object as it really is but instead expands the angle to form a small disk of light, known as the diffraction disk or pattern. The smaller the diffraction pattern, the better the resolution. Resolution is simply the scope's ability to show fine detail. An exact measure of this is offered by close double stars. It should be noted that the common standard--Dawes Limit--does not call for actual separation. Dawes Limit recognizes only the bright center of the star image.

Dawes Limit (and telescope resolving power) is accomplished by giving the minimum separation between two stars yet allowing the stars to be seen as separate points. This is Dawes Limit. It does not mean you can see the stars cleanly separated but only that you can tell there are two stars. The general theory states that you can tell that there are two stars if the edge of one diffraction disk does not extend beyond the center of the other. Dawes Limit is 1/2 the angular diameter of the diffraction disk. Dawes Limit is definitely a limit and not something you are going to see real easy, nice and clear.

For starters, it is probably better to double the quoted Dawes Limit for your scope. At this separation two stars should be seen as just touching.

Mnemonics

Mnemonics, (the M is silent), are devices to assist the memory. To recall the spectroscopic classification of stars by temperature: O-B-A-F-G-K-M-R-N-S (Oh Be A Fine Girl, Kiss Me Right Now Smak!). The temperature decreases with type O as the hottest.

To recall the planets from Mercury to Pluto , use the sentence "Mary's Violet Eyes Made John Stay Up Nights Pondering." (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto).

To recall the first nine asteroids, use the phrase "Certain Planets Journey Very Ancient Heavens In Faint Magnitudes." (Ceres, Pallas, Juno, Vesta, Astraea, Hebe, Iris, Flora, Metis).

Mnemonic phrases or sentences can be used to recall numbers, each digit by the number of letters in a word. As an example, remember Mars' mean distance from the sun in astronomical units by "a fiery or red planet, spherical" (1.52369).

North Central Region A. L. Convention

This year's convention will be held during the weekend of May 14th at Marquette, Michigan. There will be a chartered bus leaving from the Milwaukee, Wisconsin area. The cost will be $35 - $40 per person. If there is enough interest, the bus will stop in Chicago first. The bus is a touring type bus (not a yellow school bus). There should be plenty of room for luggage and telescope equipment. Bus information can be obtained from Dan Koehler, Milwaukee Astronomical Society (414) 662-2987. More information on the convention itself can be obtained from Shirley Shibley, 412 High Street #1, Marquette, MI 49855 (906) 225 - 1066.

PUNS, QUIPS AND QUOTES:

"Men love to wonder, and that is the seed of science. ---Ralph Waldo Emerson

"People only think a thing's worth believing in if it's hard to believe." ---Armiger Barclay

"I can pardon everyone's mistakes but my own." ---Marcus Porcius Cato (234-149 B.C.)

"By identifying the new learning with heresy, you make orthodoxy synomynous with ignorance."--Desiderius Erasmus (1465-1536)

10.03 MIRRORS

(1) Plane Mirrors

(a) Light reflection from a smooth surface (such as polished metal) is called *regular* (specular) reflection and from a rough surface (such as concrete) is called *diffused* reflection.

(b) Plane mirror is a highly polished plane surface which forms a virtual, upright image whose size equals the real object, with the image distance q equal to the object distance p (Fig. 10.03-1).

(c) Geometric relations between the object and its virtual image are defined below.

(α) *Symmetrical properties:*
Image distance p = object distance q
Image height h = object height h'
Angle of reflectance θ' = angle of incidence θ

(β) *Antisymmetrical properties:*
Image left side = object right side
Image right side = object left side

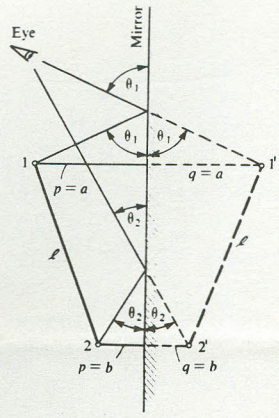


Fig. 10.03-1

example:

The printed page of a book in a plane mirror appears as an image of the same size, but the letters are shown in reversed order and sense.

(2) Spherical Mirrors

(a) Curved mirror is a highly polished curved surface which produces a real or virtual image of a real object. Most curved mirrors used in practical applications are spherical, obtained by cutting off a portion of a sphere as shown in Fig. 10.03-2.

(b) Two kinds of spherical mirrors are the *concave mirror*, with its reflecting surface on the inside of the spherical surface (Fig. 10.03-3), and the *convex mirror*, with its reflecting surface on the outside of the spherical surface (Fig. 10.03-4).

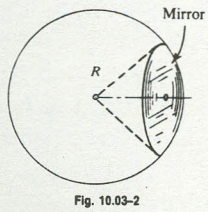


Fig. 10.03-2

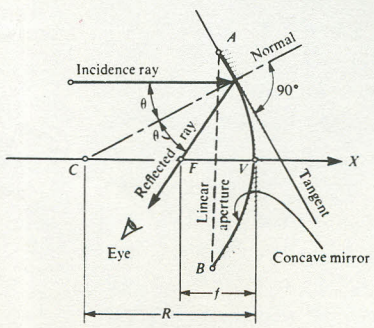


Fig. 10.03-3

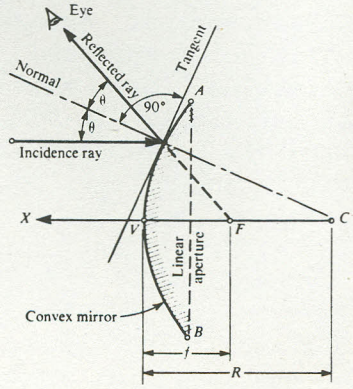


Fig. 10.03-4

(c) Principal focus F of a spherical mirror lies on the principal axis X of the mirror and is the point of intersection of lines of action of all reflected light rays which strike the mirror parallel to the X axis. The focus is real for a concave mirror (Fig. 10.03–5) and virtual for a convex mirror (Fig. 10.03–6).

(d) Geometry of spherical mirrors of Figs. 10.03–3 and 10.03–4 is defined by the center of curvature C, the radius R of the reflecting spherical surface, the position of the principal axis X, the vertex V, the linear aperture $\overline{AB}$, and the focal length

$$\overline{FV} = f = R/2$$

(e) Mirror equation is the relationship

$$\frac{1}{p}+\frac{1}{q}=\frac{2}{R}=\frac{1}{f} \qquad \{p, q, R, f \text{ in m}\}$$

from which

$$p=\frac{qf}{q-f} \qquad q=\frac{pf}{p-f} \qquad f=\frac{pq}{p+q}$$

where p = object distance from the mirror, q = image distance from the mirror, R = radius of curvature of the mirror, and $f = R/2$ = focal distance.

(f) Concave mirror produces a real image (in front of the mirror) or a virtual image (behind the mirror) of the object according to the ratio $p:f$.

If $p > f$, the image is real and inverted (Fig. 10.03–7a to c).
If $p = f$, no image is formed (Fig. 10.03–7d).
If $p < f$, the image is virtual and upright (Fig. 10.03–7e).

The size l' of the image in terms of the size of the object l is

$$l' = -ql/p = Ml \qquad \left\{\begin{matrix} l, l', p, q \text{ in m} \\ M \text{ dimensionless}\end{matrix}\right\}$$

where p, q, and f are those of (e), and M = magnification factor.

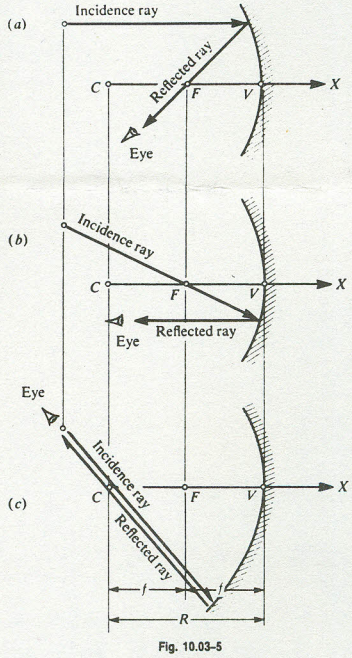


Fig. 10.03–5

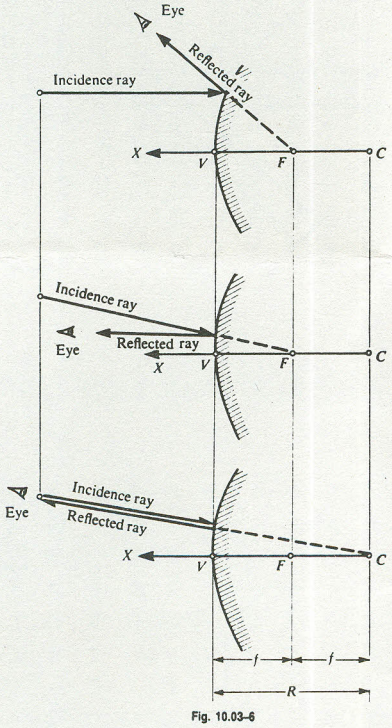


Fig. 10.03–6

examples:

The application of the mirror equation (e) and the magnification equation (f) is shown below, where the mirror is concave, $R = 8$ m, $f = 4$ m, and $l = 3$ m.

The geometric construction in each case follows the number sequence of light rays, and two rays are necessary to locate one image point.

In Fig. 10.03–7a, $p = 12$ m,

$$q=\frac{12\times4}{12-4}=6\text{ m} \qquad l'=-\frac{6\times3}{12}=-1.5\text{ m}$$

the image l' is real and inverted, and $|l'/l| = \frac{1}{2}$ (reduction).

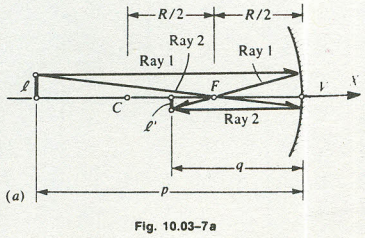
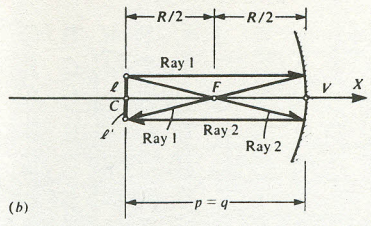
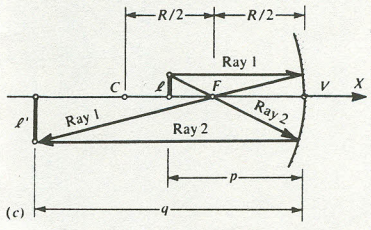
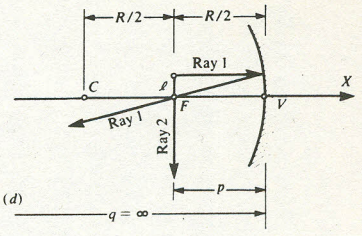


Fig. 10.03–7a







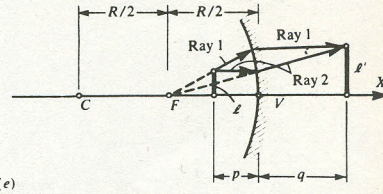


Fig. 10.03–7 (Continued)

In Fig. 10.03–7b, $p = 8$ m,

$$q=\frac{8\times4}{8-4}=8\text{ m} \qquad l'=-\frac{8\times3}{8}=-3\text{ m}$$

the image l' is real and inverted, and $|l'/l| = 1$ (equal size).

In Fig. 10.03–7c, $p = 6$ m,

$$q=\frac{6\times4}{6-4}=12\text{ m} \qquad l'=-\frac{12\times3}{6}=-6\text{ m}$$

(a) the image l' is real, inverted, and $|l'/l| = 2$ (enlarged).

In Fig. 10.03–7d, $p = 4$ m,

$$q=\frac{4\times4}{4-4}=\infty$$

and no image is produced.

In Fig. 10.03–7e, $p = 2$ m,

$$q=\frac{2\times4}{2-4}=-4\text{ m} \qquad l'=-\frac{(-4)\times3}{2}=6\text{ m}$$

the image is virtual and upright, and $|l'/l| = 2$ (enlarged).

(g) Convex mirror produces only virtual, erect, and smaller images. The size of the image l' in terms of the size of the object l is given by the equation of (f). Note that R and f in convex mirrors are negative quantities (Fig. 10.03–8).

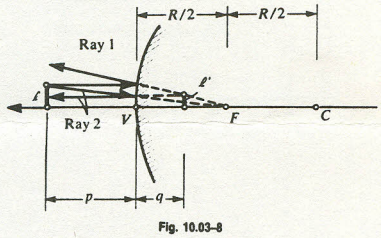


Fig. 10.03–8

(b)

example:

The object of $l = 3$ m is located at $p = 12$ m in front of a convex mirror of $R = -8$ m and $f = -4$ m, as shown in Fig. 10.03–8.

(c) The distance of the virtual image is $q=\frac{(-12)\times4}{12+4}=-3$ m, and the size of the image is $l'=-\frac{(-3)\times3}{12}=0.75$ m (reduced).

(h) Sign convention of the parameters p, q, R, f, and M is given below:

p is positive when the object is in front of the mirror.
q is positive when the image is real (in front).
q is negative when the image is virtual (behind).
R, f are positive in a concave mirror.
R, f are negative in a convex mirror.
M is positive when image is upright.
M is negative when image is inverted.

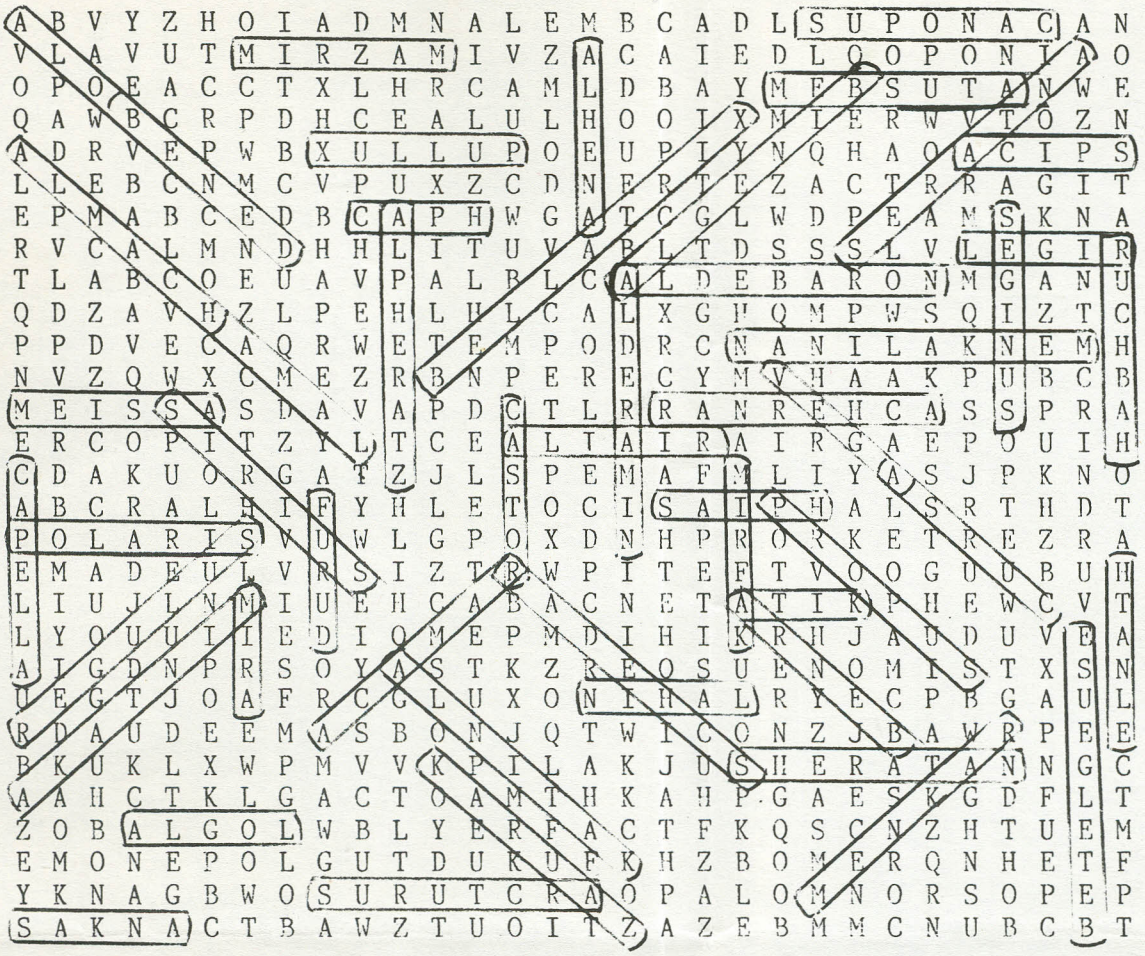
SPECIAL THANKS TO:

Celestrial Log
Focal Point
Handbook of Physical Calculations
Observer
Tom Quinn

DEADLINE FOR NEXT ISSUE:

July 1, 1988

ANSWER TO STAR FIND (JANUARY ISSUE):



PUZZLE ME

(MATCH CONSTELLATION WITH IT'S MEANING)

Auriga	Stern
Cetus	Snake
Grus	River
Pyxis	Hare
Columba	Goblet
Virgo	Crow
Bootes	Scales
Ophiuchus	Sails
Orion	Twins
Libra	Bull
Lepus	Crane
Serpens	Whale
Corus	Hunter
Mensa	Serpent Handler
Volans	Ship's Compass
Puppis	Charioteer
Crater	Corn Maiden
Eridanus	Table
Vela	Maiden
Taurus	Herdsman
Gemini	Dove

ANSWER TO STAR FIND (SEPTEMBER 1987 ISSUE):

