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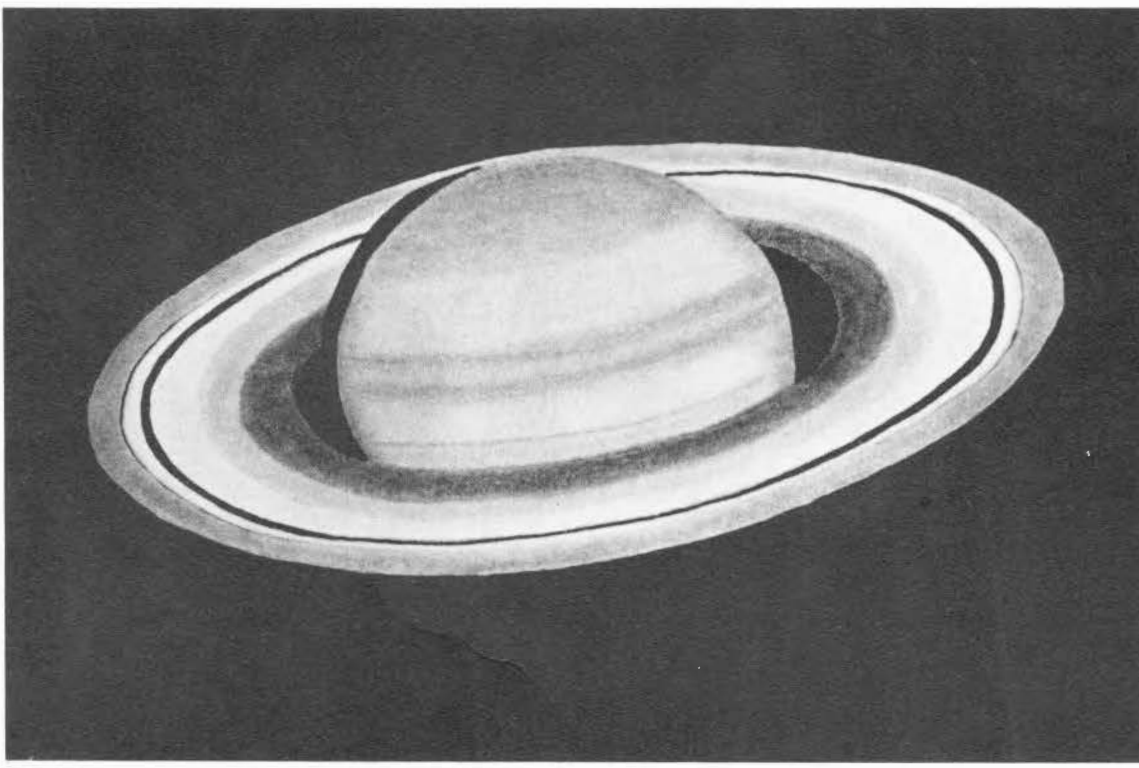

Drawing of Saturn by Alan W. Heath on October 3, 1971 at 0 hrs., 30 mins., Universal Time. 12-inch reflector, 318X. Seeing very good. There is a Section Report on the 1971-72 apparition of Saturn on pages 139-147.

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IN THIS ISSUE

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PLANNING FOR THE TRANSIT OF MERCURY ON 1973, NOVEMBER 10

By: Richard G. Hodgson, A.L.P.O. Mercury Recorder

1. Circumstances of the Transit

On 1973, November 10, a Saturday, there will be a transit of the planet Mercury across the disc of the Sun. To observe the event from start to finish (it has a duration of over 5 hours), one should be located between about 10° and 25° E. longitude, preferably south of the Alps and Balkans in Europe, or southward in Africa. The southern portion of Africa is particularly favored. For those of us who must observe from North America (most A.L.P.O. members), the latter portion of the transit will be visible in the eastern part of the continent. For observers along the Atlantic coast of Canada and the United States, the transit will end about an hour after sunrise; those farther west will have a shorter view.

This transit of Mercury is important, not only because it involves a relatively rare event -- the next transit will occur on 1986, November 13 -- but because for us in North America it will be the last such opportunity until 1999, November 15, when observers in the western portion of North America will get a chance.[1]

According to data in The American Ephemeris and Nautical Almanac, this year's transit will be visible to observers east of a line running approximately from Ft. Severn, Ontario, Canada (in the middle of the south shore of Hudson Bay), through International Falls, Minnesota; Watertown, South Dakota; Kearney, Nebraska; Dodge City, Kansas; and to a point just east of Big Bend National Park in Texas. Of course, the farther southeast one is of this line, the longer the event will be. It would be well to have the Sun a few degrees up in the sky before third and fourth contacts.

2. Care in Preparation

Those planning to observe the transit should give careful attention to weather reports, and to ground fog conditions which often prevail at sunrise. Avoid areas that tend to have early morning fogs. It would be well to select a site several weeks in advance and to check for these conditions. Be sure to have an excellent horizon to the southeast.

If one is planning to time 3rd and 4th contacts precisely (and I trust all who can will), it would be well to have a short wave radio to pick up time signals from WWV or CHU, and a stopwatch (or better 2 stopwatches, one for each contact). The technique is essentially similar to that used for occultation observations. If at all possible, those participating should have some experience with occultation observations.

Perhaps this is laboring the obvious, but those who have been on solar eclipse expeditions and the like well realize there is nothing worse than trying to learn something new at the last minute, knowing that celestial objects do not wait. The same advice goes for photography. Know your camera and your telescope-camera combination several weeks or more in advance. Practice sunspot photography until you get it right, and it comes easily for you. This transit (as observed in North America) will not offer much time to make impromptu experiments.

It would be well to remind readers who are not experienced solar observers that extreme caution must be exercised in order that the observer is not blinded by the Sun. The mere use of a Sun filter over the eyepiece is not sufficient protection (regardless of what some manufacturers may say or imply). The heat of the Sun concentrated in the eyepiece has not infrequently caused such filters to crack, and serious and permanent damage can be done to the observer's vision before he is aware of it. The writer has known several young amateurs who have had close calls with blindness because of cracked Sun filters.

Three methods of observation can be recommended: (1) projection of the Sun's image on a screen, which is completely safe; (2) use of a Herschel solar wedge and a Sun filter over the eyepiece (both must be used to be safe); (3) use of a full-aperture solar filter which prevents most of the Sun's light and heat from reaching the main mirror or objective lens of the telescope. More information about these various methods can be obtained from J. B. Sidgwick's The Amateur Astronomer's Handbook and other similar works.

3. Useful Transit Work

Transits of Mercury are usually regarded as having limited scientific value, but are well worth observing due to their relative rarity (occurring at intervals of 3, 10, and 13 years). As the next paper in this issue of J.A.L.P.O. points out, precise timing of the four contacts may provide a check on the accuracy of atomic clocks. Other valuable applications of transit data may also come to light in time.

Useful work may be summarized as follows:

1. Timing Contacts. These are probably the most important. Equipment needed has been noted earlier.

2. Measures of Mercury's Diameter. It is doubtful that A.L.P.O. members will be able to contribute anything new on this subject, but it is a useful educational exercise. Methods of measurement include: (1) filar micrometer measures, (2) measures based on photography, and (3), measures based on the intervals between 1st and 2nd, and/or between 3rd and 4th contacts. (Cf. A. Dollfus, ed., Surfaces and Interiors of Planets and Satellites, pp. 56-63 (1970)).

3. Possible Atmospheric Effects. While the evidence is abundant that Mercury does not possess a significant atmosphere, one whould be alert to note any additional evidence for or against the existence of a tenuous atmosphere. Such evidence might include the "Black Drop Effect" sometimes noted near 2nd and 3rd contacts. Beware of instrumental flaws and other spurious effects.

4. Satellite Search. Observers with large apertures and suitable solar observing equipment should examine the region around Mercury visually and photographically with fairly high magnification in search of possible satellites of the planet. The writer seriously doubts that there are any, but our present knowledge is only sufficient to exclude satellites of 9th magnitude or brighter (i.e., larger in diameter than about 40 kms.). The region around the planet within 30 diameters of the planet ought to be carefully examined.

Let us hope many A.L.P.O. members will observe this transit of Mercury. Reports of observations should be sent to the Mercury Recorder without delay for analysis and publication of the results.

Reference

1. See Werner Sandner, The Planet Mercury, pp. 76-84 on transits. This chapter records some experiences of past observers and gives a list of transit dates and areas of observation.

LONG-PERIOD TIME INTERVAL MARKERS FROM MERCURY TRANSITS

By: Reinhold Gerharz, USNAVL, Fort Belvoir, Virginia

Abstract

The discussion below illustrates the need for precise markers of long periods of time and their link to an atomic frequency standard. Among the observable macrophysical phenomena, the conjunction times of Mercury transits appear to offer the most reliable means for marking long interval epochs.

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The second of time is defined[1] as the duration of 9,192,631,770 cycles of the (incoherent) quantum emission of the cesium 133 atomic beam hyperfine transition F = 4 to F = 3. The mean stability of cesium clocks has been tested for about 1½ decades[2]. Short period comparisons with standard quartz oscillators and with other quantum effect frequency generators have been made[3], but a link with an independent long period interval generator has not yet been established. Such a device could uncover conversion errors in deriving Universal Time and might expose macrophysical drifts from the atomic standard.

The atomic time standard replaced the world time second, which was derived as a subdivision by 31,556,924.974 of the tropical year 1900. This standard suffered chiefly from the following impracticalities: (1) it was a standard by definition only; (2) it involved an irretrievable epoch with standard intervals meaned from past events; and (3) it remained inaccessible for comparison with more modern quantum effect interval markers.

A close linkage of the atomic time domain with that of macrophysics and astronomy has now become desirable, for over very long periods quantum effect time markers prove to be increasingly susceptible to technical failures. Their most disparaging aspect is the limited life (about 5 years) of atomic clocks. Moreover, comparison at different locations introduces time losses which are not solely caused by the nature of electromagnetic signals[4] and by the Relativity Principle. These variables set the limit for the accuracy of our most widely used basis for a long period epoch in civil timekeeping: the length of the solar day. This datum is still derived from meridian transits of stars and contains the empirical correction by Newcomb: $\Upsilon_{sol} = 1.002737909 \times \Upsilon_{sid}$. The inherent error margin amounts to about 10^{-7} parts and is caused by a combination of the aperiodic changes of the Earth's rotation, tidal effects, and other secular phenomena. The mean data from such transit observations furnish the adjustments for Universal Time as leap seconds and in multiples of $\pm 5 \times 10^{-9}$ parts of the defined atomic time. The apparent caprice of this method calls for additional and independent comparisons between standards of the atomic domain and the very few available long-period markers of macrophysics.

The most desirable features of such a secondary standard would be simple steps for analysis and minimum content of independent variables. A compromising approach may be gained from standards derived from material bodies spinning in magnetic suspension fields[5]; but the best long-period interval generators are only accessible as celestial phenomena, like the motion of massive bodies. The ones most familiar to astronomers offer sidereal time markers, but most of these appear impracticable on account of their hidden variables and error margins in time and position. These phenomena may be categorized in five groups. We are reminded that:

1) Pulsars exhibit signal fluctuations[6] caused by mass shifting star-quakes, fadings in brightness, scintillation, background noise, and other unknown factors.

2) Most of the bright eclipsing binaries show unmanageably wide signals and unstructured bands, which also depend on the occurrence time of various parts of their emission spectrum.

3) Recurrent position versus time determinations of the bright moons of Jupiter or of the extraterrestrial planets appear impracticable for long interval markers on account of long-period gravitational perturbations, and of a necessary position link with fundamental stars. Additional problems are caused by their signal faintness and the ensuing defects of contrast and resolution. Further, the variable delays of their arriving signals (first observed by O. Roemer and caused by the finite speed of light) make the analysis more difficult still. Many of the position errors may be rigorously explored during the coincidences of the orbital planes of the Galilean satellites with Sun and Earth[7], which also would offer supporting data for a redetermination of the speed of light in cis-Jovian space with the Roemer method.

4) Another series of events, directly observable in heliocentric coördinates, results from the conjunction times of the inner planets and preferably from their solar transits. Venus may be ruled out at once because of the rareness of its transits and because of severe contrast effects of the Venusian atmosphere on accurate position determinations.

5) The sole remainder in this survey is the solar transits of Mercury, which occur in regular intervals of 10 and 13 years during the November and May coincidences of the orbital planes of Earth and Mercury. The conjunction time of the transits may be adopted as the interval marker of a long-period secondary time standard.

The positional irregularity of Mercury's orbit has been analyzed[8], indicating that gravitational perturbations by Sun and planets amount to about 1.2 seconds of arc per year. One-third of this amount is caused by the relativistic advance of the planet's perihelion. Because of the planet's restricted visibility at dusk or dawn, ordinary position determinations would not appear desirable for a precise time link. Transit observations, however, can turn out very accurately and may suffice for the desired time link. Most of the necessary corrections for the planet's orbital elements have been discussed before[9], and the correlation of Mercury's conjunction time with a primary frequency standard may be made a routine task of standards laboratories.

Few if any efforts have been made previously to link Mercurian conjunction times with the new time standard. One marker occurred on 7 November, 1960, $16^h53^m\ 33^s.9 \pm 0^s.2$ U.T.[10], but was not reduced to geocentric coördinates. For the transit of 14 Nov., 1953, a radio link with Station WWV was established[11], but a cesium clock reference was not available then. At the 1970 mid-time of transit, about 2.99764×10^8 solar time seconds should have passed since the 1960 marker was derived. This figure equals a total number of cesium clock intervals of approximately 2.755627×10^{18}. The number of significant digits, of course, remains limited to ten because of the inherent instability of the atomic standard since it became operational in 1956. As a reference for the past time intervals, it would be necessary to integrate and correlate all cesium clock intervals with the 1960 event. This effort needs the control and monitoring of the monthly corrections of master clocks in the standards laboratories. For the 1960 transit observations and the time link, all corrections of Universal Time 2 would need to be included which were applied during the previous decade to the secondary link between the newly introduced cesium clocks and the old quartz-controlled standard frequency transmitter WWV. For a while in the past, a partial record of these corrections was published monthly[12]. No consecutive marker has been derived as yet from observing the transit of 9 May, 1970, 20^h22^m U.T.; and no coördinating plans are available to link the 1973 transit (predicted for 10 Nov., 1973, $10^h33^m\ 10^s.2$ U.T.). This future event will last 5 hrs, 26 mins. and is observable in Europe, Africa, Western Asia, and the Atlantic coast of North America.[13]

If the 1973 transit also remains uncorrelated with the atomic time standard, there will be little future chance to derive a marker before 13 Nov., 1986, 16^h09^m U.T. After such long delay, the corrections of standard frequency generators to the solar day and the summation of all corrective intervals may be unavailable or at least very difficult to uncover. Linking atomic frequency to the scale of a macrophysical long period marker may provide similar conveniences for determining epochs, just as the counting of Julian Days does in the indexing of routine observations.

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OBSERVING MARS V - THE 1973-74 MARTIAN APPARITION

By: C. F. Capen and V. W. Capen, ALPO Mars Section

The 1973-74 Martian apparition is most favorable for observers in the northern and equatorial regions of the Earth. Mars will be accessible for telescopic observation during this summer, autumn, and winter. This is the last favorable apparition for the ocher planet until July, 1986. Mars observing programs have been initiated this year by the Lowell Observatory International Planetary Photographic Patrol, sponsored by NASA, and the Mars Sections of the Association of Lunar and Planetary Observers, Société Astronomique de France, the British Astronomical Association, and the Oriental Astronomical Association.

Apparition Characteristics

The 1973-74 apparition is considered perihelic since opposition occurs only 57 heliocentric degrees after perihelion passage on July 26. See Fig. 1. The telescopic appearance of the disk: its axial tilt, phase, and apparent disk diameter are shown in Fig. 2. Some relevant characteristics given in the graphic ephemerides of Figs. 3 and 4 are:

1973, July 12-Coincidence of subsolar and subearth points, $D_s = D_e = -21.^\circ5$ latitude.
July 26-Perihelion passage (250° L_s); -20° D_e; diameter 12".
August 25-So. summer solstice (270° L_s); -16° D_e; diameter 15".
October 17-Closest approach to Earth; diameter $21.''5$; -17° D_e.
October 25-Opposition about 40×10^6 miles from Earth (307° L_s); -18° D_e.
October 29-Coincidence of subsolar and subearth points, $D_s = D_e = -19^\circ$ latitude.

The telescopic disk diameter at maximum is only $3.''4$ less this year than the maximum $24.''9$ diameter reached during the most favorable apparition in August, 1971. This disk diameter is excellent for the most critical of telescopic observations. See Sky and Telescope, July, 1973, for further general information.

The Martian mean solar day is about 40 minutes longer than that of the Earth. Because the axial rotation is slower than the Earth's, Mars turns through only 350° of areographic longitude in 24 hours. Hence, any particular Martian feature will arrive on the central meridian (CM) about 40 minutes later each night. This daily 10° lag in Martian longitude will add up to a full retrograde rotation of the planet in 36 days, thus allowing all longitudes to be seen from the Earth during this interval.

The areographic longitude that appears on the CM of Mars at any time of observation (Universal Time) can be calculated by merely adding the rotation rate of Mars of $0.^\circ24$ per minute ($14.^\circ6$ per hour) to the 0^h, U.T., daily longitude value given in the Ephemeris for Physical Observations of Mars 1973 tables of The American Ephemeris and Nautical Almanac. Refer to Ref. 1 for CM Rotation Tables.

Useful visual observation can be made when Mars presents a disk diameter of 6" or larger. The dashed curve of the Graphic Ephemeris for 1973, shown in Fig. 3, indicates that this condition exists for about 11 months, from April, 1973, until mid-March, 1974. Mars is favorably placed north of the celestial equator from the first of July to the end of the apparition. A favorable disk diameter greater than 12" makes possible quality observations from late July to late December, a long period of 157 days. Practical photography is possible when the disk diameter exceeds 8", from late May through early February. High resolution observations are possible for a period of 35 days centered on the date of opposition, from September 26 to November 6, when the apparent diameter exceeds 20".

The seasons of Mars are analogous to the terrestrial ones, and are of especial interest to the astronomer because of their effects on observable phenomena. Much seasonal activity is expected in the southern and equatorial regions of Mars from June through November, 1973.

Martian Calendar

Earth Date (TD)	Southern Hemisphere	Martian Date (MD)
April 1, 1973	Spring equinox	Sept. 22 (180° L_s)
June 16	Mid-spring	Nov. 8 (225° L_s)
Aug. 25	Summer solstice	Dec. 22 (270° L_s)
Nov. 9	Mid-summer	Feb. 4 (315° L_s)
Feb. 1, 1974	Autumn equinox	Mar. 21 (00° L_s)

Observational Phenomena

The tilt of the Martian rotational axis (-05° to -24°) favors the observation of the southern hemisphere and equatorial region, as shown in Fig. 4. This condition allows observation of the antarctic meteorology and the spring-summer retreat of the edge of the South Polar Cap. In 1971 the South Cap put on a spectacular display during its rapid spring thaw. An intricate rift system developed, and peripheral projections became bright and detached themselves from the cap edge. One famous birght cap remnant known as the Mountains-of-Mitchel, also called Novus Mons in the Schiaparellian system of nomenclature, became detached from the cap in late June (220° L_s). It was in good view during the first week in July and was last seen around August 8-10 (260° L_s). The Mons was not so spectacular this year as in August, 1971 because the apparent disk diameter was small at this epoch. The polar cap and peripheral birght patches can be seen best with the aid of green (W58), yellow (W15 or 21), or orange (W23) color filters. (W is for Wratten.)

Martian meteorology is the dynamic phenomena of the ocher world. The study of white-cloud aerosols, yellow dust clouds, blue-hazes on the limbs, and surface brightenings has assumed increasing importance in this past decade. The seasonal occurrence of clouds appears to be coupled with the sublimation and condensation of the material of the polar caps. A remarkable formation of "W-clouds" was recognized in 1954 photographs to occur in the Tharsis-Amazonis region by E. C. Slipher of the Lowell Observatory (Ref. 2) and was later recognized in the 1960's as a type of recurring orographic clouds by the authors (Ref. 3). From Mariner IX photography, these clouds are known to form in the vicinity of the large volcanic peaks of Nix Olympica (133°; +18°), Ascraeus Lacus, (104°; +11°), Pavonis Lacus (112°; +01°), and Arsia Silva (120°; -09°). The "W-clouds" are seen best in blue and violet light. Their recorded positions relative to the dark oases named above are important to the study of seasonal winds and related whitenings. The "W-clouds" have not been active during this Martian southern spring-summer period. Perhaps they are a northern hemisphere summer phenomenon?

The past observational record shows that yellow storms usually occur each Martian year around the time of the summer solstice in the southern hemisphere and close to perihelion passage (Ref. 4). A yellow cloud appeared overnight in the Serpentis-Noachis region on September 21-22, 1971, as predicted by the senior author (Ref. 5). The small yellow cloud soon evolved into a global storm that persisted for several months (Ref. 6). Thus, the 1973 preopposition period should be the "dusty season" on Mars. As expected, moderate yellow cloud activity has been observed during June and again in August in the Serpentis-Noachis-Hellas (320°; -28°) region and in the Phaethontis-Argyre I and Martian-Eye regions. The yellow clouds were seen best with the aid of yellow (W15), orange (W23), red (W25), and magenta (W30) color filters.

Martian surface features become ill-defined when observed in blue (W38) light, and are not seen in violet (W47) light. This effect is currently thought to be due to the intrinsic nature of the Martian surface in reflecting the long wavelengths of light (green to red) and absorbing more of the short ones (violet and blue). However, there occur periods of several days when the surface features become visible in violet light. This phenomenon was called "blue-clearing" by its discoverer, E. C. Slipher (Ref. 2). The "blue-clearing" was attributed to a temporary dissipation of a mysterious violet layer in the Martian atmosphere. Recent studies have indicated that it is instead due to a change in the reflective properties between the light and dark regions of the planet. No definite correlation with the seasonal behavior of the polar caps has been noted to date. Whatever the cause, systematic observations in blue (W38A) and violet (W47) light of the occurrence and location of this enigmatic phenomenon are of interest to the astronomer.

Certain discrete light areas exhibit localized whitening which appears to be a seasonal occurrence on Mars. Bright, white patches are more prevalent at a time when a polar cap is rapidly thawing around summer solstice. They are attributed to either a surface deposit of frost or a near-surface dense fog. A few selected areas which may show whitenings in green (W57) and yellow (W15) light this apparition are: Aram (15°; 00°), Ophir (68°; -08°), Sinai (62°; -25°), Thaumasia (75°; -30°), Tharsis (100°; +02°), Nix Lux (112°; -08°), Nix Olympica (133°; +18°), Memnonia (160°; -20°), Zephyria (190°; -12°), Elysium (215°; +30°), Isidis Regio (280°; +20°), Neith Regio (275°; +35°); Nymphaeum (305°; +08°), Hammonis Cornu (315°; -10°), and along Deucalionis Regio (345°; -12°). White patches which form south of the equator around opposition should show especially well because the subsolar and subearth points then coincide (Fig. 4). It is important to learn which whitenings occur more often in the morning or afternoon or persist all day.

Once free of the retreating polar cap, early in this apparition, the entire Hellas

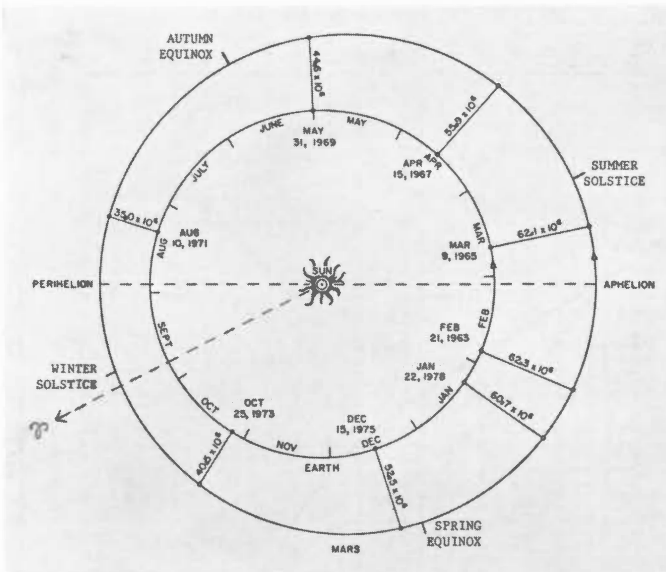

Figure 1. Heliocentric chart of the orbits of the Earth and Mars, showing oppositions of Mars from 1963 to 1978. The distance between the two planets in miles at each opposition is marked. The orbit of Mars is also marked to indicate the beginning of each season in the northern hemisphere and the perihelion and aphelion longitudes.

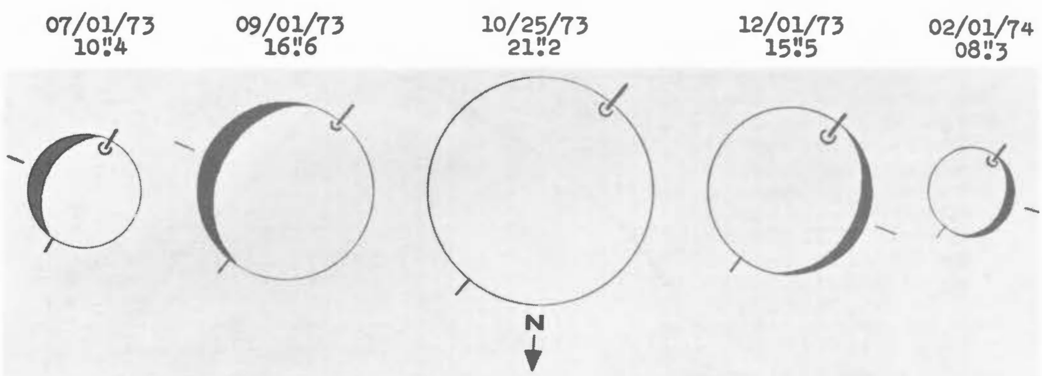

Figure 2. The 1973-74 apparition aspects of the Martian telescopic disk showing the relative disk diameters, terminator (phase), and position of the rotational axis of Mars.

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basin appeared a dark ocher hue. White clouds frequented the vicinity of the Hellas in July and August. When the yellow cloud evolved in this region, the Hellas took on a commanding bright yellow hue. The other high-latitude light areas of Ausonia, Electris, Argyre, etc., were affected at times during southern spring by patches of white and polar hazes.

Yellow cloud activity is now thought to be responsible for certain changes exhibited by the Martian surface albedo features. Astronomers are anxiously awaiting the 1973 collection of high-resolution photographs and fine detailed visual drawings to learn of the changes brought about by the Great Yellow Storm of 1971. Changes have been noted in the Serpentis, Hellespontus, Noachis, and Solis Lacus regions after past yellow cloud activity.

Secular changes have been observed within the Aethiopis-Libya and Tempe desert regions for the last decade. The Nodus Laocoöntis (246°; +15°) has changed shape and apparent location as a result of the fading of its west boundary; the Moeris Lacus (278°; +08°)

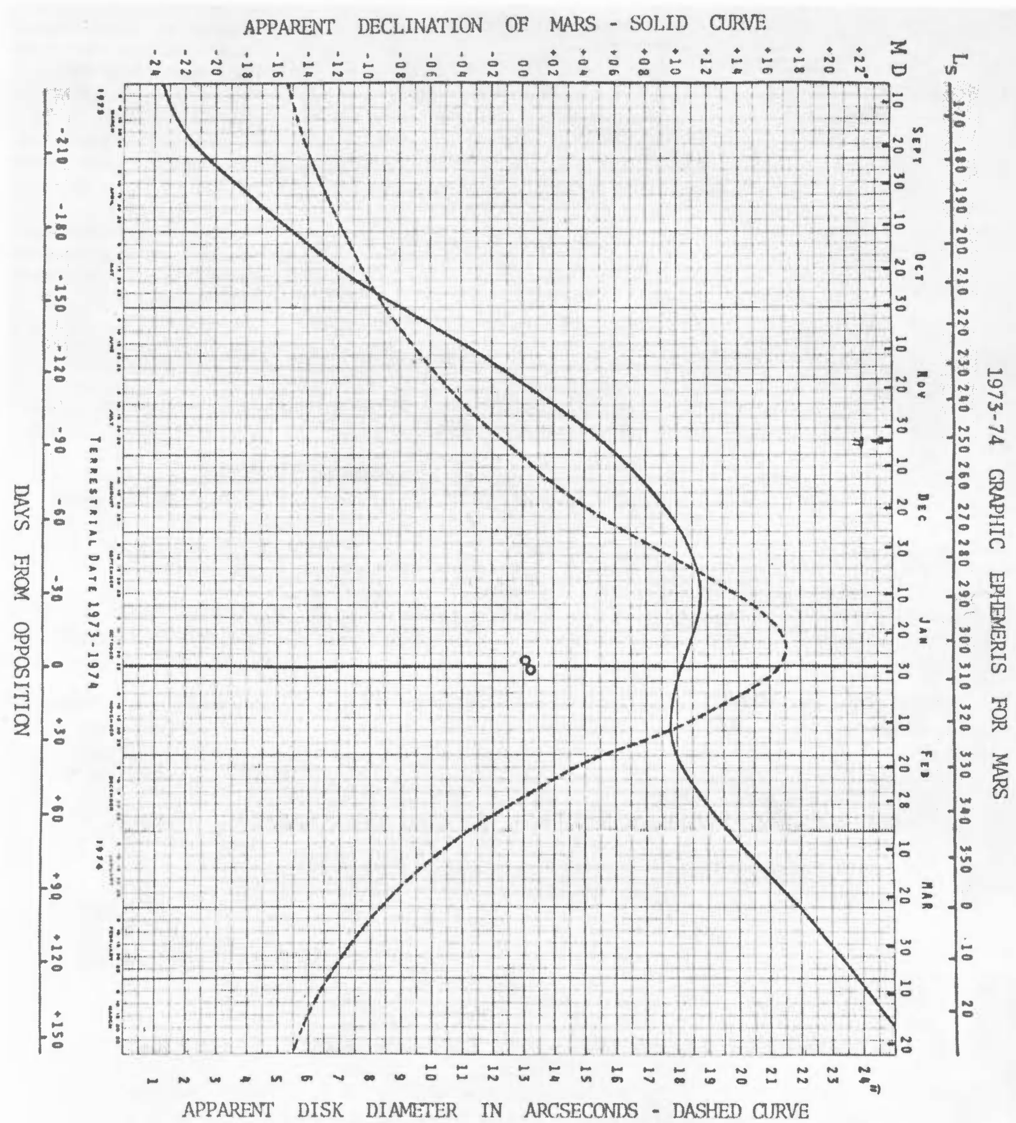

Figure 3. An ephemeris for the 1973-74 Martian apparition is presented in graphic form. The Martian date (MD) and planetocentric longitude of the Sun (L_s) are shown at the right. The terrestrial date and days from opposition are at the left. The apparent declination (solid line) and the apparent diameter (dashed line) of the disk of Mars are shown for each date. Graph by V. W. Capen. See also text.

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and Nepenthes-Thoth (268°; +09°) have been fading since 1969. The new Tempes streak (63°; +47°), first photographed in 1963 (Ref. 3), was a most prominent feature from 1965 to 1969. It lost some of its former contrast during the last apparition. Consequently, the 1973 appearances of these features are of great interest to the student of Mars. Surface features are seen best through orange (W-23), red (W-25), and magenta (W-30) filters.

The familiar seasonal changes in contrasts, sizes, and colors of the dark and light albedo features can be observed in the southern hemisphere and equatorial regions this year. Antoniadi reported that the Syrtis Major underwent a definite seasonal change in

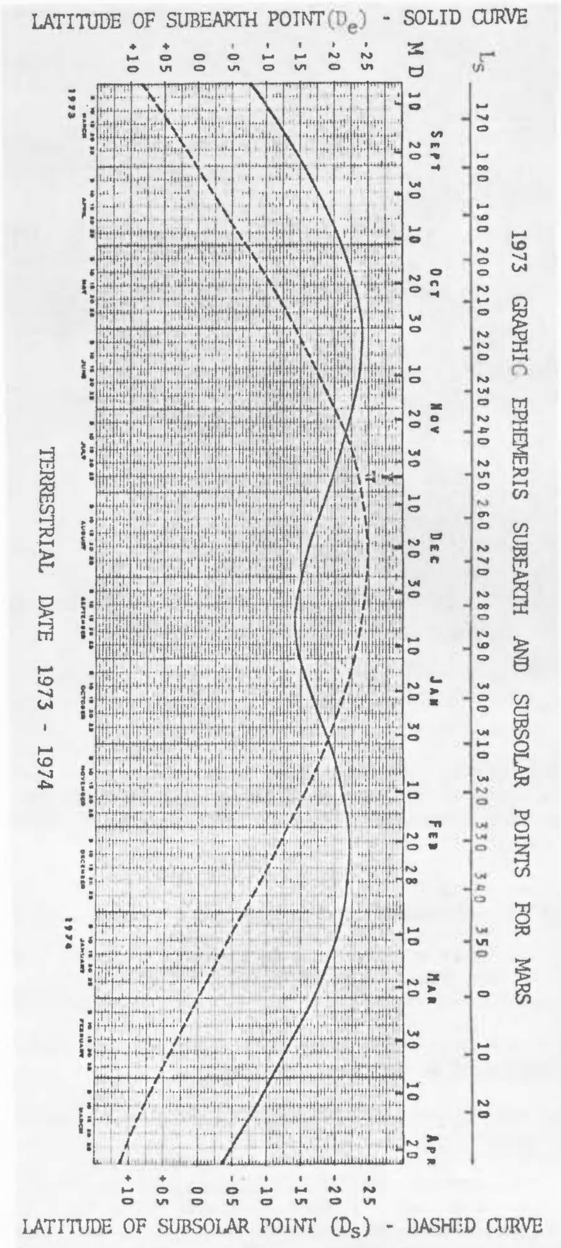

Figure 4. A graphic ephemeris to show the Martian latitudes of the subearth (solid line) and subsolar (broken line) points during the 1973-74 apparition of Mars. See text. Graph by V. W. Capen.

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its size and internal contrasts (Ref. 7). His observations showed the east boundary to vary with the Martian seasons. The Syrtis became narrow dur- northern autumn and broad in spring. Will the narrow aspect be seen this year?

The evaluation of Martian disk colors through a telescope is undoubtedly affected by the psychophysical nature of complementary colors. The important fact is not the knowledge of the intrinsic colors of a region, but that the color contrasts do vary seasonally. Color filters are an essential aid for the study of the colors of markings, fine surface details, and detection of bright atmospheric clouds and hazes. Tricolor filter comparison (checking red vs. blue; red vs. green) of Martian features is a technique used to identify basic colors and to determine color trends. Refer to Fig. 5 and References 3, 8, and 9 for application of color filters. The normally dark, purple-gray Syrtis sometimes changes suddenly to a light blue hue. Nineteenth century visual observers have reported the Ipygia (300°; -22°) to be a yellow-green color during southern spring. Modern observations with color filters indicate that the seasonal color changes in the Syrtis region are probably due to the presence of blue-white clouds and those in the Ipygia may possibly be due to yellow dust clouds.

In 1916 Antoniadi published "The Phenomena of the Martian Year," a time-and-events Martian calendar based on 56 years of observations from 1856 to 1912 (Ref. 10). He demonstrated that many seasonal events do indeed recur. We have prepared a similar updated Martian phenomena calendar for southern spring-summer based on Antoniadi's cognizance and the authors' current observations from 1954 to 1971 to be used as a general guide to possible recurring events in 1973-74. The first column gives the terrestrial date (TD), the second column the planetocentric orbital longitude of the Sun (L_s), and the third column briefly describes the phenomena. Refer to the South Polar Cap key-name chart of Fig. 6.

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Note by Editor. Mars Recorder Capen will be very glad to hear from those who wish to make purposeful studies of the Red Planet at its current favorable approach. He can supply a Mars Observing Kit which will assist anyone's observations, and several issues of a helpful Martian Chronicle 1973 have already been published.

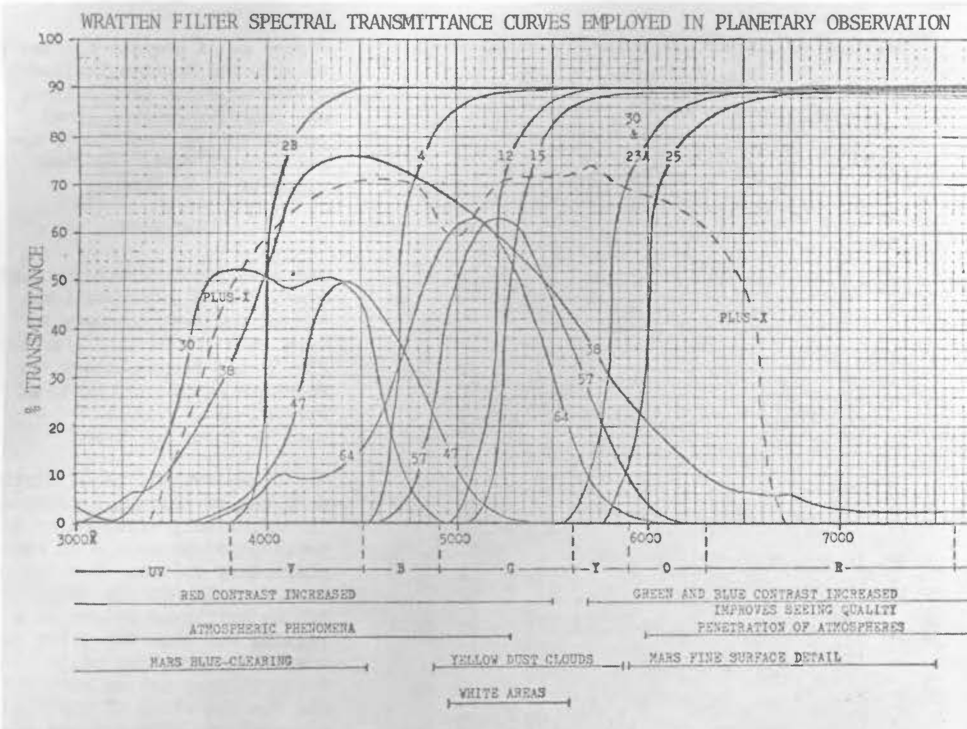

Figure 5. Color filter transmittance curves. The area under each filter curve defines the spectral transmission of that filter. At the bottom of the graph are shown the effective observational possibilities along the visual spectrum. Graph by C. F. Capen.

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TD	L_s	Phenomena
1/4/73	180°	So. spring equinox. So. pole emerges from darkness of winter. South Polar Cap maximum diameter, subtending $\geq$ 65°. Disk diameter 6". North Polar Hood present.
19/4/73	190°	SPC should be free of its hood. Possible W-clouds in Tharsis-Amazonis. Wide Syrtis Major shrinks on E. border. NPH bright.
06/5/73	200°	SPC shrinking. NPC lost to view. Syrtis Major continues to shrink. W-clouds possible.
23/5/73	210°	SPC develops dark Magna Depressio at 270° longitude; -80° latitude. Syrtis narrows rapidly. W-clouds? At 215° L_s a dark rift, Rima Australis, appears connected with Magna Depressio from 20° to 240° longitude; and SPC develops bright projection at 10°-20° longitude in Argenteus Mons. Yellow cloud in Serpentis-Hellespontus?
8/6/73	220°	Bright SPC projection Novissima Thyle 300°-330° longitude. Dark rift Rima Angusta appears from 60° to 270° longitude. W-clouds possible. Yellow cloud in Noachis-Hellas?
24/6/73	230°	Rapid regression of SPC. Bright elongated Novissima Thyle detaches from SPC and becomes the isolated Novus Mons (Mts.-of-Mitchel). Rima Australis broadens, and Magna Depressio becomes dusky feature. Syrtis Major retreats on E. border. North Polar Hood prominent.
10/7/73	240°	SPC rapid regression. Novus Mons small, bright, and high-contrast. Rima Australis widens. SPC isolated bright spot at 155° longitude?

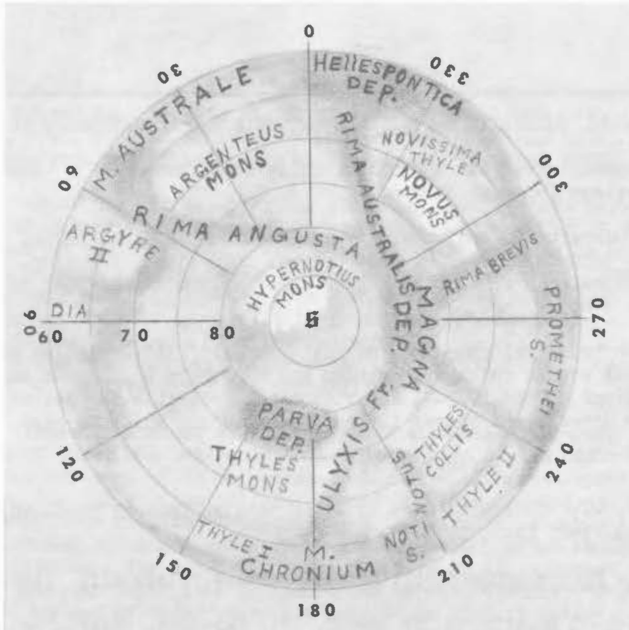

Figure 6. An orthographic south polar projection reference map of Martian feature locations and key-names. By C. Capen. See also text.

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TD	L_s	Phenomena
		Any white patches near -20° latitude may brighten, $D_e = D_s$. Atmosphere of Mars very clear, L_s 240° - 250°. Occasional morning limb hazes, L_s 240° - 270°.
26/7/73	250°	Mars at perihelion. SPC in rapid retreat, ≈26° in diameter. Novus Mons smaller. Yellow cloud expected over Serpentis-Hellespontus (L_s 250° - 275°). Syrtis Major narrow. W-clouds possible.
10/8/73	260°	Novus Mons is now reduced to a few bright patches, and disappears. W-clouds possible. Limb hazes. Bright spots on light areas. SPC 16° diameter. Yellow cloud possible in Serpentis-Noachis. Hellas bright spot?
25/8/73	270°	Summer solstice in south hemisphere, winter solstice in N. SPC 14° diameter. Yellow dust cloud may diminish, or may develop into a S. hemispheric storm? Hellas bright spot. Syrtis Major very narrow? Numerous white spots in southern hemisphere light features.
10/9/73	280°	SPC 12° diameter. Evening terminator projections expected in vicinity of Syrtis, Hellas, and Amazonis areas. North Polar Cap invisible. North Polar Hood may reach +45° to +40° latitude. Fine detail for mapping seasonal-secular changes.
28/9/73	290°	SPC 10° diameter. Terminator projections possible? Check for whitenings. Surface feature contrasts intense unless affected by yellow haze.
14/10/73	300°	SPC becomes difficult-to-see feature. Syrtis Major narrow phase? Period of maximum disk diameter of 21".5, and opposition 1973. Fine detail for mapping seasonal-secular changes.
30/10/73	310°	SPC 09° diameter and difficult object. White patches near -20° latitude may brighten, $D_e = D_s$. Yellow cloud over Libya? Delicate surface features should be interesting.
17/11/73	320°	SPC 07° diameter, difficult object.
05/12/73	330°	SPC static remnant. Syrtis Major wider? Clouds in vicinity of Libya-Syrtis?

TD	L_S	Phenomena
23/12/73	340°	SPC difficult. Antarctic hazes. NPH variable and occasionally bright.
12/01/74	350°	Antarctic hazes increase. NPC occasionally seen through NPH. Some north hemisphere features darken.
1/2/74	00°	Autumnal equinox of S. hemisphere; vernal equinox, N. hemisphere. S. pole passes into darkness. N. pole emerges into light of spring. Antarctic hazes. In NPH Arctic hazes? NPC maximum diameter of 50°. Disk diameter 8".5.

Such a tabulation of the principal phenomena during this half of the Martian year alerts the observer to seasonal events which are certain and to others which need verification. The favorable conditions of the 1973-74 apparition make possible the search for, and discovery of, many unique details and chages in the dynamic world which is Mars.

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THE DISTRIBUTION OF DARK MATERIAL IN SOUTH EQUATORIAL BELT DISTURBANCES ON JUPITER

By: Wynn K. Wacker, A.L.P.O. Jupiter Section

The purpose of this paper is to discuss some data which indicate that the current notions about the distribution of dark material in Jupiter's South Equatorial Belt during a SEB Disturbance are incorrect, and to propose an alternative scheme which, it is hoped, will fit more closely with the observations.

It is impossible in a paper of this size to present in adequate depth a description of these South Equatorial Belt Disturbances. For this, the reader is referred to the writings of Peek[1] and of Reese[2]. A brief general description, together with observations of the most recent (1971) SEB Disturbance, can be found in Sky and Telescope, Vol. 42, No. 3, pp. 176-180. In brief, an SEB Disturbance usually occurs after the SEB_s has faded to virtual invisibility. As described by Reese, dark material appears to erupt from near the center of the SEB Z and is spread to the two SEB belt components by the prevailing winds. Reaching the components, the dark material is spread until it encircles the planet, drifting in a preceding direction along the SEB_n and in a following direction along the SEB_s. Material continues to erupt from the source, which remains fixed in System II longitude, until the entire belt is dark and active. After several months, the activity dies down; and the belt gradually fades back to its pre-Disturbance appearance. There have been eleven observed SEB Disturbances: in 1919, 1928, two in 1943, 1949, 1952, 1955, 1962, 1964, and two in 1971. Two others, in 1937 and 1946, were not actually observed, but are inferred from changes in the condition of the belt[3].

One of the things which the aforementioned writers have failed to include in their general descriptions of an SEB Disturbance is the color of the material ejected. Most of the Jovian belts exhibit a strong red or red-orange color when undergoing high activity, and I hope to discuss this phenomenon in a later paper. The SEB is no exception to this rule. The material ejected from a Disturbance may at first appear simply black or dark, due to concentration, much as it is difficult to tell the color of food coloring before it has been diluted. That the red color of the SEB following a Disturbance is actually due to the dark material distributed by the Disturbance was very clearly demonstrated for the 1952 Disturbance by the observations of Reese[4].

There is a class of objects which also exhibit strong reddish coloration, consideration of which has relevance to the discussion of the distribution of material during an SEB Disturbance. I am referring to the dark elongated spots or streaks found in and around the NEB_n, often called "barges" despite the objection of Ainslie to this term[1]. These objects drew the attention of E. E. Barnard as early as 1890[5]. When they first appear, these spots are quite round and very dark, often being mistaken for satellite shadows. After a few days, the spots elongate in an east-west direction and become somewhat less dark, at which time the red color becomes visible. Often seen associated with the preceding end of these spots are long wisps of dark material which cross the NEB in a south preceding slant and merge with the NEB_s. Barnard called these "horse-tails" and says: "Some of them [the spots] were intimately associated with a number of very singular reddish spurs or 'horse-tails', . . . The black spots were on these horse-tails, and seemed to retain their first positions on them with remarkable constancy--the spot and horse-tail having apparently the same rotation period. . ."[6]. The obvious conclusion to draw from these observations is that material is erupting to form a spot, subsequently being dispersed by one set of winds to form the streak, and by a second set of winds to cross the NEB into the equatorial acceleration (System I) region to form the horse-tail.

To see the importance which these NEB_n spots have with regard to the SEB Disturbances, it is necessary to refer to a little known phenomenon, namely, North Equatorial Belt Disturbances. The modern observer, familiar with the NEB's greater prominence and activity in comparison to the SEB, might be surprised to learn that from the time the B.A.A. Jupiter Section Memoirs start in 1892-93 to the 1907-08 apparition the SEB was the most prominent belt nearly all of the time[1]. At times during this period and up to 1912, the NEB would become very thin and faint, later returning to a more normal appearance. The descriptions indicate that the mechanism of revival was very similar to that of an SEB Disturbance. I hope to review this literature in a future paper. There were three observed NEB Disturbances, in 1893[7,8], 1906[1,9], and 1912[1,10]. The 1912 Disturbance occurred, unfortunately, near the end of the apparition so that little is known about it. In the other two NEB Disturbances, revival appeared to involve the outbreak of small very dark spots in the latitude of the NEB_n with transport of dark material from these spots across the NEB to form spots on the NEB_s and eventually to shade the entire belt. A sketch by Denning[9] of the outbreak of the 1906 Disturbance shows a dark, somewhat elongated spot with dark material issuing from the preceding end at a south preceding slant to form a dark section of NEB_s. The resemblance to a barge and horse-tail is striking. It suggests that the barge and horse-tail is the same sort of object as the Disturbance feature, inferring a similar role in the distribution of material to the belt. Indeed, there is other evidence to suggest that the distribution of dark material in the "normal" belt is the same as that which occurs during a Disturbance, the lack of contrast against a dusky background being the main factor which distinguishes the former from the latter.

Returning to the SEB, a close examination of sketches of past SEB Disturbances, particularly series strip sketches, reveals that the Disturbance spots appear very similar to the spots in the NEB. SEB_s spots appear round and very dark close to the source of the Disturbance, while farther away they are elongated in an east-west direction and not so dark. Dark material streams from the p. end of these spots across the SEB Z in a north preceding slant and connects with spots and dark sections of the SEB_n. Thus, the NEB and SEB Disturbances are mirror images of each other, with the equator being the axis of symmetry. This symmetry leads me to suggest that the source of the dark material in an SEB Disturbance lies in or near the SEB_s, not in the SEB Z as Reese has suggested. Examination of discovery sketches of SEB Disturbances shows that the first outbreak is often a dark spot near the latitude of the SEB_s or, if sufficient time has elapsed for transport of dark material to occur, a dark SEB_s spot with a "tail" extending across the

SEB Z. These dark spots are often associated with brilliant white ones, as are the barges on the NEB_n[1].

Having questioned the location of the source of the dark material, we might also question whether that source remains essentially stationary in System II longitude. Examination of a number of series strip sketches of past Disturbances convinces me that it does not. This finding has ramifications for the Uniformly Rotating Source Hypothesis. Advanced by Reese[1], the theory proposes that the source of the dark material lies in a lower Jovian layer which undergoes a constant rotation. An attempt by Chapman and Reese[3] to determine the location and rotation period of the sources under this assumption led to a number of possibilities, with the two most promising arrangements being three sources with a rotation period of $9^h\ 55^m\ 42^s.55$ and two sources with a rotation period of $9^h\ 54^m\ 52^s.55$. Despite the fact that it required a greater number of sources, the longer period was favored over the shorter one because it was believed that the material erupted from a point with an essentially constant System II longitude. I have attempted to make a rough estimate of the rotation period of the source during an SEB Disturbance by measuring published series strip sketches to determine the change in the longitude at which new SEB_s spots appear. Sketches were available for 1928, 1943, and 1958. The sketch for 1928 was unusable because the S. Tropical Disturbance greatly distorted the features in its longitude. The one for 1943 was somewhat confused because of the occurrence of two sources, but an estimate was made anyway. The two estimates were in the range of $9^h\ 54^m\ 40^s$ to 50^s. This is quite a crude estimate; a much better one could be made by going to the original transit data, but it is interesting in that it favors the shorter period, the opposite of the previous conclusions.

This paper has suggested that, contrary to previous theories, the source of dark material in SEB Disturbances lies in or around the latitude of the SEB_s, and that the source exhibits a considerable negative drift in System II. There is evidence that the mechanism of distribution of dark material in a normal equatorial belt is the same as that in a disturbed one. Clearly, re-examination of old observations and theories is required in the light of this new evidence. New observations will be needed to confirm or refute these hypotheses. Fortunately, it appears that detailed observations of NEB_n spots may reveal mechanisms useful in understanding the much rarer SEB Disturbances.

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Postscript by Editor. Mr. Elmer J. Reese kindly examined Mr. Wacker's manuscript and strongly recommended its publication. He thinks that the critical point may well be the motion in longitude (II) of an SEB Disturbance source while the Disturbance is developing. In Mr. Reese's opinion the evidence is strong that such a source is nearly stationary in System II. He, Mr. Wacker, and the Editor will certainly be glad for further observational evidence and further study of existing data on this matter.

THE 1971-72 APPARITION OF SATURN

By: Julius L. Benton, Jr., ALPO Saturn Recorder

The report which follows covers the observing period from September 2, 1971 to April 30, 1972. The value of B, which is the Saturnicentric latitude of the Earth referred to the ring plane, varied between -24°.39 and -25°.29. As can be easily deduced from this information, an even greater portion of the southern hemisphere of Saturn was visible to observers during the apparition than in preceding years. Opposition occurred on November 25, 1971, at which time Saturn was at apparent visual magnitude of -0.2. The major axis of the ring system was then 46".41, while the minor axis of the rings was 19".43 on opposition date. In addition, on the same date the equatorial diameter of the planet was 20".6, and the polar diameter was 18".4.

The following individuals contributed observational data to the Section during 1971-1972:

Observer	Location	No. of Dates of Observation	Telescope
Benton, Julius L.	Savannah, Georgia	10	4" and 6" Refrs.
Budine, Phillip W.	Walton, New York	12	4" Refr.
Capen, Charles F.	Flagstaff, Arizona	2	24" Refl.
Colligan, Tom	Pt. Washington, New York	5	8" Refl.
Delano, Fr. Kenneth J.	Fall River, Massachusetts	23	$12\frac{1}{2}$" Refl.
Doel, Ron	Willingboro, New Jersey	11	8" Refl.
Haas, Walter H.	Las Cruces, New Mexico	6	6" and $12\frac{1}{2}$" Refls.
Heath, Alan W.	Nottingham, England	20	12" Refl.
Hockstein, Stephen M.	Bronx, New York	4	6" Refl.
Keel, Billy	Nashville, Tennessee	2	2.4" Refr.
Manning, George G.	Bronx, New York	3	3.5" Refl.
Marquette, Mark D.	Buffalo, New York	16	6" Refl.
Patton, Chet	Buchanan, Michigan	5	5" Refr.
Reinert, Paul	Norristown, Pennsylvania	7	$4\frac{1}{4}$" Refl.

A total of 126 reports was received from the 14 indivuduals listed above, and the following distribution of submitted observations by months will serve to demonstrate those periods of concentrated coverage:

1971, September: 4	1972, January: 26
October: 17	February: 9
November: 26	March: 16
December: 13	April: 15

The bulk of the observational data was secured during the months of November and January, as can be seen above. Saturn emerged from the glare of the Sun (conjunction) during mid-June, 1971, but virtually no observations were reported until September. This indicates the same severe neglect of the earliest parts of an apparition which has been quite common in the past, and the writer would like strongly to urge individuals to begin their observing programs much sooner. Reference to The American Ephemeris and Nautical Almanac will aid enthusiasts in planning their programs prior to each apparition of Saturn. The planet entered once again into the solar glare during May, 1972, conjunction occurring on the 31st of that month.

The writer would like to express his sincere thanks to all individuals who actively participated in the observing programs of the Saturn Section during the 1971-72 apparition of the planet. Thanks are in order as well as to the Saturn Section of the British Astronomical Association for their coöperation in attempting to confirm suspected activity on Saturn. In the future, it would be most beneficial for such efforts of international coöperation to continue.

The Globe

Southern Portions of the Globe. In general, there appears to have been a slight increase in activity in the southern hemisphere of Saturn during 1971-72 compared to preceding apparitions, perhaps in part because greater portions of the south hemisphere were accessible to amateur telescopes as the rings opened up nearly to their fullest extent. It may be interesting here to make a preliminary comparison of various intensity estimates of Saturnian features in recent years:

ZONES:	1967 - 1969	1969 - 1970	1970 - 1971	1971 - 1972
EZ	7.8	6.9	6.4	7.1
STeZ	4.8	4.4	4.1	6.3
STrZ	---	---	---	6.6
SEB Z	4.5	4.9	4.7	4.5
SPR	4.0	3.8	4.0	4.2
BELTS:				
SPC	5.2	6.0	5.3	6.3
EB	4.0	3.9	3.8	4.0
STeB	4.0	---	4.1	3.9
SEB_s	3.0	3.2	3.5	3.5
SEB_n	2.5	2.9	2.9	3.4
SPB	3.8	3.4	3.3	3.2

Constant: Outer third of Ring B taken at 8.0 on the ALPO Numerical Intesity Scale from 0.0 (black - shadows) to 10.0 (brightest).

Upon close examination of the above data, it becomes readily apparent that the EZ has declined somewhat in brightness as the rings have opened up, at least until the present 1971-72 apparition. A similar situation is observed for the STeZ. In addition, the SEB Z has tended to show some decline in overall brightness since 1969. With regard to the belts, very little has been noted in relation to variations in intensity over the past few years, with the possible exception of the SEB_n during 1971-72. One must be extremely careful, however, not to make the mistake of assuming too much from the limited data sampling which has accumulated over recent years. An increase in observer participation during the current apparition may have greatly decreased the overall incidence of error likely to be present, substantially affecting the periods which were so poorly observed since about 1967. A much more valid and rigorous comparison of the contributed observational data will be possible only when observers begin to respond effectively, in greater numbers, to the newer techniques of observing Saturn. When such material has been accumulated and adequately reduced and analyzed, one can expect more reliable conclusions. During 1971-72, a much more thorough coverage of the planet Saturn has been attempted; and it is the aim of this Recorder to keep such a response alive in coming years.

South Polar Region (SPR). During the month of February Capen noted that the SPR was very large and dark with a distinct greyish-green color (Figures 7 and 8). He also observed the SPC (South Polar Cap) and reported this feature to be much weaker and lighter than the surrounding area, having a neutral grey coloration. Doel reported that in March the SPR was rather dusky and lacking in uniformity, but he did not indicate having detected specific regions of differentiation. Observations by Haas were in general agreement with those just discussed. Haas was able to see the elusive SPB (South Polar Band) on most occasions throughout the 1971-72 period, reporting it as a diffuse, greyish to bluish-grey band encircling the dusky background of the SPR. The same observer did not mention having obtained views of the SPC at any time during the apparition. Keel noted that the SPR was greyish in color during early November and quite prominent; but he indicated that the SPR faded considerably later in the month, the general region displaying a faint yellow hue. Marquette recorded both the SPR and the SPC early in the apparition, both regions exhibiting a marked intensity gradient with the SPC showing up much lighter than its immediate surroundings. By February and March, the two regions were difficult to distinguish from one another, according to Marquette. Heath was the only observer to report that the SPC was darker than the SPR. In general, Heath observed that the color of the SPR was grey with the darker SPC visible on occasions and especially prominent in November; this result is somewhat in agreement with results obtained by Keel (although Keel reported a bright SPC in contrast to the dark one noted by Heath). Observations by Budine, Reinert, Benton, and Patton were in close accordance with results described above.

South South Temperate Zone (SSTeZ). Budine reported this region throughout the apparition as being somewhat darker than the STeZ. Benton was able to detect this area only during April, describing its color as a faint greyish-yellow tone.

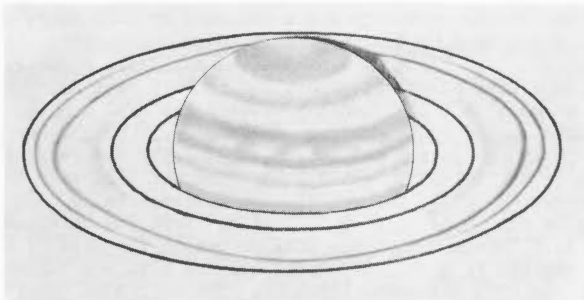

Figure 7. Drawing of Saturn by Charles F. Capen on February 18, 1972, 1^h20^m - 1^h50^m, U.T. Lowell Observatory 24-inch Clark refractor, 830X. Seeing 4-6 (scale of 0 to 10, with 10 best). Transparency 5+ (limiting magnitude). Green and orange light (Wratten Filters 12, 21, 57, and 36). Compare to Fig. 8 at the same time.

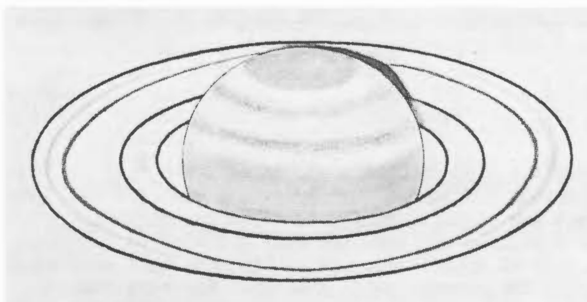

Figure 8. Drawing of Saturn by Charles F. Capen on February 18, 1972, 1^h20^m - 1^h50^m, U.T. Lowell Observatory 24-inch Clark refractor, 830X. Seeing 4-6, transparency 5+. Violet light (Wratten Filters 38, 47, and 30). Compare to Figure 7. Note duskiness of Equatorial Zone.

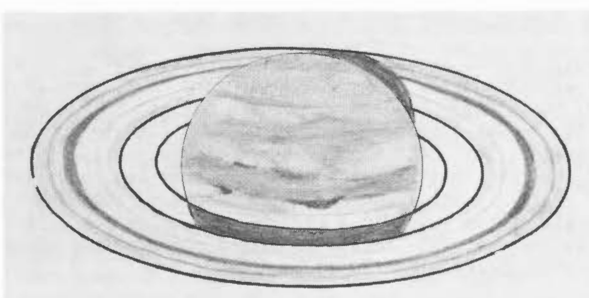

Figure 9. Drawing of Saturn by Ron Doel on March 21, 1972, 0^h21^m - 0^h50^m, U.T. 8-inch reflector, 160X. Seeing 6-7. Transparency 4.5. No filter.

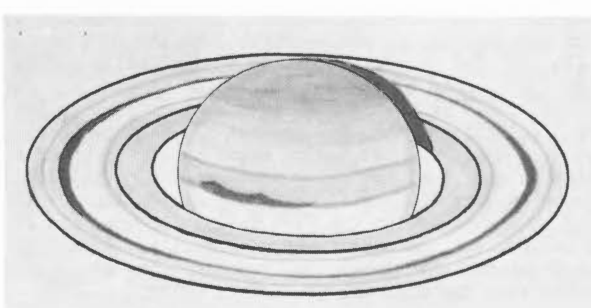

Figure 10. Drawing of Saturn by Phillip W. Budine on January 6, 1972, 2^h30^m - 2^h50^m, U.T. 4-inch Unitron refractor, 214X. Seeing 8. Transparency 5. No filter.

South Temperate Zone (STeZ). During the early parts of the apparition Budine noted that the STeZ was very bright, particularly in December, almost equal to the EZ in intensity. By January Budine observed that the STeZ had faded in intensity, continuing thus until late March, when the region again appeared to brighten. By the 6th of April the brightness of the STeZ had surpassed that of the EZ, but by the 11th of the same month the STeZ had faded nearly two steps on the intensity scale utilized by ALPO observers. Examination of the intensity estimates made by Budine appears to indicate only a minimum degree of systematic error on his behalf. For a more exhaustive analysis, however, observations would have to have been made more closely together and to have been attempted by more than one observer. Making a comparison of intensity between the STeZ and the STrZ, Budine noted that these two regions showed quite a bit of difference in brightness during the majority of the apparition. Only in January and late March did the two regions come within 0.5 "steps" of each other on the intensity scale. The STeZ and STrZ were most nearly equal in intensity on January 22, 1972, the numerical difference being only 0.3, and on March 30, with the intensity differing only by 0.2 units. From the observations made by Budine, one should note with interest that the STrZ surpassed the STeZ in brightness from early January through the 4th of April. On April 6th the STrZ was fainter than the STeZ. By the 11th of April, the STrZ was again brighter. The following tabulation will serve to summarize these results by Budine during 1971-72:

	1971		1972								
Zone:	Nov 5	Dec 31	Jan 6	Jan 20	Jan 22	Mar 1	Mar 10	Mar 30	Apr 4	Apr 6	Apr 11
STeZ	7.0	7.2	6.0	5.8	6.5	6.0	5.6	6.8	6.8	7.3	5.5
STrZ	5.5	6.0	6.5	6.5	6.8	7.0	7.2	7.0	7.2	6.8	7.2
EZ	7.5	7.5	7.2	7.0	7.5	7.5	7.3	7.0	6.9	7.2	7.5

Outer third of Ring B = 8.0 (constant).

Using a similar comparison between the STrZ and the STeZ, Heath noted that the STeZ was usually equal to the STrZ in intensity throughout the apparition and of a dull grey color. Heath, therefore, did not indicate any significant fluctuations in brightness between the two regions as Budine did. Patton pointed out that the STeZ and STrZ corresponded very closely in intensity during the 1971-72 apparition, but he did note that occasionally the STeZ was much harder to detect amid the general polar shading. The same observer recorded a white color for the STeZ. Doel was once able to observe a bright whitish area in the STeZ near the following limb of Saturn. Confirmation is lacking, however, for this last observation.

South South Temperate Belt (SSTeB). Doel was the only individual to report this feature during 1971-72, describing it as a rather dark and greyish band in March.

South Temperate Belt (STeB). Budine detected the often elusive STeB on several occasions during the apparition, recording it as being quite thin and dark, usually with a neutral grey color (Figure 10). Small, dark condensations were noticed in the general region by the same observer, but the features were apparently not distinct enough to facilitate transit timings. Benton observed this belt only on two evenings, noting it as a dull and neutral greyish band. Doel reported that the STeB was dusky grey and conspicuous, with a number of faint condensations visible during January. Haas suspected the STeB only once, and Heath did not report it at all. Capen recorded a magenta-grey color for this feature, using the 24" refractor at Lowell Observatory. Patton submitted observations of the STeB, which are essentially in agreement with those discussed here.

South Tropical Zone (STrZ). Budine observed the STrZ throughout the 1971-72 period and noted some interesting changes in its intensity as compared to that of the STeZ and the EZ. Most of the results obtained in this analysis were most adequately discussed above in the section dealing with the STeZ. Usually, however, the STrZ remained brighter than the STeZ for the majority of the apparition; and on March 30th the STrZ was equal to the EZ in intensity. On April 4th the STrZ was 0.3 steps (on the intensity scale) brighter than the EZ, and it is interesting to note that after the 1st of January the two features were never more than a factor of 0.5 units apart in intensity. Clearly, the STeZ underwent the greatest intensity fluctuations; the STrZ and the EZ, as noted earlier, only underwent a minimum of variation. On December 31st Budine noted the presence of a white oval in the STrZ, having an estimated numerical intensity value of 7.8 on the ALPO scale. The white oval was again visible on January 20th (intensity 7.2) and on January 22nd (intensity 7.3). Doel also observed some activity in the STrZ during January, and from his description it is apparent that he observed the same feature as Budine. According to Heath, the STeZ and STrZ were of about the same intensity throughout the apparition, as discussed earlier. Patton reported that the STrZ was greyish in color.

South Equatorial Belt (SEB). Heath observed that the SEB was frequently double during the apparition, the northern component (SEB_n) usually the darker of the two. The color of the two compoenents was noted by Heath to be generally brownish, contrasting well with the greyish tone of the SPR. The same observer noted several minor irregularities from time to time in the SEB, and from late November to early January the belt was quite faint and of low contrast. Heath did not report the existence of any distinct SEB Z in

1971-72. Haas observed that the SEB was separated into its two components, his results indicating the very slightly darker tone of the SEB_n. Throughout the apparition, Haas noted that the SEB was a brownish-grey color. On October 9th, Haas observed a few small dark hump-projections along the northern edge of the SEB_n, but he indicated that they scarcely looked individualized enough for CM transits. (Note also Figure 9.) The SEB Z was detected by this observer as a fairly distinct feature on September 4th and on November 25th. Capen reported a weak reddish to pink hue for the SEB on February 18th, and he recorded some vertical festoon structures crossing the SEB Z in orange and green light (also on February 18th). Quite contrary to the results described above, Budine noted that the SEB_s was darker than the SEB_n during most of 1971-72. Only on two dates did he report the SEB_n significantly darker than the SEB_s (March 1st and March 10th). On March 10th, Budine observed several dark elongations and condensations in the SEB, not distinct enough to facilitate CM transits. Condensations were noticed in the SEB_n on March 30th and April 11th as well, but again they were not distinct enough for transits. Budine reported the SEB Z throughout the apparition, quite separate from the belt components. Doel observed the SEB_n and SEB_s as quite obvious features, separated by a somewhat distinct SEB Z throughout the 1971-72 period. He noticed several dark irregularities in the SEB_s and SEB_n in January. Delano reported a reddish-brown color for the components of the SEB in November, while Patton recorded a grey color for the area consistently during the period. In general, the SEB did not appear so conspicuous in 1971-72 as in recently past apparitions; and most observers continued to report, as noted earlier, that the SEB_n was consistently darker that the SEB_s, and this difference continued to remain in agreement with what has been reported in 1970-71 and earlier periods.

Readers may wish to examine the aspect of the SEB latitudes on Figures 7-10 and the front cover drawing.

Equatorial Zone (EZ). Heath reported that this region was generally dull, having an off-white or yellowish color, although it was still the brightest part of the globe on most occasions. The same observer noted several vague whitish ovals of low contrast in the EZ, giving it a mottled appearance. On a few nights of good seeing, Heath was able to detect the often difficult EB (see front cover). Haas recorded a yellowish-white color for the EZ, and as the apparition progressed the EZ became dull. Although quite difficult, the EB was sighted by Haas on several dates of better-than-average seeing. Capen observed that the EZ displayed a rather distinct light yellow color, and he noted that this feature was a broad and diffuse dark band in blue and violet light (see Figure 8). The EB was visible with considerable ease, according to Capen (Figure 7), but it must be remembered that he was observing with the 24" refractor at Lowell Observatory. Budine indicated that the EZ was usually the brightest feature on the planet; but on some occasions the STrZ and STeZ were equal to or brighter than this feature, as discussed in earlier sections of this report. Budine noted the presence of faint white ovals in the EZ, confirming some similar reports by other observers mentioned above. It is likely that these were the same features, but transit data are lacking to facilitate any positive identifications. On September 12th, from Armagh, Northern Ireland, Moseley detected two white ovals in the EZ and timed their CM transits. Appleyard and Wardley confirmed these observations at Sheffield on September 18th with subsequent transit data, from which a suggested rotation period of 10^h15^m was derived. These results were communicated to the writer by Mr. G. E. Satterthwaite of the B.A.A. Saturn Section. Doel and Benton noted a yellowish color for the EZ; the sometimes elusive EB was also reported by these observers.

Shadow of the Globe on the Rings. Observers agree that the shadow of the ball of Saturn on the ring system was a distinct black throughout 1971-72. Capen noted that the shadow of the globe on the rings was most significant in the fact that it was not a uniform arc but instead was bent at Cassini's Division. This effect is shown on Figures 7, 8, and 10. This curious geometrical appearance, one might visualize, can be due to a thinning of the Ring B material outward (thickness-density change) or to a particle-size change (a scattering function). Capen indicated that it is questionable whether or not this irregular shadow can be caused by a difference in the height of atmospheric features on the Saturnian globe itself. Photos showed the same effect.

VISUAL NUMERICAL INTENSITY ESTIMATES OF SATURNIAN FEATURES IN 1971-72

Feature	Number of Estimates	Derived Average Intensity
Zones		
EZ	33	7.1
STrZ	31	6.6

VISUAL NUMERICAL INTENSITY ESTIMATES OF SATURNIAN FEATURES IN 1971-72 (Cont.)

Feature	Number of Estimates	Derived Average Intensity
Zones:		
STeZ	23	6.3
SSTeZ	11	5.4
SEB Z	41	4.5
SPR	37	4.2
Belts:		
SPC	2	6.3
EB	9	4.0
STeB	14	3.9
SEB_s	39	3.5
SEB_n	40	3.4
SPB	7	3.2
Rings:		
B (outer third - ALPO Standard)	--	8.0
Terby White Spot	3	7.5
A (immediately outside Cassini's)	12	7.0
B (inner portion)	9	6.6
A (outside A5)	19	6.2
A (inside A5)	18	6.0
A (general)	14	5.9
A5 (Encke's - near ansae)	7	3.5
B2	4	3.3
B1	4	3.2
Crape Band	5	2.2
C (off ball)	8	1.0
B10 (Cassini's - in front of ball)	7	0.8
B10 (Cassini's - near ansae)	5	0.2
Shadow Ball on Rings	6	0.2

Intensity estimates are based on the accepted ALPO scale of 0 to 10, with 0.0 representing complete black (shadows) and 10.0 indicating the brightest objects. The accepted standard for Saturn is the outer third of Ring B, which has been assigned a value of 8.0. A discussion of how to make reliable intensity estimates can be found in the Saturn Handbook, available from the writer.

The lack of perfect blackness of the last three features in the table is a measure of limited telescopic resolution and imperfect observing conditions.

Latitudes of Saturn's Belts and Zones. As in other recent years, Haas was the only observer to submit usable visual latitude estimates of features on the disc of Saturn during 1971-72. Employing the technique he developed some years ago, Haas estimated the fraction of the polar semidiameter of the planet's disc subtended on the CM by the belt whose latitude is desired. The method is obviously very simple and the data obtained are often quite reliable, and the method has been the accepted technique for ALPO Saturn observers now for nearly two years. Mathematical reduction to latitudes appears below, but one must recognize that it is somewhat presumptuous to try to draw too much from data accumulated by only one observer, regardless of how accurate his work may have been. This should act as a stimulus to other individuals to begin participating in this realm of Saturn observing. The instructions for participating in the program can be found in the Handbook mentioned earlier.

LATITUDES OF SATURNIAN FEATURES DURING THE 1971-72 APPARITION

Saturnian Feature	Eccentric (Mean)	Saturnicentric	Saturnigraphic
S edge of Ring B proj.	+24°2	+21°8	+26°7
S edge Crape Band	+16.3	+14.6	+18.1

LATITUDES OF SATURNIAN FEATURES DURING THE 1971-72 APPARITION (Cont.)

Saturnian Feature	Eccentric (Mean)	Saturnicentric	Saturnigraphic
N edge SEB_n	-22°4	-20°2	-24°7
S edge SEB_n	-26.4	-23.8	-29.1
N edge SEB_s	-25.9	-23.4	-28.5
S edge SEB_s	-27.6	-25.0	-30.3
N edge SEB	-27.0	-24.4	-29.7
S edge SEB	-33.3	-30.4	-36.4
N edge SPB	-73.1	-71.2	-74.8
S edge SPB	-89.2	-89.1	-89.3
STB (center)	-54.3	-51.2	-57.3
EB (center)	-03.8	-03.4	-04.3

[Notes by Editor on Observed Latitudes. It appears well to point out that each latitude in the table above rests upon four or less positional estimates. The edges of the Ring B projection and the Crape Band vary in latitude as the tilt B varies; but since their true latitudes can be computed, a sufficient number of estimates of their position would permit a needed analysis of random and systematic errors in the method. The north edge of the SEB_n and the north edge of the SEB reference the same feature; so do the south edge of the SEB_s and the south edge of the SEB. There are obvious errors in the reduced average latitudes above: the north edge of the SEB_s simply cannot lie north of the south edge of the SEB_n, and the south edge of the SPB can hardly fall within a degree of the south pole. The three kinds of latitude in the table and the method of reducing the observations are described in Journal A.L.P.O., Vol. 24, Nos. 1-2, pg. 32.]

The Rings

Ring B. As has been the case for many apparitions in the past, during 1971-72 all numerical intensity estimates made by ALPO observers of Saturnian features followed the accepted standard of 8.0 for the outer third of Ring B. Generally, most individuals recorded that Ring B was somewhat brighter than any of the other features in the ring system or on the globe of the planet. Heath noted that the outer part of Ring B was brighter than the less vivid inner portion, and he consistently recorded the colors of the two regions as white and grey respectively. Under the best conditions of seeing and transparency, Heath was able to detect a fairly obvious "border" between the outer and inner portions of Ring B, but he did not indicate any specific intensity minimum in his records. Haas observed Intensity Minimum B2 on September 25th and on October 9th, 1971; and on November 25th he recorded B1 (which may or may not be the same feature). Both of these features were observed near the ansae, and they were never reported by Haas to approach black on the intensity scale. According to the same observer and in close agreement with the findings of Heath, the outer portion of Ring B was significantly brighter than the inner part. Color estimates by Haas gave a whitish appearance for the whole ring. Observations by Budine were very similar to those discussed; but it should be mentioned in passing that Budine reported additional intensity minima near the ansae, all appearing something other than black. In his records Budine makes reference to B3, B5, and B7.

Ring A. During the 1971-72 apparition A.L.P.O. observers agreed that Ring A was not so bright as in previous years. Heath noticed that there was a definite difference in intensity between the outer and inner parts of Ring A, the outer being the darker of the two. Colors noted by the same observer were white and grey, for the inner and outer portions of the ring respectively. Heath reported that Encke's Division (A5) was quite distinct in good seeing and almost completely black, visible nearly all the way around the rings. See his drawing on the front cover. Cassini's Division was also well seen by Heath, appearing distinctly black and visible completely around the ring system. Haas noted that there was a difference in brightness of various portions of Ring A. Just outside Cassini's Ring A was the brightest, becoming less vivid farther out. Inside A5 it was duller than outside A5. Near the ansae Haas was able to see Encke's Division (A5) on several occasions, but he was not able to assign it a numerical intensity anywhere near 0.0 (for black shadows). Cassini's Division (A0 or B10) was observed by Haas encircling the rings completely, being more nearly black near the ansae and with the globe visible through the "division" as it passed in front of the disc of the planet. With respect to color, Haas noted a bluish-white hue for the entire Ring A. Other observers noted slightly similar phenomena, but it should be pointed out here that the data submitted by Heath were in direct contradiction to those obtained from other contributors.

Ring C. Quite a few individuals were able to detect Ring C in front of the globe of Saturn, noting its color as reddish-brown. Benton, Haas, and Heath reported Ring C off the ball of Saturn as a dark inner border to Ring B, all three observers assigning a greyish color to the feature. Heath observed that the inner edge of Ring C was distinct during periods of good seeing.

Ring D. The often elusive (and considered doubtful by many) Ring D was not reported during this apparition. Ring D is a supposed ring exterior to Ring A.

White Spot on the Rings. Heath recorded the presence of a Terby White Spot adjoining the globe's shadow throughout most of the apparition. At the time of opposition, Heath reported a spot on each side of the globe adjoining what he referred to as a "false shadow" on the rings. On several occasions during the apparition Haas also reported a similar feature. Most authorities agree that ordinary limb-darkening is not sufficient to cause this effect, which appears to be a contrast phenomenon between the very bright Ring B and the very dark shadow.

Bicolored Aspect of the Rings. On September 25th Haas reported that the west and east arms of the ring system were of equal brightness using a Wratten filter No. 25 (red). The eastern arm (following) was suspected to be slightly brighter than the western component with a Wratten Filter No. 47 (blue). On October 9th Haas observed that the W arm was brighter than the E arm using a W #47, but no effect was observed with the red filter nor in integrated light. These were the only instances where any bicolored aspect of the rings was observed during 1971-72. Heath reported that he could not find any difference in the brightness of the E and W arms on the twenty occasions when he made observations of the planet. It may be interesting to investigate just how much of a role differential refraction plays in this phenomenon, which has been reported fairly often over the past several years. Differential refraction would be greatest when Saturn is near the horizon, much less when the planet is higher in the sky.

The Satellites of Saturn

Visual magnitude estimates of Saturn's brighter satellites were made by Delano from October 18, 1971 through March 27, 1972, in which he used a $12\frac{1}{2}$" reflector for his observations. To make his visual estimates, Delano worked on the assumption that the satellite Titan (VI) was stable at apparent visual magnitude 8.4, the standard used by all ALPO Saturn observers. The remainder of the satellites were compared with Titan's brightness.

Tethys. In 19 observations of Tethys, the satellite was observed to range from 10.4 to 10.6 in magnitude, for an average of 10.43 and an amplitude of approximately 0.2 magnitudes.

Dione. The 20 observations of Dione made by Delano indicated that it too ranged from 10.4 to 10.6 magnitude, for an average of 10.41 and an amplitude of approximately 0.2 magnitudes.

Rhea. This satellite ranged between 9.8 and 10.2 magnitude in 23 observations, giving an average of 9.86 and an amplitude of 0.4 magnitudes.

Titan. Titan was at magnitude 8.4 in 22 observations and at magnitude 8.0 only once, on March 19th.

Iapetus. Iapetus was at its brightest from the 12th to the 28th day following greatest eastern elongation, being as bright as magnitude 9.8 and no fainter than magnitude 10.4 during this 16-day period. Generally, Iapetus was brighter during the first 40 days following greatest eastern elongation than during the remaining 40 days of its orbital period (the period for Iapetus is actually $79^{d}22^{h}1$). In fact, Iapetus was invisible more often than not throughout the 40-day period between western and eastern elongations. Delano indicates that city lights interfered with his observing so much that his limiting magnitude (using his $12\frac{1}{2}$" reflector) was about visual 11.5.

As an aside, the writer recently learned from Reverend Delano that his $12\frac{1}{2}$" reflector was stolen from his backyard, terminating his observational work. It is most unfortunate that this very active observer must suspend his valuable work while he awaits the purchase of another instrument. In the meantime, the writer would like to encourage other observers to begin more detailed studies of the satellites of Saturn, an area where there is definite need for additional data.

Concluding Remarks

As was evidenced by the report just presented, quite a number of individuals participated actively in the programs of the Saturn Section, certainly more than in the past few years. This response is encouraging, and it is the sincere hope of the writer that it is a trend toward even greater observer coöperation. When more people begin sending in observations, it is possible for us to derive much more from the data; and we are obviously more confident and satisfied with our findings.

There still remain areas in which more concentrated effort is needed, and these are listed below:

1. Visual estimates of colors on the planet, with strict adherence to a suitable standard, which would add the greatest possible degree of objectivity to the observations.

2. Continual patrol of the globe of the planet for disturbances and spots, which can yield rotation periods for a particular latitude if transits are taken.

3. Photometric or visual measurements of the brightness fluctuations of the satellites, using a suitable standard of comparison.

4. Attempts to determine, by visual estimates or otherwise, the latitudes of belts and zones on the disc.

5. More research into the bicolored aspects of the rings versus the effects of differential refraction, etc.

The observer who possesses a telescope of moderate aperture (4" for refractors and 8" for reflectors) can fully participate in these programs; and even if he has a smaller instrument, he can take part in some of these research efforts. In any case, the Recorder will be most pleased to direct an individual who shows promise into the areas of useful work with his specific instrument. Members of the A.L.P.O. who are interested in Saturn, but who feel that they do not know enough to participate (or who have a reluctance to contribute for some other reason), should write to the Saturn Recorder for help and advice. It is our purpose to steer those enthusiastic individuals, who really want to make themselves useful, into the proper lines of observational endeavor.

THE 1973 A.L.P.O. - ASTRONOMICAL LEAGUE MEETING IN OMAHA

By: Richard G. Hodgson

The 1973 A.L.P.O. Convention was held jointly with the Astronomical League at Creighton University, Omaha, Nebraska, from Wednesday through Sunday, August 1 through 5. Unfortunately Director Walter H. Haas was unable to attend, and appointed the Reverend Richard G. Hodgson to serve in his place.

The Convention began with registration Wednesday afternoon. A tour of the historic observatory on the Creighton campus was conducted by Fr. Vaske that evening. Vistors were impressed by the fine old 5-inch Steward refractor (built about 1884) in its dome, and by a fine transit instrument of the same period.

On Thursday morning, after welcoming addresses, scientist-astronaut Dr. Joseph P. Allen presented an illustrated lecture on "N.A.S.A. Astronomical Programs". In the afternoon there were papers on solar observing, limits of telescope seeing, and pictures taken of the June 1973 Atlantic-African solar eclipse. In the evening, following the A.L.P.O. business meeting (discussed below), Comets Recorder Dennis Milon, aided by Charles Morris, conducted a discussion of comet observing techniques, which was very well attended. The approach of the Great Comet Kohoutek (1973f) doubtless has done much to excite interest in comet observing. [How to observe this extraordinary comet is discussed elsewhere in this issue. -Editor.]

On Friday, August 3, most of the A.L.P.O. papers were presented. Lunar Recorder Roy Parish spoke on "Some Early Results of the A.L.P.O. Messier-Pickering Program". Lunar Recorder John Westfall presented the paper "Observing the Mountains of Mars," expressing the view that shadows of enormous mountains such as Nix Olympica (about 24 to 29 kms.high) should be visible from Earth under favorable conditions. Such shadows have yet to be observed, possibly because observers have not made a concentrated enough search, Westfall indicated. He supplied an ephemeris for those interested in trying to observe the shadow of Nix Olympica. William H. Glenn discussed "Sky Color and Darkness at the Total Solar Eclipse" with slides taken in Prince Edward Island in 1972. A useful paper by Charles Morris, "Reduction of Comet Magnitude Estimates", followed.

On Friday afternoon, following a general talk by Dr. Edward J. Zeller of the University of Kansas Space Technology Laboratories reviewing the inner planets, Charles F. ("Chick") Capen of Lowell Observatory, the A.L.P.O. Mars Recorder, gave an excellent illustrated talk on "Martian Telescopic and Mariner T. V. Features". Capen discussed the various albedo features and micro-features on Mars. He also showed pictures of Martian satellite Phobos, revealing it to be saturated with craters. Reverend Richard G. Hodgson then spoke on "Useful Work on Minor Planets", indicating the work of the recently formed Minor Planets Section.

On Friday evening there was a field trip to Lueninghoener Planetarium at Midland College, Fremont, Nebraska for those particularly interested in planetarium education. The Lueninghoener Planetarium is an outstanding example of what can be accomplished in a planetarium with a 30-foot dome. On this occasion a special program was presented involving discussion of projection problems, audio problems, and program development. The facility also has a large roof observatory providing for simultaneous observations with a variety of telescopes.

The meetings on Saturday, August 4, featured papers on variable star observing, instrumentation (including one on "Mirrors and Lens Coatings" by Robert E. Cox), and general topics. The guest speaker at the banquet in the evening was Dr. Karel Hujer of the University of Tennessee, who spoke on Copernicus. At the banquet the Grand Prize (one of many door prizes) was awarded to John Westfall -- a 4-inch refractor.

A field trip Saturday evening to the University of Nebraska's new Behlen Observatory (housing a 30-inch Boller and Chivens Cassegrain) was hindered by cloudiness. On Sunday morning, after presentation of final reports and a forum on problems of sky pollution, the Convention adjourned.

The A.L.P.O. business meeting dealt with several important matters. No decision was made concerning the place of meeting for next year, although an invitation from the W.A.A. to meet at U.C.L.A. in August, 1974 was discussed*. The decision accordingly will be left to the Director, Walter Haas. The business meeting reaffirmed the view of the meeting at Riverside, California, in 1972 that dues be made $10 per year in order to provide more funds to aid the Director in producing the Journal. The members present felt that there is now too much of a burden placed upon him. Thus far the Director has been reluctant to raise dues this high.

One very helpful suggestion made by J. Russell Smith received the warm endorsement of the business meeting. That was the idea that a page in alternate issues of JALPO should be set aside to list the publications and forms provided by the different observing Sections, their cost, and the name of the person from whom they may be obtained. It was pointed out that information concerning handbooks, forms, etc. swiftly gets lost in a pile of back issues. In Sections having more than one Recorder, moreover, time is often lost if one writes to the wrong person.

Perhaps the most important item in the business meeting was the motion that its chairman (Rev. R. G. Hodgson) appoint a committee to look into the state of the proposed A.L.P.O. Constitution, making modifications on the basis of suggestions of the members in the interest of simplicity, and seek incorporation of the A.L.P.O. under Nebraska law (which is easily done in that state, and which has been done recently and inexpensively by the Omaha Astronomical Society with the aid of some lawyer members). It was further determined to poll A.L.P.O. members regarding adoption of the Constitution (as modified by the committee) early in 1974, and have the results ready within a calendar year. The vote in favor of these proposals was unanimous. Before the Convention adjourned, in accordance with this motion, Reverend R. G. Hodgson announced the appointment of a committee of four: Dr. John Westfall, Chairman; J. Russell Smith; Russell Maag; and Robert Allen. In explaining the difficult decision of making appointments, Hodgson indicated he had chosen Westfall as a prominent Recorder; Smith, because he was a prominent charter member of A.L.P.O.; Maag, because he was also a charter member, and had had recent experience in incorporations; and Allen, because of his experience in the Omaha incorporation. Allen, incidentally, served very well as host chairman for this year's Convention.

*However, see the announcement on page 167.

COLOR FILTER TECHNIQUES FOR BRIGHT COMETS

By: C. F. Capen

The use of high transmission color filters makes possible a whole new field of observational research for the comet observer. Comets are very unpredictable celestial objects. Each one has its own characteristics and behavior during its trek through the Solar System. Most comets appear luminous bluish-white. Some have a reddish hue, while a few Sun-grazers have been known to emit in the yellow sodium D-line region of the spectrum. A light color filter which best matches the reflected or emitted light from that part of the comet under study can improve the detail. When comets are brightest and exhibit their longest tails they are closest to the Sun and have to be observed in a twilight sky. Filters can sometimes be used to darken the sunrise or sunset background sky by reducing the effect of scattered light in the atmosphere. If the sky is reddish, use a light blue filter (Wratten-82A and W-38); and if the sky is bluish, use a light yellow filter (Wratten-81A or B and W-4)[1]. The intrinsic or basic color of the comet vs. the color of the twilight sky naturally determines whether a particular filter will be helpful.

Color filters can be employed most advantageously to aid in determining the composition and classification of cometary heads and tails. The splendor of bright comet tails is unsurpassed. However, the delicate and changing structure that lies within the head can be the most challenging and intriguing feature of a comet. The head consists of a central dense and usually bright nucleus and a fuzzy, variable atmospheric shell called the coma. The nucleus has been described by astrophysicists as a "dirty snowball". When the nucleus is influenced by solar radiation, it brightens and forms a coma, sometimes gas and dust jets appear, and expanding concentric envelopes form outside the coma. The effects of the jets can be traced back along the tails. In fact, the clue to each comet's behavior and appearance lies within the cometary head.

The composition of cometary heads is most variable, being either gaseous (emission), or dusty (reflected sunlight continuum), or some ratio of both. The neutral molecules of CN, CH, C_2, C_3, OH, H, NH, NH_2, Na, Si, Ca, Cr, Mn, Fe, and Ni have been identified within various comets' comas. The coma usually appears small in red (W-23A and W-25) or orange (W-21) light, and larger in UV (W-18A photo), violet (W-47A), and blue (W-23) light due to the most often present violet CN and blue C_2 emission bands. However, CN also has a fluorescent band in the red. If NH_2 is most abundant, it can dominate the red spectral region. The emission of Na is seen best in yellow light (W-4 and W-8). The presence of dust shows strongest in yellow (W-4), yellow-green (W-57), orange (W-21), and red (W-23A and W-25) light. If the head is both gaseous and dusty, it can shine in both blue and red light simultaneously, giving a magenta hue (W-30). Thus, color filters can possibly determine the intensity ratio of emissions to continuum and help to classify the type of comet head in a similar way to how tail types are classified.

Because the composition of comets is variable and unpredictable, so is their behavior, color, and brightness. In fact, their structure and spectral emission can vary within a matter of hours. Consequently, it is advisable visually to observe systematically each night using light blue, green, yellow, orange, and sometimes magenta filters. The aspect of the head and tail structure should be recorded in each color, and any differences should be noted. The color filters that show best the nucleus, head structure, tail-spines, envelopes, etc. can thus be determined and can then be employed each night for visual and photographic observation. For example, the spiral feature in the head of Comet Bennett (1969i) showed a rotation period from 1.4 to 1.5 days.

It is advantageous to employ narrow band-pass or interference filters for observing Sun-grazing comets during maximum brightness when near perihelion in the daytime or shortly thereafter in a nighttime sky. As an example, Comet Ikeya-Seki (1965f) showed up well through an Na D-line filter. The yellow light from the sparkling comet was passed through the glass filter while the blue skylight was blocked. The filter effect was that of viewing a comet in a dark nighttime sky. Photographic and visual observations using violet, blue, and yellow interference filters should be tested on Comet Kohoutek late in December, 1973 and early in January, 1974. Interference filters can be obtained from Optica b/c Co., Oakland, Ca. for $39 each. See References 2 or 3 for filter transmittance graphs.

Direct photography using the empirically determined effective color filters is also suggested in order to obtain a valuable record of hourly changes within the head. Short exposures from a few seconds to a minute (@ f/15, Plus-X, no filter) are required to record details in regions of different intensity. Since the exposures are short, it is possible to take a series of equal length and from them produce composite prints in the darkroom. The composite printing technique increases the definition and contrast of fine structure while decreasing the effect of film grain. The author successfully composited the tri-nuclei of Comet Ikeya-Seki in 1965.

The same filter techniques can be employed in the classification and observation of structure in cometary tails. Type I tails consist of molecular ions of CO^+, CO_2^+, CH^+, Ca^+, N_2^+ and sometimes the element Na. They have a straight appearance which lies on the Sun-comet line known as the radius vector. These ionic tails exhibit changing structure during the active phase of the comet. The gases absorb sunlight and re-emit it in a characteristic wavelength or color which is unique to the individual gas. This type of tail is usually seen best through a light blue filter (W-82A and W-38) because the CO^+ band is often the strongest. Bright head spikes, jets, tail-spines, and rays develop at the head and move back along the tail. Bright condensations or knots and helical structures can also be present.

Type II tails are composed of dust particles and shine by reflected sunlight in a continuous spectrum. These tails are curved behind the radius vector since the acceleration on the dust particles is relative to the distance from the Sun's gravitational attraction. Usually Type II tails appear yellow to reddish in color and show less structure except when banded and rayed synchrones are present due to intermittent expulsion of dust from the head. Yellow-green (W-57), yellow (W-81B and W-4), orange (W-21), or light red (W-23A) filters should show the tail structure best.

Both types of tails may appear in the same comet. However, there is a sorting process which separates the ionic gases from the dust particles, which process is a function of distance from the head of the comet. The detection of the intrinsic color of the two types of tails is facilitated by filter comparison with a light blue filter and then a yellow or orange one. If the orbital aspects are right, a shadow cone from the nucleus may appear along the radius vector.

References

1. Anonymous; Kodak Filters for Scientific and Technical Uses (B-3), Eastman Kodak Co., Rochester, N. Y., 1972.

2. Barbera, R., et al.; Astrofilters for Observation and Astrophotography, 2nd edition; Optica b/c Co., Oakland, Ca., pg. 34, 1973.

3. Optica b/c Co.; New Optica Interference Filters, Sky & Telescope, Vol. 45, No. 6, pg. 399, June, 1973.

THE REDUCTION OF COMET MAGNITUDE ESTIMATES AND COMET OBSERVING

By: Charles S. Morris, A.L.P.O. Comets Section

The purpose of this paper is to summarize some of the recent work done concerning the reduction of comet magnitude estimates. Also, suggested reduction and observing procedures are discussed.

Aperture Corrections*

Over thirty years ago Bobrovnikoff (1941a and b, 1943) showed that on the average a given comet will appear 0.167 magnitudes fainter for each inch of increased aperture used. This aperture correction was determined by using magnitude estimates obtained with refractors. Theoretical justification for such an empirical correction has been given by Meisel (1970). Recently, it has become apparent that the Bobrovnikoff aperture correction does not work for reflecting telescopes. This situation led to the decision to undertake a study to re-evaluate the aperture correction for refractors and to determine for the first time an aperture correction for reflectors.

Observations of 22 comets (see Table I) made by members of the A.L.P.O. Comets Section were used to determine the aperture corrections. From these data comparisons were made between observations secured within $0^{d}.75$ of each other. Each comparison consisted of the determination of delta aperture, which is defined as the smaller aperture subtracted from the larger aperture, and delta magnitude, which is defined as the difference between the magnitudes obtained with these apertures.

*Also see Morris (1973).

The following restrictions and assumptions were made:

1. Only magnitude estimates made using the Bobrovnikoff method (1941b), in which the eyepiece is racked out-of-focus so that the comparison stars and the comet appear similar in size, were used.

2. No magnitude estimate was used if there was any doubt concerning the aperture or type of telescope used in making that estimate.

3. Magnitude estimates made with the naked eye were assumed to have been made with a refractor of zero aperture (Bobrovnikoff 1941a).

4. In the determination of the aperture corrections it was assumed that when delta aperture = 0, then delta magnitude = 0 (i.e., the fitted line was forced through the origin).

The aperture correction for refractors ($APCOR_1$) was determined from 480 comparisons made among refractor observations. The average values of delta aperture and delta magnitude for these comparisons are listed in Table II. The aperture correction was found by determining the best fitting straight line through these points. The slope of that line represents the aperture correction in magnitudes per inch. The resulting value of $APCOR_1$ was 0.139 ± 0.020 (probable error).

Although the value of $APCOR_1$ obtained in this study is slightly less than the Bobrovnikoff value it is felt that, due to the small range of delta aperture used in this study, this new result is essentially a confirmation of Bobrovnikoff's findings. In practice either value will usually suffice because refractor estimates are ordinarily made with relatively small apertures.

In order to obtain the aperture correction for reflectors ($APCOR_2$), the magnitude estimates made with refractors were corrected to a standard aperture of 2.67 inches using Bobrovnikoff's aperture correction. In addition to the comparisons made among reflector observations, comparisons were also made between the corrected refractor estimates and the reflector estimates. With this procedure a total of 227 comparisons was obtained. The average values of delta aperture and delta magnitude for these comparisons are listed in Table III. From these points the value of $APCOR_2$ was found to be 0.048 ± 0.006.

Recently, Meisel (1973) has extended his theoretical study of aperture corrections to reflectors. His results indicate that an "average" reflector should have an aperture correction which is 30% to 40% that of the same size refractor. This theoretical result is in good accord with the present empirical study.

The Reduction of Comet Magnitude Estimates

As a result of the above study, the following procedure for the reduction of comet magnitude estimates is suggested:

1. Only those observations for which the aperture, type of instrument, and source of comparison star magnitudes are known should be used.

2. If it is possible, the average aperture corrections for the comet in question should be determined. The reason for this step is that the average aperture correction for a given comet may be related to the degree of condensation of that comet. Thus, if there are a sufficient number of observations (usually over 100), one should determine if there are deviations from the average aperture correction under consideration.

3. The next suggested step is to check for deviations from the average aperture correction in question for individual observers. The idea that individual observers have different aperture corrections was first proposed by Bortle (1972). Confirmation of this individual error has come from the aperture correction study. Examples are limited since it requires a large aperture for the difference in the aperture corrections of two different observers to become apparent. However, the fact that differences do exist in personal aperture corrections can be seen by examining the four observations of P/Giacobini-Zinner 1972d listed in Table IV. These observations by John Bortle and the author were obtained using the same telescope and the same comparison stars. In each case there is about half a magnitude difference in the magnitude estimates. Bortle (1972) has determined his personal aperture correction for reflectors to be 0.045, whereas the author's appears to be closer to 0.07.

4. In cases where observations are too few to permit the derivation of the required aperture corrections for the individual observer and/or the comet, it is suggested that the observations be corrected for aperture using the following formulae:

$$H_a = H - 0.167\ (Ap - 2.67) \text{ - Refractors}$$

$$H_a = H - 0.048\ (Ap - 2.67) \text{ - Reflectors.}$$

where H is the directly observed magnitude, H_a is the aperture corrected magnitude, and Ap is the aperture in inches.

5. The rest of the reduction should proceed as in the past (i.e., correction for the changing Earth-comet distance, etc.).

Table I. List of 22 Comets employed by Charles S. Morris in an aperture correction study.

(See text on page 150)

Comet	Number of Comparisons: Refractors	Number of Comparisons: Reflectors
1959 IV	-	1
1960 II	-	3
1962 III	10	31
1962 VIII	2	4
1964 VI	1	-
1964 VIII	1	-
1965 VIII	70	7
1966 V	1	18
1967 II	-	2
1967 VII	16	22
1968 I	41	39
1968 IV	2	1
1968 VI	63	57
1968 VII	-	2
1968 IX	1	2
1969 VI	-	1
1969 VII	-	2
1969 IX	143	9
1970 II	76	-
1970 X	-	1
1970 XV	46	17
1971 V	7	8

Table II. Data employed in a comet magnitude aperture correction study for refractors.

(See text on page 151)

Delta Aperture (inches)	Delta Magnitude	Number of Comparisons
0.60	0.12	268
1.27	0.18	127
2.17	0.31	67
3.34	0.27	18

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In Our Next Issue. Plans for Vol. 24, Nos. 9-10 include Section Reports on Venus, Mars, Jupiter, and comets. J. Russell Smith is gathering material for a current breakdown of all materials and services offered by all the different ALPO Sections. John Westfall has supplied tables for the C.M. of Saturn in 1974 and a schedule for future observations of Luna Incognita. There may, of course, be some early and exciting news on Comet Kohoutek. --Editor

A.L.P.O. COMETS SECTION

COMET 1972d P/Giacobini-Zinner

Observer J.E.Bortle

Date (UT) 1972 October 9

Address Gold Road

Stormville, N.Y.

Time (UT) 09:05 - 09:12

Dist. from horizon 29°

Place of Observation Gold Road, Stormville, N.Y.

Approximate R.A. $07^h\ 56.3^m$

Approx. declination -10° 33'

Sky conditions (Transparency, haze, moonlight, twilight, city lights, faintest naked eye star near comet): Seeing 3-4(0-5) Sky limit 7+ faintest star near comet 6

MAGNITUDE ESTIMATES (State methods and telescopes used): Extrafocal comparison by the Sidgwick+and Bobrovnikoff*methods using stars from the U Puppis field (AAVSO

Total magnitude 11.7 + Tel. 32cm refl.55x Magnitude of nucleus 14.0: Tel. 32cm refl

11.9 * 32cm refl.55x

Comparison stars, magnitudes, and catalog used: 11.5, 11.7, 12.2 positions relative to U Puppis: 170°,8'; 190°,5'; 15°,5'

DESCRIPTION (State methods and instruments used--i.e., photo, visual, micrometer, etc.): 32cm reflector,f/5.6,used visually at 55x,65x,146x

Tail length ~1½' Pos. angle of tail (plot on an atlas and measure) 270°

Remarks on tail (detail, color, shape, etc.): There was a possible very short (not more than 1½'),faint extension toward PA 270°. It was faintly noted at both 55x and 146x.

Coma description (diameter, shape, jets with P.A., etc.): A circular and diffuse coma,boundaries undefined. A possible nucleus of magnitude 14.0: centrally located at 146x. Under the very good sky conditions the comet was an easy object. Coma diameter 1.0'.

Degree of condensation of coma. Scale: 0=diffuse, 9=stellar. 2

(A sketch will be of value.)

FIELD SKETCH: (Draw on an atlas if possible and recopy.) no sketch

Power

Diameter of field

Note: Drawing paper may be used instead. If the sketch is intended for publication, it should not be folded.

Figure 11. Sample observation of a comet on the A.L.P.O. Comets Section observing form. These forms can be ordered from Dennis Milon, 378 Broadway, Cambridge, Massachusetts 02139. Observers of the Great Comet Kohoutek and other future comets are strongly urged to obtain a supply of these convenient forms.

Table III. Data employed in a comet magnitude aperture correction study for reflectors.

(See text on page 151)

Delta Aperture (inches)	Delta Magnitude	Number of Comparisons
0.25	0.00	1
1.44	0.17	14
2.00	0.23	9
3.35	0.08	113
4.17	0.35	6
5.36	0.31	31
6.33	0.28	12
7.33	0.26	8
9.49	0.51	33

Table IV. Comparison of four observations of P Giacobini-Zinner 1972d by Morris and Bortle.

(See text on page 151)

Date (UT)	Observer	Magnitude	Instrument
1972 Sept. 5.37	Morris	10.4	12.5" Refl.
5.37	Bortle	9.9	12.5" Refl.
6.37	Morris	10.6	12.5" Refl.
6.37	Bortle	10.2	12.5" Refl.

Comet Observing

As a result of doing the aperture correction study, the author has come to the conclusion that a review of basic observing methods is useful. To improve the quality of comet observations, he offers some suggestions concerning observing procedures.

There are three basic methods which can be used to determine the magnitude of a comet. These are listed below:

1. Bobrovnikoff Method (see page 151).

2. In-Out or Sidgwick method. When using this method, one compares the out-of-focus comparison stars with the memorized image of the in-focus comet (Sidgwick 1955).

3. Beyer Method. When using this method, one racks the eyepiece way out of focus until the comet and the comparison stars are so expanded and diffuse as to be invisible (Beyer 1952). It should be noted that the comet must be expanded many times its original size for this method to work.

Of the three methods the Bobrovnikoff method is most frequently used. This circumstance, combined with the fact that there is very little known about the aperture correction properties of the other two methods, leads to the strong recommendation that any observer who chooses to use one of the other methods should also estimate the comet's brightness using the Bobrovnikoff method as a check.

The In-Out method is rather easy to use. It is particularly useful when one is attempting to estimate the brightness of a very faint and diffuse comet. Magnitude estimates made using this method will probably be a few tenths of a magnitude brighter than those made using the Bobrovnikoff method. It also appears likely that magnitude estimates made using this method follow the aperture corrections presented in this paper fairly well.

The Beyer method is the hardest to use. It is recommended that only observers with many years of observing experience (i.e., in making magnitude estimates of comets) should attempt to use this method. According to Beyer (Bortle 1972), this method of observing requires no aperture correction at all. However, more inter-comparisons with observations made using the Bobrovnikoff method are needed before the aperture correction properties of this method can be determined properly.

The following is a list of suggested observing procedures* and of common errors made by observers:

1. Since observing conditions are very important it is suggested that observers use the limiting naked eye magnitude of stars as a transparency scale (both near the comet and at the zenith). Too many times observers use scales which are not defined and thus make it impossible to determine the actual conditions.

2. When reporting comet magnitudes, be sure to report the following information (if

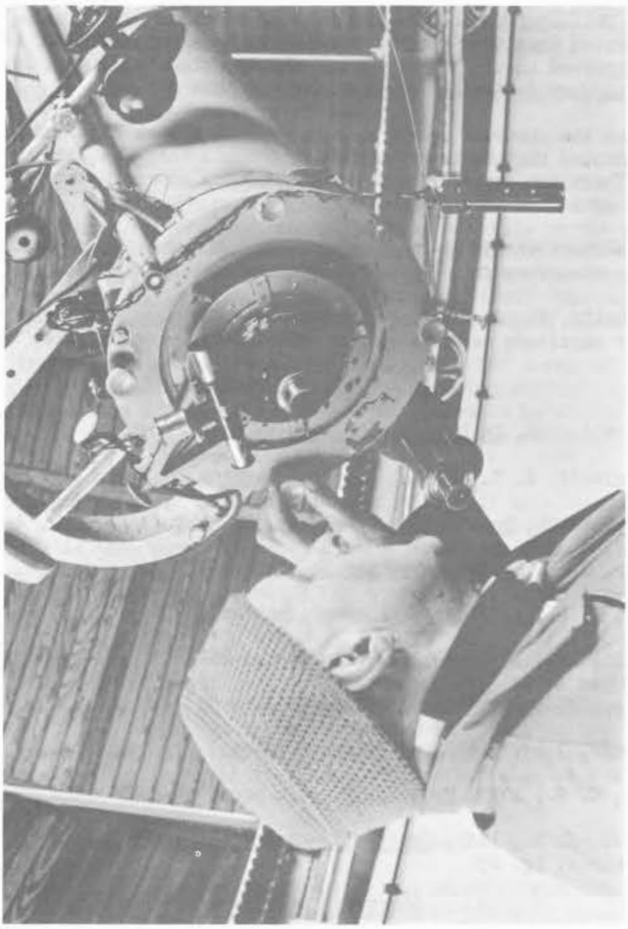

Figure 12. Dr. Max Beyer at the visual photometer attached to the 26-centimeter f/12.5 refractor of Hamburg Observatory in Bergedorf, West Germany. Since 1931 he has used a standard technique for estimating comet magnitudes (described in the article by Charles Morris), thus compiling a valuable long-term list free of some observing variables. In order to obtain the magnitudes of comparison stars, he measures their brightness with a visual Graff wedge photometer. Dr. Beyer, who was 79 years old in 1973, reports his analyses in the journal Astronomische Nachrichten. This 1963 photo is from a color slide in the ALPO Comets Section files. Photograph and caption contributed by Dennis Milon.

*See "Comet Observing" by Dennis Milon, ALPO Comets Section Recorder, for general information. It is also available as a reprint, along with comet report forms at $2.00 for 50, both from the Comets Recorder at 378 Broadway, Cambridge, Mass. 02139.

possible):

A. The aperture of the telescope.
B. The type of telescope.
C. The method used.
D. The magnification used.
E. The focal ratio of the telescope.

3. A common mistake made by observers is to estimate the magnitude of the nucleus as brighter than the total magnitude of the comet. This occurs because observers attempt to estimate the magnitude of the nucleus (of a bright comet) using the same telescope and/or magnification that they used to obtain the total magnitude of the comet. Thus, it is strongly suggested that observers avoid this problem by using a larger instrument or more magnification when estimating the magnitude of the nucleus.

4. When the observer makes measurements of a coma size and degree of condensation, it is recommended that he use the same instrument that was used to obtain the magnitude estimate. There are several questions concerning aperture corrections which might be answered if such data were available.

5. Observers should be very careful when determining position angles of tails, etc. because many observers fall into blunders when making this determination.

6. Finally, it is stressed that the observer should clearly state what instrument was used for magnitude estimates, coma size determinations, etc.

References

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Bobrovnikoff, N. T., 1941a, Contrib. Perkins Obs., Nos. 15 and 16.

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COMET KOHOUTEK 1973f: A PREVIEW

By: Charles S. Morris, ALPO Comets Section
and Dennis Milon, ALPO Comets Recorder

The fourth new comet of the year was discovered by Lubos Kohoutek on two plates exposed with Hamburg Observatory's 80-cm. f/3 Schmidt on March 7, 1973. By March 26th it was determined that this comet would pass 0.14 astronomical units from the Sun when it comes to perihelion at the end of December; and hence it will probably become a spectacular object during December, 1973, and January, 1974.

The comet was 16th magnitude at discovery at about 4.7 astronomical units from the Sun. By early June it had moved into the evening twilight, and will remain inaccessible to amateur telescopes until the beginning of October, 1973 when it moves into the morning sky. At that time the comet should be at least 10th magnitude.

The only observations of 1973f received by the Comets Section so far are from Michael Mattei at Harvard, Mass. He observed it on April 20.15 UT with a 61-inch reflector and on April 21.02 with a 6-inch Clark refractor, calling it 14th magnitude on both dates. Negative reports have been received from Charles Morris (24-inch reflector, Michigan State University Observatory) and John Bortle ($12\frac{1}{2}$-inch reflector).

The fact that this comet was discovered nine months before perihelion gives us the rare opportunity to alert observers well in advance. Thus, a complete ephemeris is reproduced on page 159 to encourage observations of what may become the greatest comet of this century. The ephemeris was computed and compiled by Charles Morris using a computer program designed by Michael McCants, Austin, Texas. It replaces one issued on July 19, 1973, which is inaccurate after January. The orbital elements were given by Brian Marsden on IAU Circular 2541 for June 6th:

$$T = 1973,\ \text{Dec. } 28.4751\ \text{E.T.} \qquad \left.\begin{array}{l}\omega = 37^{\circ}.8178\\ \Omega = 257.7774\\ i = 14.3065\end{array}\right\}\ 1950.0 \qquad q = 0.142368\ \text{A.U.}$$

Dr. Marsden gave the following information in a Smithsonian Astrophysical Observatory release.

"It will reappear in the morning sky in October, and by the end of that month it could already be as bright as 7 mag. The comet will move away from the sun in the morning sky to a maximum elongation of some 44° by mid-November, the magnitude then being perhaps 5. It will be south of the ecliptic, but scarcely better visible in the southern hemisphere than in the northern. By mid-December, the comet will be 25° west and south of the sun and perhaps of 0 to -2 mag. The comet crosses the ecliptic December 27, and at perihelion the following day it will be only some 0°7 from the sun: the magnitude could be -5 to -10, and the comet should be at least a telescopic object in daylight.

"After perihelion, the comet moves rapidly away from and to the north of the sun and comes into the evening sky. By January 10, it will be 30° from the sun and perhaps still 0 to -3 mag. The next 10 evenings or so, we can expect the comet to be at its best as it continues to move away from and to the north of the sun. It will be closest to the earth, 0.80 a.u. away, January 15.

"By the 20th, the magnitude should be 0 to +1. Full moon will have been on the 8th. The comet will attain its maximum elongation from the Sun (69°) in mid-February, the magnitude being about 5. It will then pass through its descending node and move slowly back into twilight, fading to 8 mag. by mid-March and perhaps 12 mag. by May. After conjunction, further observations should be possible with large telescopes later in 1974 and into 1975.

"Comet 1973f was brighter than Comet Bennett 1970 II when the latter was observed at comparable distances from the Sun in early 1971. Since Comet 1973f has a perihelion distance that is only about a quarter that of Comet Bennett, it should become much brighter; and if it develops a dust tail, it could be the most spectacular comet of the century. Discovery of such a potentially fine comet more than 9 months before perihelion is quite unprecedented, and it may never happen again that such a long lead-time is available for planning observations of a comet passing so close to the Sun."

The ALPO Observing Program for Kohoutek

Our plans for Kohoutek are similar to those employed on other bright comets since the Comets Section began in 1957. However, special programs may be given in announcements mailed by the Recorder. To receive these, as well as future news of other comets, send a supply of self-addressed and stamped long envelopes to Dennis Milon, 378 Broadway, Cambridge, Mass. 02139. The information to be included with a visual observation is outlined on comet report forms available from the Recorder at $2.00 for 50 (or duplicate your own). A sample form is shown on pg. 153. The important point is to keep each day's observation on a separate sheet. If reports are sent in quickly, other observers can be alerted to interesting developments. As a policy on sending photographs, please mail duplicates which can be retained in the ALPO files; both color and black-and-white are welcomed.

<u>How to make magnitude estimates</u>. Visual magnitude estimates of a comet's total (or coma) brightness have been a major ALPO program on all comets. Analysis of magnitudes allows different comets to be compared, individual rates of brightening and fading calculated, and changes correlated with solar-caused events. The accepted technique is to compare comets with the out-of-focus images of stars. Galaxies and nebulae may appear a logical choice, but their magnitudes are not so precisely known as those of stars, which also give a wider range in magnitudes. Because magnitudes obtained from the sizes of star

disks on an atlas are not accurate enough, the observer should equip himself with catalogs; and these are recommended:

Arizona-Tonantzintla Catalogue. For stars 5th magnitude and brighter. Published in July, 1965, Sky and Telescope, reprints available at 50¢ from Sky Publishing Co., 49 Bay State Road, Cambridge, Mass. 02138. Use this and The American Ephemeris (for planets) when 1973f is naked eye.

American Ephemeris and Nautical Almanac. For magnitudes of planets. For 1973, $6.25; 1974, $7.30. U. S. Government Printing Office, Washington, D. C. 20402.

Catalogue of Bright Stars. Goes to mag. 6½. $15 from Yale University Observatory, Box 2023, Yale Station, New Haven, Conn. 06520.

Skalnate Pleso Catalogue. Stars to 6.2, but does not contain certain revisions of the Yale. $9.50 from Sky Publishing.

Smithsonian Astrophysical Observatory Star Catalogue. Use for stars fainter than above catalogs, down to mag. 9-10. Contains uncertainties, so make several comparisons when using it. Four volumes, $27 from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

AAVSO variable star charts. Use when the comet is below mag. 10 or passing through a chart field at other times. The chart catalog is a dollar (including postage) from AAVSO, 187 Concord Ave., Cambridge, Mass. 02138. To aid their small staff, enclose stamped envelopes when ordering charts.

Instruments. The smallest optical aid needed to show a comet conveniently should be used, starting with the unaided eye. Binoculars are a good choice to follow Kohoutek's brightness for several months. They have a wide magnitude range and a large field of view to locate comparison stars. Binoculars should be mounted on a tripod; some are already tapped, or order the Edmund tripod mount No. 50,362 at $3.75.

Richest Field Telescopes, as described in Amateur Telescope Making, Book Two, provide beautiful views of comets; and their wide fields give many comparison stars.

Ephemeris of Comet Kohoutek. The different columns in Figure 13 on page 159 have the following meanings:

RA = right ascension.
DEC = declination.
DELTA = comet's distance from Earth in astronomical units.
R = comet's distance from Sun in astronomical units.
CES = Angular distance of comet from Sun in degrees.
TL = millions of miles per degree of tail length observed.
PA = position angle of tail (0° = north, 90° = east).
M_1 and M_1^* = predicted total magnitude of comet, where:
$M_1 = 2.5 + 5 \log\Delta + 15 \log r$ (after Marsden).
$M_1^* = 4.8 + 5 \log\Delta + 10 \log r$ (after Morris).
Δ = distance from Earth.
r = distance from Sun.
The particular magnitude formula which best represents the comet's variations in brightness cannot be determined until the comet is picked up in October.
M_2 = magnitude of the nucleus: $M_2 = 8.0 + 5 \log\Delta + 10 \log r$ (after Marsden).
ALT and TIME = the maximum distance above the horizon in dark skies (the Sun must be at least 10 degrees below the horizon) and the time (local standard time) at which it occurs. ALT (given in degrees) and TIME are for a latitude of 40 degrees north.
MT (Morning Twilight) and ET (Evening Twilight): This symbol indicates that the comet will only be visible in a bright sky or in some cases only in the daytime (assuming the comet is bright enough).

Technique of Estimating Magnitudes. Most observers use the Bobrovnikoff method in which the comet and stars are placed out of focus until they have equally large disks. Then the observer estimates the comet's brightness between a brighter and a fainter star, such as "comet is 3/10ths of the way from star A to star B," marking identifications on an atlas. The two comparison stars should be less than a magnitude apart; and several comparisons should be made, using different stars. Avoid red stars because they appear to increase in brightness when stared at for long periods.

DATE	RA	DEC	DELTA	R	CES	TL	PA	M_1	M_1*	M_2	ALT	TIME
Oct 1, '73	$10^h29^m.0$	-0 40'	2.862	2.052	30	19	275	9.5	10.2	13.4	12	4^h55^m
5	10 35.9	-1 25	2.768	1.986	32	17	276	9.2	10.0	13.2	14	4 59
10	10 45.1	-2 25	2.649	1.902	34	15	278	8.8	9.7	12.9	16	5 4
15	10 54.8	-3 29	2.526	1.816	36	13	279	8.4	9.4	12.6	18	5 9
20	11 5.2	-4 39	2.401	1.728	38	11	280	8.0	9.1	12.3	20	5 14
25	11 16.5	-5 56	2.274	1.639	40	10	281	7.5	8.7	11.9	21	5 19
30	11 28.7	-7 19	2.146	1.547	41	8	282	7.0	8.4	11.6	22	5 24
Nov 4	11 42.2	-8 49	2.018	1.452	43	7	283	6.5	7.9	11.1	23	5 30
9	11 57.3	-10 29	1.890	1.355	44	6	283	5.9	7.5	10.7	23	5 35
14	12 14.2	-12 18	1.764	1.254	44	5	283	5.2	7.0	10.2	23	5 40
19	12 33.7	-14 18	1.641	1.150	44	5	283	4.5	6.5	9.7	22	5 45
24	12 56.5	-16 28	1.523	1.042	43	4	283	3.7	5.9	9.1	20	5 50
29	13 23.4	-18 47	1.413	.928	41	3	281	2.8	5.2	8.4	18	5 55
Dec 4	13 55.7	-21 10	1.314	.809	38	3	279	1.7	4.5	7.7	15	5 59
9	14 34.7	-23 26	1.232	.682	36	3	276	.5	3.6	6.8	11	6 3
14	15 21.9	-25 15	1.171	.546	28	2	272	-1.1	2.5	5.7	7	6 7
16	15 43.2	-25 44	1.155	.489	25	2	270	-1.9	2.0	5.2	4	6 9
18	16 6.0	-26 1	1.143	.429	21	2	268	-2.7	1.4	4.6	2	6 10
20	16 30.4	-26 3	1.137	.367	18	2	266	-3.7	.7	3.9	MT	
22	16 56.5	-25 47	1.136	.304	14	2	264	-5.0	-.1	3.1	MT	
24	17 24.6	-25 10	1.138	.239	10	3	262	-6.5	-1.1	2.1	MT	
25	17 39.6	-24 41	1.140	.208	8	3	262	-7.4	-1.7	1.5	MT	
26	17 55.3	-24 5	1.140	.180	5	4	263	-8.4	-2.4	.8	MT	
27	18 11.8	-23 21	1.136	.157	2	8	271	-9.3	-3.0	.2	MT	
28	18 28.8	-22 30	1.126	.144	1	13	45	-9.9	-3.4	-.2	ET	
29	18 45.7	-21 35	1.107	.144	4	4	65	-9.9	-3.4	-.2	ET	
30	19 1.8	-20 41	1.081	.158	7	2	67	-9.3	-3.0	.2	ET	
31	19 16.6	-19 49	1.052	.181	10	2	68	-8.5	-2.5	.7	ET	
Jan 1, '74	19 30.5	-19 0	1.021	.210	12	2	68	-7.6	-1.9	1.3	ET	
2	19 44.0	-18 13	.992	.241	14	2	68	-6.8	-1.4	1.8	1	17 48
3	19 56.2	-17 26	.965	.273	16	2	67	-6.0	-.9	2.3	3	17 49
5	20 20.5	-15 52	.917	.337	20	2	67	-4.8	-.1	3.1	7	17 50
7	20 44.3	-14 13	.878	.400	24	1	66	-3.8	.5	3.7	10	17 52
9	21 7.9	-12 30	.848	.461	28	1	66	-2.9	1.1	4.3	14	17 54
11	21 31.3	-10 40	.826	.519	32	1	65	-2.2	1.5	4.7	17	17 55
13	21 54.5	-8 45	.812	.576	36	1	65	-1.6	2.0	5.2	21	17 57
18	22 50.0	-3 52	.812	.710	45	1	64	-.2	2.9	6.1	30	18 2
23	23 40.0	0 43	.853	.835	54	2	65	1.0	3.7	6.9	37	18 7
28	0 22.9	4 36	.925	.953	60	2	66	2.0	4.4	7.6	43	18 13
Feb 2	0 58.8	7 42	1.021	1.065	64	2	67	3.0	5.1	8.3	47	18 18
7	1 28.8	10 7	1.133	1.172	67	2	68	3.8	5.8	9.0	50	18 23
12	1 53.9	12 0	1.255	1.276	68	3	69	4.6	6.4	9.6	51	18 29
17	2 15.3	13 30	1.385	1.376	69	3	71	5.3	6.9	10.1	52	18 34
22	2 33.8	14 42	1.520	1.472	68	4	72	5.9	7.4	10.6	52	18 40
27	2 50.1	15 40	1.658	1.566	67	5	73	6.5	7.8	11.0	51	18 45
Mar 4	3 4.6	16 29	1.798	1.658	66	5	74	7.1	8.3	11.5	50	18 50
9	3 17.8	17 10	1.939	1.747	64	6	76	7.6	8.7	11.9	48	18 55
14	3 29.9	17 45	2.080	1.834	62	7	77	8.0	9.0	12.2	46	19 1
19	3 41.1	18 15	2.221	1.920	60	8	78	8.5	9.4	12.6	44	19 6
24	3 51.5	18 42	2.361	2.003	57	9	79	8.9	9.7	12.9	41	19 12
29	4 1.4	19 4	2.499	2.085	55	10	80	9.3	10.0	13.2	39	19 17
Apr 3	4 10.8	19 24	2.636	2.166	52	12	81	9.6	10.3	13.5	36	19 23
8	4 19.7	19 42	2.770	2.245	49	13	82	10.0	10.5	13.7	33	19 28
13	4 28.3	19 57	2.902	2.323	46	15	83	10.3	10.8	14.0	30	19 34
18	4 36.5	20 10	3.031	2.400	43	17	84	10.6	11.0	14.2	27	19 40
23	4 44.5	20 21	3.156	2.475	40	20	85	10.9	11.2	14.4	23	19 46
28	4 52.2	20 31	3.278	2.550	37	22	86	11.2	11.4	14.6	20	19 52
May 3	4 59.7	20 39	3.397	2.623	34	26	87	11.4	11.6	14.8	17	19 59
8	5 6.9	20 45	3.511	2.696	31	30	88	11.7	11.8	15.0	13	20 5
13	5 14.0	20 50	3.621	2.768	28	35	90	11.9	12.0	15.2	10	20 11
18	5 20.8	20 54	3.727	2.838	25	41	91	12.2	12.2	15.4	6	20 17

Figure 13. Ephemeris of Comet Kohoutek 1973f. Prepared and contributed by Mr. Charles Morris. The different columns and their interpretation are explained in the section "Ephemeris of Comet Kohoutek" on page 158.

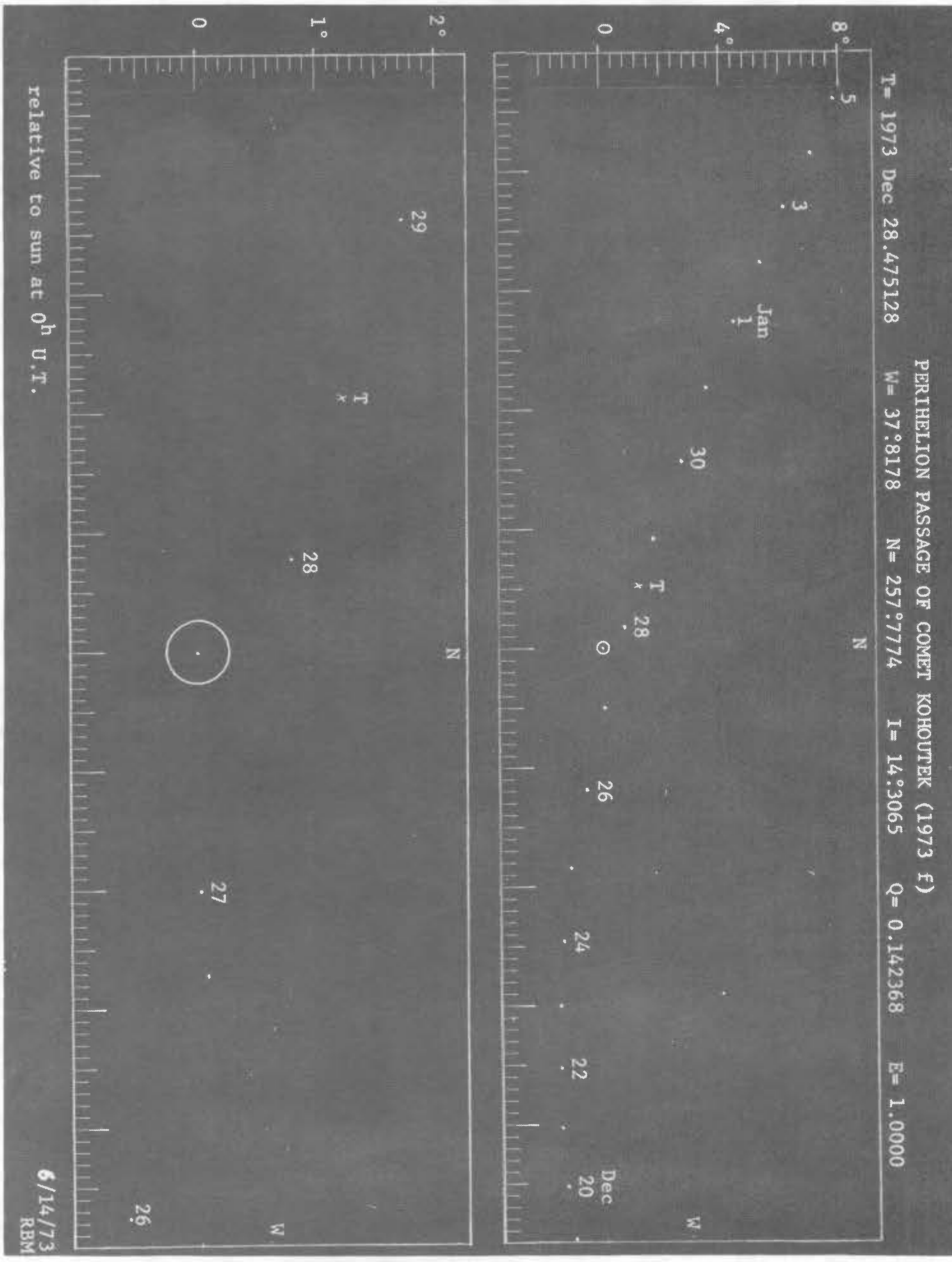

Figure 14. The location of Comet Kohoutek relative to the Sun has been plotted by R. B. Minton of the Lunar and Planetary Laboratory, Tucson, Arizona, using the same orbital elements given in the ALPO ephemeris on pg. 159. On December 24, 1973, the comet might be visible during the annular eclipse of the Sun. T indicates perihelion, or closest passage to the Sun, which does not coincide with its closest apparent approach as seen from the Earth. During this time interval, the comet's tail will swing around rapidly, in the position angles predicted in the ephemeris.

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The general problem of comet magnitude estimates is discussed by Charles Morris in his article on pp. 150-156 of this issue. His address is 1128-0 Graduate House West,

West Lafayette, Indiana 47906. To help him continue this study, observers are asked to give their telescope's aperture, type, f/ratio, magnification, and the estimating method used.

When the comet is bright and low in the sky and comparisons must hence be made with stars or planets at higher altitudes, the observer should record the original comparison ratio and the exact time because altitudes must be calculated to correct for atmospheric extinction.

Estimating the magnitude when Kohoutek is in the daytime sky will be especially difficult; but observers can remember that Venus reaches -4.4, and the Full Moon is about -12.

Dr. Joseph Ashbrook has suggested a method of dimming the comet to make it more comparable with stars in the nighttime sky. Look through the objective end of binoculars aimed at the comet, but using only one eye; with the other unaided eye, look at a star field and make a comparison. As a control observation, also estimate how much a first magnitude star is diminished; and apply the correction to the comet, plus an atmospheric extinction factor.

<u>A Photoelectric Photometer for Comets</u>. In <u>The Strolling Astronomer</u>, Vol. 24, Nos. 1-2, R. B. Minton has described how to build a photometer for \$50 to \$100. It has been used successfully on his 6-inch reflector to measure comet magnitudes to $\pm$ 0.02 stellar magnitudes and to obtain coma diameters. This back issue is still available from the Editor for \$1.50; or write to Mr. Minton at Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721.

<u>How to Measure the Comet's Size</u>. One way to prepare for Kohoutek is to determine the fields of view of your instruments and eyepieces. When timing the passage of a star across the eyepiece field near the celestial equator, the diameter of the field in minutes of arc will be $\frac{1}{4}$ of the passage time in seconds. At some distance from the equator, multiply this result by the cosine of the declination.

The diameter of the head, or coma, can be measured by allowing it to drift across the eyepiece field. Two timings are made: first, time to the second when the coma touches the eyepiece edge; second, time when it exits the field. The interval in seconds is multiplied by a factor varying with declination as in the table given here, and the answer is in minutes of arc.

Dec.	Factor
0°	
	0.25
12°.2	
	0.24
20°.4	
	0.23
26°.2	
	0.22
30°.9	
	0.21
35°.1	
	0.20
38°.9	
	0.19
42°.4	
	0.18
45°.7	

Dec.	Factor
45°.7	
	0.17
48°.8	
	0.16
51°.8	
	0.15
54°.7	
	0.14
57°.4	
	0.13
60°.1	
	0.12
62°.7	
	0.11
65°.2	
	0.10
67°.7	

The length of the tail can be estimated in terms of an eyepiece or binocular field, or can be measured by drawing on a star chart having parallel lines of right ascension. Precautions are necessary because of distortion in the non-equatorial zones. Use star catalogs for the declinations of the stars north-south of each other for another measure. Tails longer than charts will require a celestial globe, or a formula. If the beginning and end of the tail are plotted and the head is at right ascension A and declination D, while the tail end is at α and δ respectively, then:

$$\cos d = \sin \delta \sin D + \cos \delta \cos D \cos (A-\alpha),$$

where d equals the length of the tail. The difference in the two RA's must be converted to degrees by taking one hour of right ascension to equal 15 degrees.

The following star atlases are recommended, all available from Sky Publishing Co.

	Scale	Limiting Magnitude
Norton's	7.9 degrees per inch.	6 1/3
Skalnate Pleso	3.3 degrees per inch.	7.75 visual
Atlas Eclipticalis	1.25 degrees per inch.	complete to about 9.0
" Borealis	same	photographic, but goes to
" Australis	same	12.75 in places.

Photography. For tips on photographing comets, refer to past issues of Sky and Telescope, especially the coverage of Comet Ikeya-Seki 1965f and Comet Bennett 1969i. Back issues of The Strolling Astronomer containing comet reports are often available from the Editor for $1.50 per issue. Two books by Henry Paul (available from Sky Publishing) are valuable: Outer Space Photography and Telescopes for Skygazing. Besides wide-field views of the tail, try short exposures on the head to catch spiral features and jets. Spectroscopic film can be used to show dust in the comet on a red sensitive film and gas on blue sensitive film. Spectroscopic 35 mm. film can be ordered from Optica b/c Co., 4100 Mac Arthur Blvd., Oakland, Calif. 94619. However, experience with Comet Bennet showed that excellent photographs were obtained on ordinary Kodak Tri-X panchromatic film and on High Speed Ektachrome when fast lenses were used. To correct for reciprocity failure and to obtain a neutral background, use the color compensating filter recommended by Kodak.

The technique of guiding on a comet's head is discussed by Richard D. Lines in his article on making and using a micrometer microscope in The Strolling Astronomer, Vol. 24, Nos. 5-6, June, 1973.

Amateur photographs showing the gas tail of Kohoutek are being solicited by astronomers of the Max Planck Institute of Astrophysics in Munich, West Germany. One of them, Klaus Jockers, writes from Sacramento Peak Observatory, Sunspot, New Mexico 88349, that they would like to produce a time lapse movie to show motions in the plasma tail, hopefully with a picture every 10 minutes. More details will be given in Comets Section Announcements.

The Astronomical League program for Kohoutek is headed by Robert E. Fried, 4610 Orkney Lane, Atlanta, Georgia 30331. He is asking for 5-by-7 prints of Tri-X negatives made in white light, CN light with a Wratten No. 34 gelatin filter, and CO^+ light with a Wratten No. 44A.

BOOK REVIEWS

The Rings of Saturn, NASA TT F-701, by M. S. Bobrov, NASA Tech. Translation of Kol 'tsa Saturna, Academy of Sciences USSR, Astronomical Council, "Nauka" Press, Moscow, 1970. For sale by National Tech. Information Service, Springfield, Virginia 22151, $3.00. 128 pages, 39 figures, 6 photographs, and 7 tables.

Reviewed by C. F. Capen

This paper bound volume describes the present-day knowledge of a singularly unique phenomenon in our Solar System - the beautiful rings of Saturn. Observations of the rings are discussed, methods of analyses are given, and a number of conclusions as to their nature are presented.

The Introduction begins with a quote from the "On the Stability of the Motion of Saturn's Rings" by J. C. Maxwell: "When we in fact see how this majestic arc is suspended over the equator of the planet with no visible means of support.... We cannot become reconciled to this phenomenon as if it were some simple fact, we cannot describe it simply as the result of observation, and we cannot accept it without seeking for an explanation for it." The author expostulates the importance of the existence of the rings to the study of cosmogony. In essence, the rings are an observed satellite object. This latter statement neatly puts them in their proper dynamic perspective. There are 7 chapters, 34 sections, an appendix list of designations used in the simple to moderately complex formulas of Chapter VII, and an excellent list of 130 references. However, it is amazing how a student of this planet could be ignorant of or disregard the reference work by A. F.

O'D. Alexander, The Planet Saturn!

Chapter I details the zonal structure, divisions, fine or temporary divisions (10 divisions), and dimensions of the rings as noted by several prominent observers. Barabashove and Semeykin are credited with detecting in 1933 the presence of material between Ring C and the visible boundary of the planetary disk using blue light. No reference is made to P. Guerin's photographic discovery of a new divisional gap inside of and contiguous to Ring C or of the fourth Ring D (as now designated), located between the new gap and the ball of Saturn, which was announced in Comptes Rendus on December 15, 1969. Perhaps the manuscript had already gone to press.

Chapter II is a small but important introductory discussion on the 29-46 yrs. cycle of changes in ring openings, the edge-on view, observational aspects of the dark side of the rings, and their disappearance.

Chapter III describes astrophysical, radiometric, and radio-telescope observations and their results. The spectroscopically determined linear rotational velocities of the rings are reviewed. The appearances of the planet and ring system in visual, near ultraviolet, and in infrared are given and compared. The brightness and color differences as obtained by spectrophotometry are reported and compared. There is much contradictory evidence given here. Polarization observations by Lyot and Dollfus are briefly covered. The importance and use of the phase curve (photometric data vs. phase angle) is emphasized. Some rather interesting observations are reported, e.g.: Schoenberg's observations during 1913-18 and those by Fesenkov from 1926-28 showed the eastern ansa to be brighter than the western one. Camichel's series of photographs in yellow light obtained during 1943-57 indicated that the brightness ratio between Ring A and Ring B varied as a function of the angle of elevation of the Sun above the plane of the rings. The visual observation of the occultation of star BD-20°4568 by Saturn made by our own Dr. J. Westfall, ALPO Lunar Recorder, is reported; and the importance of this method of observation in order to determine the optical thickness of the rings is stressed.

Chapter IV derives a theoretical model for Ring B from the previously discussed observational data. From this model the properties of a typical particle lead to an interesting discussion of the ratio of large (macroscopic) particles vs. dust particles as constituents of the B ring.

Chapter V should be of interest to all planetary observers because it is an analysis of observations made with the rings on-edge or with very small inclinations. The introduction defines the observational aspects between the Earth and Saturn at small ring plane angles, states important observations that can be performed, and critiques Russell's theoretical formula for describing the illumination of the dark side of the rings. An interesting descriptive report of the 1966 IAU coöperative observations during the recent most favorable tri-Earth passage through the ring plane is presented in detail. The reviewer was fortunate to have participated in this international observing program and found this chapter to be a good summary.

The discovery of the tenth satellite, Janus, by Dollfus is most interesting. Photographic photometry curves of the intensity of the rings during the October and December, 1966 passages of the Earth through the ring plane obtained by Dollfus, Focas, and Kiladze made it possible to determine the physical thickness of the ring system. During the edgewise apparition of 1907-08, G. Fournier and Schaer independently observed an outer dusky ring. This outer "D - ring" was compared to the Loch Ness Monster by O'D. Alexander in The Planet Saturn, because some people see it and some do not. The Monster has reared its libertine head once again. W. A. Feibelman, using the 30-inch refractor of the Allegheny Observatory in 1966-67, obtained long exposure photographs that showed microdensitometer tracings of an extension of the ring system beyond the outer periphery of Ring A. This outer Ring D extends so far out that the new 10th satellite Janus revolves around Saturn within this tenuous ring boundary! The chapter ends with an interesting discussion of observational evidence, both pro and con, for an atmospheric envelope to the rings.

Chapter VI is primarily a review of theoretical formulas of ring dynamics. Bobrov thoroughly critiques past theoretical studies of H. Struve, H. Jeffreys, Maxwell, Cook, and Franklin on differential rotation, ring stability, and the effect of particle collisions. Recent theoretical studies are considered. Observations which show the rings to be quite stable and various mechanisms that possibly prevent complete flattening of the rings are given.

The final Chapter VII discusses the theory of the effect of mutual shading and its comparison with the observations. Introductory remarks interpret in layman language what the following theoretical discussions mean in determining the density, thickness, and total mass of the rings. The Seelinger and the Cone-cylinder approximations and the photometric phase function are reviewed. Various ring models are critiqued by comparisons between observed and theoretical phase curves. The 1966 IAU observing program obtained a phase curve for Ring B at small ring plane angles which was identical to curves obtained at large and medium angles, a result which indicates that Ring B is a many-different-sized particle system. The last Section, #34, is a summary and conclusion of the physical parameters of the rings as inferred from the previously discussed observational and theoretical evidence.

The Rings of Saturn chiefly presents the observations and theoretical studies of the European astronomers. Throughout the entire volume, Dr. Bobrov asserts the need for and the importance of observational data. He instills in the planetary observer the impatience of waiting until the next edge-on presentation of the Rings of Saturn in the early 1980's. In the reviewer's copy, the text is clear and double spaced for easy reading, whereas the photographs are extremely poorly reproduced. Planetary researchers will find the long reference list well worth the cost of the book.

The context is well balanced between empirical observation and theory. The organization of the plot is that of solving a mystery. Every observer of the planets should obtain a copy to read and to keep for reference for future observing information.

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Novice Observer's Handbook, by Richard J. Wessling. Available from the author at 946 Deblin Dr., Milford, Ohio 45150. 11 pages.

Reviewed by Fred J. Lazor

Mr. Wessling has undertaken a very worthwhile project by writing a booklet for the novice amateur astronomer. It is designed to take him as a beginner and to teach him to become a practiced serious observer able to make worthwhile contributions. However, Mr. Wessling gets off to a very bad start in his introduction with such statements as "to inform the beginning student of the proper way to make observations so they will be useful to the recorders.." and "the goal of the Training Program is to establish the credibility of the observer"..."for the recorder's benefit." It is hoped, at least, that the goal of the Training Program is to inform the beginning student of the proper way to make astronomical observations so that they will be of benefit to himself and of useful scientific value.

The author then gets "on-track" with his sections on general, lunar, and planetary terminology. His definitions are generally good, especially the description of colongitude which is seldom described in print. The examples of calculating colongitude and central meridian transits are very useful; an example for converting to Universal Time would be a good addition. The section on drawing techniques is the best part of the booklet. It is precise, explicit, detailed, useful, and just plain well done. Mr. Wessling's philosophy of drawing is interesting. The booklet ends with a section entitled "Some Tips on Telescopes", which is not well written and is not appropriate to this booklet. The material in this section is already known in detail to the telescope builder and is of little importance to the novice who has just purchased a commercially manufactured instrument.

In summary, Mr. Wessling has written a good booklet for helping a novice observer to improve his skills, but his attempt to put extraneous information into this booklet has detracted from it considerably.

Note by Editor. Book Review Editor Smith and the Editor agree that many of our younger and newer members would find Mr. Wessling's Handbook extremely helpful.

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UFO's - A Scientific Debate, edited by Carl Sagan and Thornton Page. Cornell University Press, 124 Roberts Place, Ithaca, N.Y. 1972. 310 pages. Price $12.50.

Reviewed by Rodger W. Gordon

On December 26-27, 1969, The American Association for the Advancement of Science held a symposium on the topic of UFO's. The present work is a compilation of the papers presented at that time by 15 distinguished scientists and authors for the general public who wish to know more about the controversy.

The book is divided into four main areas with several contributors to each format. These areas are Background, Observations, Social and Psychological Aspects, and Retrospective and Perspective. These topics are further subdivided as the various individuals attempt to espouse their views of the subject. We are given an introduction to UFO cases, some of which are referred to later in the text. Astronomers Page, Hartmann and Roach give the educational, historical, and astronomical points of view. Of particular interest in these areas are the UFO credit course offered by Page, the USAF foul-up of the many sightings over the years by Hartmann, and an interesting approach in the attempt to secure astrophotographic evidence of the UFO's.

The main meat of the book concerns the observations of UFO's themselves. In this area Hynek, McDonald, Menzel, Hardy, and Baker discuss the positive and negative aspects of various sightings. Despite the excellent scientific arguments by these authors discussing their own points of view and interpretation of the evidence (or the lack of it), this portion of the book is highly charged with emotionalism. Yet, it is this very emotionalism which shows that scientists are human like anyone else. The most balanced view in this section is presented by Hynek, and it should be well read by those who in the past may have shied away from the subject.

Social and psychological aspects of the sightings are discussed by Hall, Price-Williams, Grinspoon, Persky, Drake, and Sullivan. Childhood fixations, suggestive broadcasts (the Orson Welles 1938 broadcast of a fictional Martian invasion), mass hysteria, and hallucinations are thoroughly discussed as well as pseudo religious beliefs. The ability (or inability) of witnesses to describe accurately rare or unusual (to them) phenomena are plumbed to the fullest extent. We find, according to the experts, that most witnesses cannot properly relate a meaningful description of what they saw. The role of the press in reporting UFO events is also discussed as well as how it may have affected future reports. Carl Sagan has given us a very interesting analysis of the difficulty in believing in the ETH (extra-terrestrial hypothesis) of the origin of UFO's. Some intersting religious motives are offered as to why persons may wish to believe in the ETH proposal.

The book does not attempt to choose sides since the reader is left to determine his own standing on the problem. Evidence interpreted by one side as possibly extra-terrestrial in origin is categorically rejected by the other side. Thus, for example, two investigators who studied the classical Trementon, Utah, pictures offer entirely opposite explanations of the objects recorded on the film. Donald Menzel is the most conservative member while James McDonald is the most outspoken in regard to the extra-terrestrial hypothesis. It is interesting to compare how two top scientists, whose fields of specialty occasionally overlap, have managed to drift poles apart in their explanations.

After reading the book, one is forced to conclude that the big question is over interpretation of the evidence. It also further appears that unless a UFO decides to land voluntarily in order to be examined by scientists, the pros and cons over evidence will not sway the opinion of either side. Hard evidence means obtaining fragments of the UFO in one way or another - something not accomplished to date despite all the rumors of the past.

No matter what the eventual answer is, there is material here for the social scientist as well as the physical scientist. This book will have served its purpose if it can get a few who are "sitting on the fence" to delve into the problems further. I highly recommend it for an up-to-date source on this controversial subject.

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Astronomy: Fundamentals and Frontiers, by Robert Jastrow and Malcolm H. Thompson, New York: John Wiley & Sons, 1972. 404 pages. Price $12.50.

Reviewed by Richard G. Hodgson

In recent years there have been many textbooks written for liberal arts students taking a one semester introductory astronomy course. The reviewer knows of five such books published in 1972 and early 1973, and it might be argued that there are too many - at least from the publisher's point of view. For the college astronomy instructor, however, the wide choice means that one should be able to find a text to one's liking.

Astronomy: Fundamentals and Frontiers by Robert Jastrow and Malcolm H. Thompson is one of these books. It is distinguished from the others by the unusual order in which it treats its subject. Instead of the traditional order of Solar System followed by stellar and galactic astronomy, Jastrow and Thompson treat the Solar System last. This order should allow for a somewhat more sophisticated treatment of planetary science; and indeed their discussion of Venus, Earth, and Mars is fairly detailed. The book tends to jump around from one planet to another, however, which may lead to confusion in the minds of introductory-level students. There is also a tendency not to distinguish theory from observed data clearly. In the opinion of this reviewer it is better to describe the various planets and satellites before theorizing about their structure and origins. The satellites of other planets are totally ignored.

Jastrow and Thompson's book also presents a chapter on "Life in the Cosmos", in which the theory of the spontaneous origin of life is presented as fact. The reviewer believes this is over simple and not acceptable in the light of present evidence. Special creation of life by Divine activity is arbitrarily excluded. In the opinion of the reviewer it would be well for students to give serious attention to the erudite chapter on the origin of life found in Frank W. Cousins' recent book, The Solar System. (Cousins finds the chance of spontaneous origins of life anywhere in the universe to be about 1 in 10^{485}* in view of the extreme complexity of the DNA and proteins involved.)

While the Jastrow and Thompson book is well written and beautifully illustrated, it is rather expensive. It is also unfortunate that distances are expressed in the old English miles rather than kilometers. In view of the recent decision to embrace the metric system (it will be required in California schools by 1976, and is used in most of the civilized world already), there is little value in having students (especially future school teachers) learn data in archaic units of measure. At the very least the metric could be given along with the old English measures.

The unusual order of Jastrow and Thompson's book is an interesting one, but the reviewer believes that it is not necessarily better. The traditional discussion which put the Solar System first not only follows the history of discovery in astronomy approximately, but also begins with that aspect of astronomy best known to entering college students. It is usually best in teaching to work from the better known to the less well known topics. The presentation of the Solar System could be much better delineated. That reference to the satellites of other planets could be totally neglected in an introductory astronomy text is a shocking surprise.

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An Introduction to Astronomy, Second Edition, by Charles M. Huffer, Frederick E. Trinklein, and Mark Bunge, New York: Holt, Rinehart, and Winston, 1973. 507 pp.

Reviewed by Richard G. Hodgson

According to its preface, "This text has been written to provide the college student in his freshman or sophomore year with a non-mathematical treatment of introductory astronomy." This is a fine textbook for a one semester introductory course, but the reviewer feels he must take issue with the above quoted description. There is a good deal of mathematics in the text, and the presentation is more rigorous and detailed than is found in most one semester texts. Such features are not a weakness if one's students have a good high school math background and an interest in science. On the other hand, the non-science oriented, liberal arts student will probably get lost and may try to drop out. It is an excellent text for science majors who have but one semester to devote to astronomy.

While there are many commendable portions of this book, the reviewer appreciates especially the attention given in Chapter 3 to constellations. Many students take astronomy so that they may attain some acquaintance with the night sky and its constellations, and are disappointed if this topic is not discussed. Most texts, preoccupied with academic topics, ignore this desire, or relegate it to an appendix. Also appreciated is an excellent discussion of Mizar as a spectroscopic binary star, with illustrations of spectral shifts.

This book follows the general pattern of discussing the Solar System prior to stellar and galactic astronomy. The Sun, however, is discussed early, between the chapters on the Moon and on the planets. Perhaps it would be better to place the Sun later in the discussion of stellar astronomy as an example of a typical star, or as an introduction to

*This number is 1 followed by 485 zeros.

stellar astronomy. Its present location appears out of place.

Again one wonders why the chapter on the history of astronomy is placed at the end of the book, and not at the beginning. Astronomical history can be rough for the uninitiated; but it can be made interesting, and can serve as part of a general introduction to the subject.

While the book is generally well done, there are some slips worthy of mention. The formula presented for determining the resolving power of a telescope (p. 145) should be identified as that of Dawes since it is commonly referred to as such in astronomy. On page 195 it is stated that "Galileo was the first to observe the dark areas..." [on the Moon]. This assertion ignores the work of William Gilbert (pre-1603) and Thomas Harriott (1609, 1610) -- see Z. Kopal, "The Earliest Maps of the Moon" in The Moon, 1, 59-66 (1969). On pages 423 and 433 the newly revised Hubble Constant should be given, i.e., 53 ± 5 km/-sec/megaparsec distance. The publication date of Dreyer's New General Catalogue (p. 378) is 1888, not 1890. On page 316 where the Draper classification of stellar spectra is presented, it is doubtful that the companion of Epsilon Aurigae should be listed as an example of an infrared star. Discussion of "novas" rather than "novae" (pp. 338ff) grates on the ear of those who are educated in Latin. Finally on page 415 it is said that the Small Magellanic Cloud is composed entirely of Population II stars, which is far from the truth. Nor would the SMC, at - 73° declination, be visible from Hawaii as implied in the text.

These blemishes are small, however, compared to the book's achievements. As a concise introduction to astronomy this work is to be highly recommended. A future edition could be improved by use of metric measures rather than the old English system which is now passing away.

ANNOUNCEMENTS

Site of 1974 ALPO Meeting. A combined Western Amateur Astronmers--Association of Lunar and Planetary Observers meeting will be held on the UCLA campus at Los Angeles, California on August 15, 16, and 17, 1974. The WAA President is now our own Tom Cragg, an active contributor to the ALPO from its earliest years and long a Saturn Recorder. Mr. Cragg and the ALPO Director will be working jointly on Convention plans, and details will be given in future issues of this Journal. It is tentatively intended to include a "panel of experts" and a variety of activities for families not interested in the paper sessions.

New Address for Phillip W. Budine. Jupiter Recorder Budine has had the following address for several months, and future letters and observational reports should be mailed to him at: R.D. 2, Box 245E, Unadilla, New York 13849.

Materials for Venus and Saturn Observers. Dr. Julius L. Benton calls attention to the following items offered by the Saturn and Venus Sections:

1. An Amateur's Guide to Visual Observations of the Planet Saturn. Price $4.50.

2. An Introduction to Observing the Planet Venus. Price $2.50.

3. The Saturn Newsletter. Bimonthly. Annual subscription $4.00.

4. Observing forms for Saturn or Venus. Free with the purchase of no. 1 or no. 2 above. Additional sets are $2.00 per set.

Correspondence about the Venus and Saturn Sections and their work is always welcomed by Recorder Benton.

Lunar Section Change. Mr. Roy Parish, Jr. has been promoted to a full Lunar Recordership. He is now in full charge of the special program on the twin craterlets, Messier and W. H. Pickering. His future plans for this program will stress studies of the exterior shadows of Messier and Pickering and topographical structures in and near the two craters. He welcomes inquiries and observations from all interested lunar observers.

Changes in Training Program. Mr. Richard J. Wessling has resigned with much regret his staff position as head of the ALPO Lunar and Planetary Training Program. He found the time required to be excessive and to interfere badly with personal observing. Mr. Jose Olivarez, Hutchinson Planetarium, 1300 North Plum, Hutchinson, Kansas 67501 has kindly agreed to take charge of our Training Program. We thank Mr. Wessling for his past services, and we thank Mr. Olivarez for his willingness to direct a program which can be of great value to new and young A.L.P.O. members. Mr. Wessling will continue to supply the Novice Observer's Handbook, which is reviewed on page 164.

A Proposed Lunar Program: Central Peaks Survey. Mr. Michael Fornarucci, 136 Midland Avenue, Garfield, New Jersey 07026 invites lunar observers to undertake a survey to determine what proportion of lunar craters of different sizes possess central peaks. He will furnish instructions and observing forms upon request. Four sample areas will be scrutinized in an attempt to settle a lengthy dispute over how common central peaks are. Should the response be sufficient, the program will be made a regular project of the ALPO Lunar Section.

Request for Jupiter Observations. With the 1973 apparition of the Giant Planet now essentially ended, Recorder Paul Mackal requests that all observations made this year be submitted soon to him and to co-Recorder Budine. Such promptness greatly helps the work of the Jupiter Recorders. The number of observations received so far is small. Central meridian transits are in especially short supply. Full disc drawings are also needed; drawing style is much less important than accuracy. Observations received will be gratefully acknowledged in the 1973 apparition reports. As usual, more coverage of the months when Jupiter must be observed after midnight is badly needed.

The Strolling Astronomer

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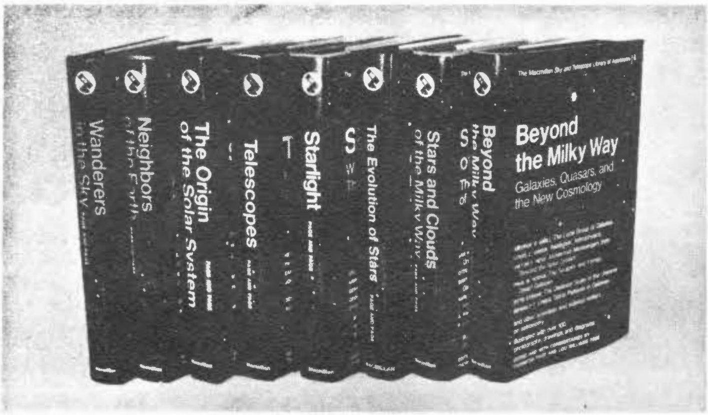

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