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Group photograph of the Fourteenth Convention of the Association of Lunar and Planetary Observers. Held at the University of Arizona, Tucson, Arizona, August 26 - 28, 1966. This photograph taken and contributed by Steve Larson, Lunar and Planetary Laboratory. See also Pages 199 - 206.

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Founded In 1947

IN THIS ISSUE

THE COMING QUEST FOR LIFE ON MARS

By: Joel W. Goodman, University of California
School of Medicine

(Paper read at the Fourteenth A.L.P.O. Convention
at Tucson, Arizona, August 26-28, 1966.)

Until recently, the National Aeronautics and Space Administration had planned to send a life-detection system to Mars during 1971, when the planet will be near perihelion at opposition. Due to the diversion of federal funds from space research to other activities, it now appears unlikely that such an experiment will transpire before 1973. When it does take place, and if it is successful, it will be an event of the greatest import, easily eclipsing the astounding results of Mariner IV. Indeed, it could provide the first incontrovertible evidence for the independent origin of life at a second locus in the universe.

Because of the expense and significance of this undertaking, it is imperative that if living organisms do exist on Mars, their presence must be unambiguously detected and their activity appropriately interpreted. The key to this requirement is the word unambiguously; for if life did originate independently on Mars, then it would appear highly probable that it followed an evolutionary pathway different from our own. Since our total experience with biological systems has been limited to terrestrial forms, we are in a somewhat disadvantageous position. It becomes apparent that what we must seek is a common denominator for all possible kinds of life.

It may appear surprising, considering the diversity of species on this planet, that there is basically only one kind of life on the earth. It is a life based on genetic information carried in a universal code by nucleic acids. All organisms, from microbes to man, are equipped with this kind of genetic material, utilize the same building blocks to construct their protoplasm, and to some degree utilize the same sources of energy. These relationships, of course, lend strong circumstantial support to the concept of evolution of all species from a common origin. Questions which arise here and which are pivotal to the delineation of life on Mars or any other planet are: Is there only a single unique way by which life can originate, and is there only a single fundamental pattern to which it can adhere? These questions, intriguing though they are and though they bear the most profound implications, will not be answered by early life-detection systems. Their solution requires an order of technological sophistication which we are unlikely to command for the next ten years, particularly at the present level of government support. The early missions will be intended only to establish whether or not life exists on Mars. Should its presence be confirmed, then a second phase of exploration will be concerned with the nature of that life.

Returning to the search for a common denominator, our current thinking about the origin and pre-biologic evolution of the Solar System and the origin of life are compatible with a certain degree of similarity between the conditions on primitive Earth and primitive Mars. Essentially, this amounts to the possession of an abundant, reducing atmosphere composed principally of hydrogen, methane, and ammonia derived from degassing of the interior. Such an atmosphere would disappear rapidly from a planet of small mass, and it is a moot question whether it could have been retained by Mars for periods of time necessary for the origin of life. However, this question aside, it seems a reasonable corollary that if prebiologic conditions were similar, then the biology of the two planets might share some fundamental characteristics. On the other hand, there appears little doubt that if Martian organisms do exist, they must differ from terrestrial forms to an appreciable degree, although the differences need not extend to basic composition. This conclusion is necessitated by a comparison of contemporary Martian and terrestrial environments. Atmospheric pressure on Mars is less than one per cent of that on Earth, while yet another order of magnitude difference exists between the water contents of the two atmospheres. One consequence of this difference is that cosmic and ultraviolet radiation, largely filtered out by the terrestrial atmosphere, would reach the surface of Mars almost unattenuated. While the level of cosmic radiation would still be sublethal, no known terrestrial organisms could survive the ultraviolet flux which Mars receives from the Sun. It must follow that if Martian life abides in unshielded locations, then, if it is not fundamentally different from life on Earth, it must possess novel mechanisms for filtering out deleterious radiation and concentrating the minute quantities of water in the planet's atmosphere. These considerations, together with the Mariner pictures depicting a Moon-like surface of Mars which has probably remained relatively undisturbed for eons of time, have considerably dampened the aspirations of exobiologists; but the situation is, nonetheless, far from hopeless.

If there is one conclusion to be drawn from the above, it is that a life-detection system should be based on as few unsupported assumptions as possible. It should be of such a nature that positive results provide unambiguous testament to the presence of life while negative responses to our detectors should enable us to conclude with some confidence that life does not exist on Mars. It is quite clear that an experiment designed to furnish such data must be landed on the surface of the planet. A fly-by or an orbiting station would be inadequate. Photographs of the earth transmitted from our weather satellites furnish no direct evidence for the existence of life on this planet.

Assuming that we have deposited an experimental package at a promising location on the surface of Mars, what type of probe would provide the most useful information? It can probably be safely assumed that if life exists on Mars, microbial life will be present. Microbes are ubiquitous on Earth; they can be found in the unlikeliest ecological niches, from hot sulfur springs to arctic ice floes. The broadest-base experiment, then, might be a microscopic examination of soil coupled with televised transmission of the high-resolution scans back to Earth. There are two weighty objections to such a procedure. First, the presence of microbe-like forms in Martian soil is no assurance of the existence of life; inanimate crystalline materials also possess highly organized structures. Secondly, the cost in terms of transmission power needed to relay a large number of pictures would probably be prohibitive, at least for early missions. What is needed, therefore, is a design which is capable of yielding useful information and which requires relatively little total transmission energy, a so-called "low-bit-rate" experiment. Examples of this type of experiment are the culture chambers which have been devised during the past few years by investigators working in this field. The simplest of these is called "Gulliver" by its originator, Gilbert V. Levin (1).

"Gulliver" is essentially a culture chamber which inoculates itself with a sample of soil obtained by two 7 1/2-meter lengths of string which are expelled from the chamber on projectiles and fall to the ground. They are reeled back into the chamber, dragging with them any particles which have adhered. Within the chamber is a growth medium which can be metabolized by viable organisms. The nutrients in the medium are tagged with radioactive carbon. If the nutrients are metabolized, the radioactive carbon is released in the form of carbon dioxide. The gas diffuses to the window of a Geiger counter, where the radioactivity is measured. If the release of carbon dioxide is due to biologic activity, then its rate of formation will increase exponentially, a feature which distinguishes biogenic from abiogenic oxidation.

The selection of nutrients for the growth medium in "Gulliver" is obviously a matter of crucial importance. The safest course, again, is one which is based on the fewest assumptions. Returning to the primitive atmospheres of the planets, we can derive useful information about the first organic compounds which were likely to be formed in such atmospheres and which are, therefore, widespread in the Solar System. This problem has been approached experimentally by passing an electric discharge through a mixture of gases believed to comprise the major constituents of the earth's primordial atmosphere (2). Among the variety of organic compounds formed in this experiment were a number which are readily oxidized to carbon dioxide by terrestrial micro-organisms. If the primitive atmospheres of Earth and Mars were similar, then it is reasonable to expect that these compounds were formed on Mars as well, and that they would be natural substrates for any life forms which might have evolved. Other, more complex experimental designs have, to a degree, evaded the chore of selecting nutrients by adopting a multi-chamber design, each chamber of which contains a distinctive growth medium.

It is worth noting that "Gulliver" has been field tested at some of the most spartan locations on this planet. It has invariably detected life on Earth. However, life, if it exists on Mars, may be sparser than at even the least favorable habitat on Earth because conditions there are so much more extreme. Testing the Martian terrain over a radius of 7 1/2 meters may, therefore, be insufficient to draw conclusions if results are negative, and the advantages of a mobile "Gulliver" rather than a stationary capsule are patent.

The reverse biogenic process, namely the conversion of carbon dioxide to organic compounds via reduction, also merits investigation. This is the process of photosynthesis, by which plants and many bacteria convert radiant energy into chemical energy. There are solid reasons for believing that if life exists on Mars, then photosynthetic organisms will be found there. First, the Sun is the most abundant and accessible source of energy in the Solar System. While the flux striking Earth is about twice that on Mars, the latter is more than sufficient to support photosynthesis. Secondly, carbon dioxide is the principal positively known constituent of the Martian atmosphere. The only other essential ingredient is a suitable reducing agent. On the earth, green plants reduce carbon dioxide with water, free oxygen appearing as a product of the reaction. All the oxygen in our atmosphere is probably derived from green plant photosynthesis, and the vegetation on this planet could have produced this quantity of oxygen in a matter of some thousands of years. There are, of course, strong reasons for doubting that water serves as a reducing agent on Mars. The dearth of both water and oxygen on the planet are convincing counter-indications. However, photsynthetic bacteria on the earth employ reducing agents other than water: hydrogen sulfide, for example. While the same could be true of Mars, the highly oxidized state of its surface does pose a problem as to the nature of likely reducing agents.

Looking farther ahead, a more satisfying arrangement than the single stage probe described above, albeit one beset with vast technical difficulties, would be an instrument package which could perform a logical sequence of experiments, each based on the results of its predecessor. Thus, we can envisage the delivery of a mission into an orbit about Mars. From the orbiting vehicle a capsule containing a diverse assortment of instruments would be launched to the surface. There would remain in the vehicle a computer programmed to direct the sequence of experiments to be performed on the ground, a transmitter to instruct the capsule and to relay information to Earth, and a receiver to obtain data from the capsule. The orbiter would thus be the "nerve-center" of the mission. The experiments performed by the capsule would proceed from the most general to the most specific. An initial probe might be an assay of the soil for biologically important substances such as nucleic acids, amino acids, and proteins, including determination of such characteristics as optical configuration. Information about the composition of the soil would permit a rational selection of nutrients for a culture chamber experiment. Development of this concept can be extended almost indefinitely, and it is apparent that a protocol of this kind would furnish information about both phases of the ultimate study, the existence and the nature of life on Mars. But the complexity of such an endeavor makes it an unlikely realization for at least the next decade.

The accumulated physical data we have about Mars, derived both from Earth-based and the Mariner fly-by experiments, reduce the likelihood of Mars as an abode of life. However, there are features of the planet which are still most easily explicable on the basis of some form of life. The dark maria undergo seasonal changes and rapidly regenerate following temporary obliteration by dust storms. An extensive new mare, Thoth, has evolved quickly; and many other regions have shown large-scale, if less dramatic, alteration. Above all, it must be remembered that the question we are asking is not whether life can originate in the climate which prevails on Mars today, but whether life which might have originated in more favorable circumstances, and which evolved through the mechanisms of adaptation and natural selection, still survives. As long as the possibility of life on Mars is tangibly not zero, the life-detection experiment is an enterprise we must undertake, not because the chances of finding life are good but because of the immense significance a positive result would bear.

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For a detailed treatment of this general subject, see: F. H. Quimby, Ed., "Concepts for Detection of Extraterrestrial Life", National Aeronautics and Space Administration, Washington, D.C., 1964.

AN ELECTRONIC IMAGE CONVERTER FOR LUNAR AND PLANETARY ASTRONOMY

By: H. P. Squyres, Jet Propulsion Laboratory

(Paper read at the Thirteenth A.L.P.O. Convention at Milwaukee, Wisconsin, July 4, 1965.)

During World War II several image converter tubes were developed for use in Snooperscopes and Sniperscopes to achieve accurate fire power in visual darkness. At the end of the war, several of these tubes were offered for sale on the surplus market for less than ten dollars.

In 1953 Dr. Alex. G. Smith wrote an article in The Strolling Astronomer (Vol. 7,

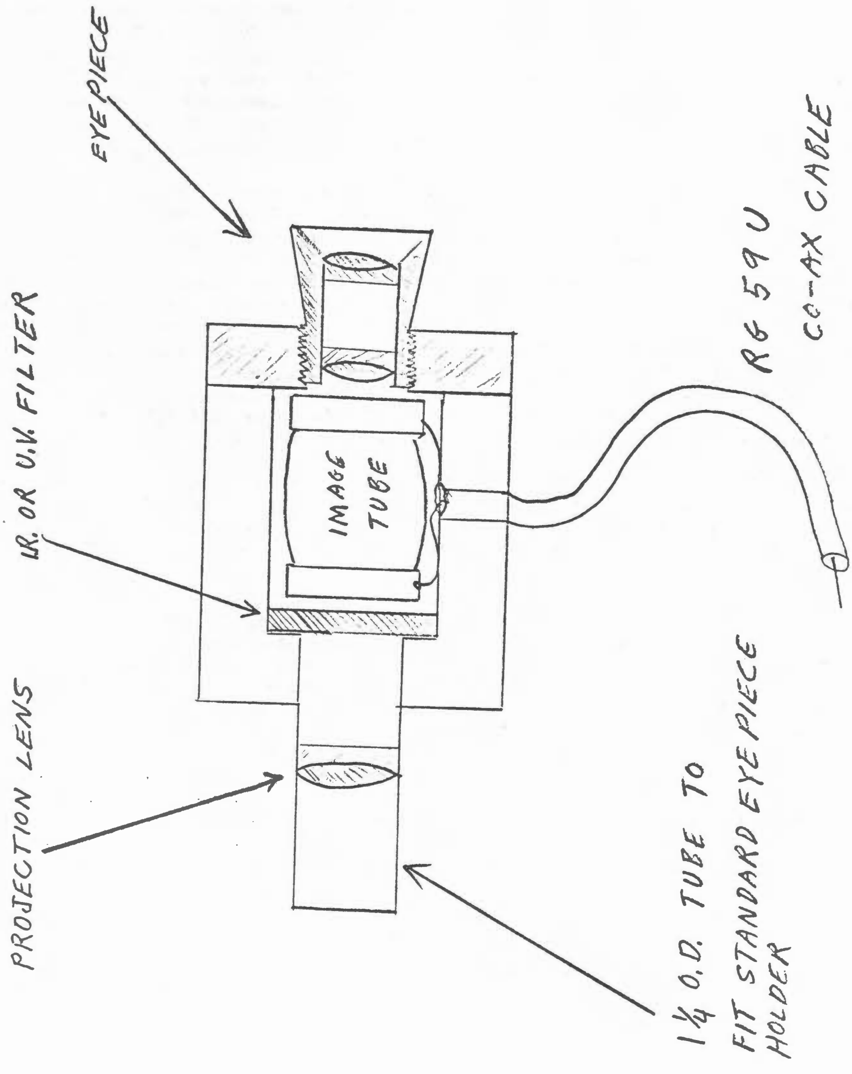


Figure 1. Diagram of mechanical layout of image converter built by H. P. Squyres for use on an astronomical telescope. See also text of his article in this issue.

page 72, 1953) on the use of a war surplus British tube (CV-147) for lunar and planetary astronomy. This tube is currently available from Edmund. Since then, several improved versions of the older type image tubes have been developed and have appeared on the surplus market at low prices.* These are the Farnsworth tubes #6032 and the #7177/1C-6. The 6032 image converter tube requires a high voltage of 20,000 volts D.C. and also a focusing voltage of about 2,700 volts D.C. The 7177/1C-6 image tube requires only a monovoltage of 5,000-6,000 volts D.C. The infrared gain of the 7177/1C-6 image tube is 3.5 compared with a gain of about 10 for the 6032 tube. The resolution of the 7177/1C-6 tube, however, is about 25 line pairs per mm. as compared to about 18 line pairs per mm. for the 6032 tube.

*C & H Sales, Pasadena, California.

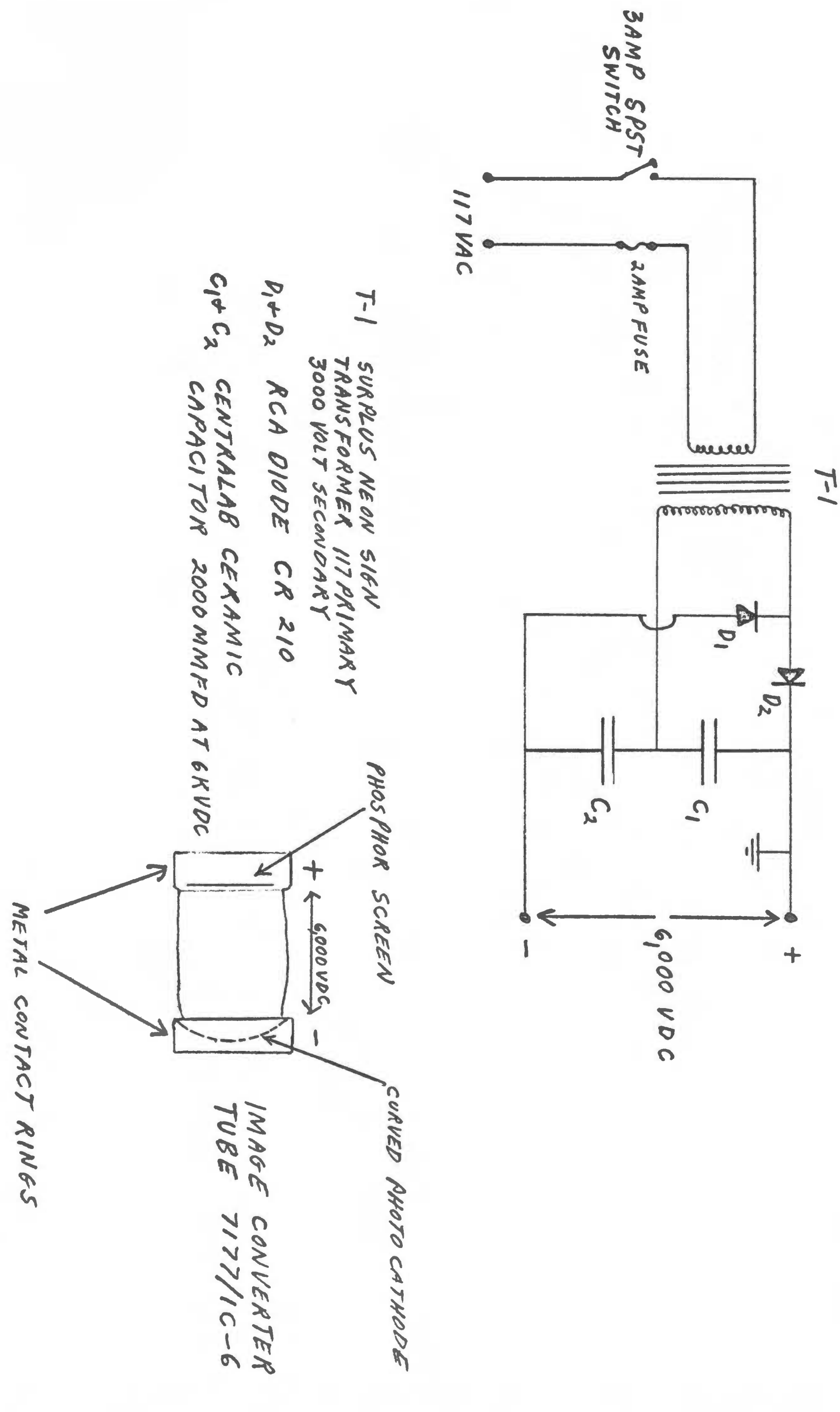
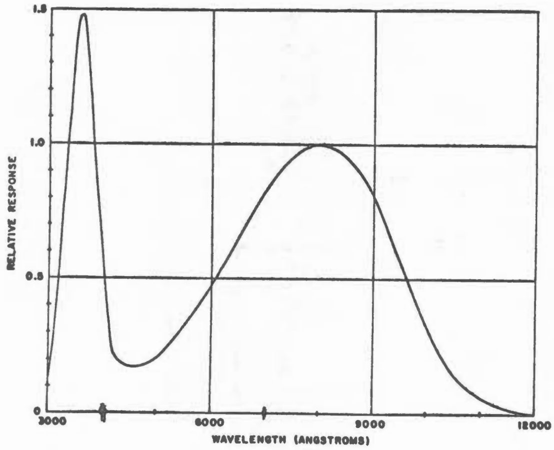
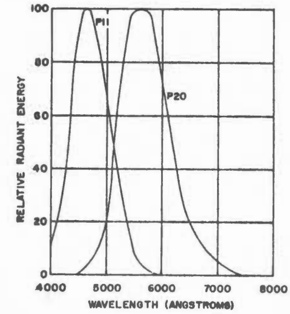


Figure 2. Schematic diagram of power supply for image converter built by H. P. Squyres. See also text.



S-1 SPECTRAL RESPONSE

Figure 3. S-1 spectral response of 7177/1C-6 image converter tube. The relative response is plotted against wavelength.



SPECTRAL EMISSION OF P11 AND P20 PHOSPHORS

Figure 4. Spectral emission of two phosphors for image tube screens. The relative radiant energy is plotted against wavelength. See also text.

The higher resolution and the monovoltage requirement of the 7177/1C-6 image converter tube make it a good choice for use by the average lunar and planetary observer.

The writer has built up an image converter for use on an astronomical telescope using the Farnsworth 7177/1C-6 image tube. The image tube is mounted in a micarta case fitted with a $1\frac{1}{4}$" brass tube which will fit any standard astronomical eyepiece holder. A projection lens inside the brass tube is used to project an image on the photocathode of the image tube. An infrared or ultraviolet filter is mounted between the projection lens and the photocathode depending on which wavelength the observer desires to use. The image on the phosphor screen is viewed with a standard binocular eyepiece and is erect since the image on the photocathode is reinverted by the electron optics of the image converter tube. A simple diagram of the mechanical layout is shown in Figure 1.

The power supply was designed using a minimum number of parts and at minimum cost. If all the parts are bought new, the total cost will be under $30.00. See Figure 2. Care should be taken to prevent accidental contact with the high voltage of the power supply. A five million ohm resistor of about one watt can be placed in each lead of the power supply output to reduce any hazard if it should be short circuited by the operator. The positive lead of the power supply should be grounded to the case of the supply; and the case in turn should be grounded to some good electrical ground, such as a water pipe or steel pipe driven into the ground near the telescope.

A good cable to use to connect the power supply to the image converter at the telescope is RG-59U coax cable. The shield of this cable is connected to the case of the power supply and also to the contact ring for the phosphor screen on the image tube. The center conductor of the coax cable runs from the negative lead of the power supply to the contact ring on the photocathode of the image converter tube. The connections to the contact rings should not be soldered but should be clamped on by a thin strip of copper or brass.

The 7177/1C-6 image converter tube has a S-1 spectral response which means that it can be used in both the ultraviolet and infrared portions of the spectrum. See Figure 3. The peak wavelength sensitivity in the ultraviolet is around 3600 Ångstroms. A Corning 7-60 glass filter is used for observations in the ultraviolet portion of the spectrum. This filter has a peak transmission near 3550 Ångstroms in the ultraviolet and nearly no transmission in the visible or infrared portions of the spectrum. Nearly any type of lens can be used for the projection lens at this wavelength since most glasses pass ultraviolet light down to 3200 Ångstroms. The projection lens can be removed from the system if the observer wishes to use just the prime focus image of the telescope. Of course, this arrangement will give a brighter but smaller image.

The writer used a Corning 2-64 glass filter for the infrared portion of the spectrum. This filter passes no ultraviolet light and very little of the visible portion of the spectrum. In the infrared it passes up to 85% of the light out to a wavelength of 2.5 microns. The peak response of the image tube in the infrared portion of the spectrum is at about 8000 Ångstroms.

The phosphor on the image tube screen is a P20 phosphor, which peaks at 5600 Ångstroms in the yellow-green part of the spectrum. This value is near the peak of the sensitivity curve of the eye. See Figure 4.

The writer has used the image converter on his own 12½" reflecting telescope with good results on the Moon. The ray systems on the Moon were observed to be much more pronounced in the infrared than in the visible or ultraviolet portions of the spectrum. The image converter was also used on the 30" reflecting telescope at the U.S.G.S. observatory at Flagstaff, Arizona during the first part of April, 1965. Dr. Henry Holt of U.S.G.S. and the writer observed that the ray system around the crater Proclus was barely visible to the eye in the visible part of the spectrum, and yet it was quite pronounced in the infrared. One other thing we noticed was that the seeing appears to improve a couple of points in the infrared as compared to the visible. The writer has tried the image converter in conjunction with his own telescope on the planet Jupiter, but the seeing was too bad to observe any detail. The image of Jupiter was faint on the image tube, but the writer thinks that it is bright enough to see detail if the seeing is good.

Of the other planets, only Venus would be bright enough in a small telescope to show any surface detail with this image converter, due to the loss in bandpass from optical filters. The writer hopes to make some systematic observations of the markings on Venus in the ultraviolet because they are seldom distinct enough for ordinary visual observations.

MEASURING PLANETARY PHOTOGRAPHS

By: F. Jack Eastman, Jr.

A question often asked of the astrophotographer is: "What do you do with your photographs?" Most people try to get a good photograph of the moon or a planet, and it usually stops there. Few persons realize the research potential of a reasonably good astronomical photograph, and fewer still realize that it is harder to get a "pretty picture" than to get one of research quality.

In this article I shall describe some simple measures, applied to planetary photographs, which yield latitudes and longitudes of features on the planet. The formulae for the subsequent reductions are given; they involve only simple algebra. All the equipment needed is a pair of dividers and a machinist's rule calibrated to 0.01 inches. Since the measures are only relative, the exact scale of the photograph does not need to be known, as it would be, for instance, in the measurement of double stars. The primary requirement of the photograph is that the limb be well defined and sharp. Planets like Jupiter and Saturn have a strong limb-darkening which will make the planet appear smaller on the print than it really is. This problem is our most important source of error. More about this later.

Let us see how the latitude of a spot on a planet may be determined. First, let us consider the special case of a spherical planet, with the observer in the planet's equatorial plane (Figure 5). What we measure from the photograph is the distance of the spot from the north pole (N) and the distance from the south pole (S), both measured along the central meridian of longitude of the planet. We also measure the planet's polar diameter to use as a check in the reductions. What we are after is the angle θ in Figure 5. It can be found from:

$$\sin \theta = (S-N)/(S+N)$$

A good check is that S + N should equal the polar diameter D. If N is larger than S, then $\sin \theta$ will be negative, or the latitude is in the southern hemisphere. All this sounds too simple...and it is. There are two principal things that complicate the problem, first, the observer is rarely in the planet's equatorial plane, and second, the planet is not a sphere.

The second of these factors gives rise to two latitude systems, and to certain numerical constants which correct for the planet's oblateness. Figure 6 shows schematically the difference, B being called the planetocentric latitude, and B" the more commonly used planetographic latitude. The difference between the two is 0° at the equator and poles, and as much as 4° (Jupiter) or 6° (Saturn) at about 45° latitude. As one can see, it is important to specify which system of latitude is being used.

Let us now look at some of the pitfalls which tend to impair the accuracy of the measures. The major one here is the apparent reduction of the planet's diameter due to the limb darkening. This effect can be reduced to some extent by printing on low contrast paper. The writer has found that the problem can be further reduced by projecting the negative upon a sheet of paper with a pre-drawn ellipse, and then fitting the limb of the planet to this outline. This process eliminates the additional loss from the printing. Of course, the detail to be measured is included on the tracing. When the tracing is complete, the central meridian is drawn as carefully as possible, and the N's and S's are measured from these. Now we are ready to reduce the observations, converting them into actual planetary latitudes.

Our first problem is that the Earth is seldom in the equatorial plane of the planet in question. We must find the quantity D_e (Figure 7) which is the amount that the Earth is north or south of the planet's equatorial plane. This value must be corrected for the oblateness of the planet in question (equation 2 below). Finally, we get a parameter B', which is then corrected for the oblateness of the planet to arrive at the latitudes B or B" (equations 4 and 5). This sounds like a mess at first, but it is not so bad as it appears. The quantity D_e is tabulated in <u>The American Ephemeris and Nautical Almanac</u> for 0 hrs., U.T. for each day of the year. The following are the complete formulae for the above reductions:

$$\sin \theta = (S-N)/(S+N) \tag{1}$$
$$\tan D_e^1 = 1.0714 \tan D_e \tag{2}$$
$$B' = \theta + D_e^1 \tag{3}$$
$$\tan B'' = 1.0714 \tan B' \tag{4}$$

or for the zenocentric system:

$$\tan B = 0.9333 \tan B' \tag{5}$$

The above equations are for the planet Jupiter only. For Saturn we need a different correction for the oblateness. To compute latitudes on Saturn, we simply change 1.0714 in equations 2 and 4 to 1.1147 and change 0.9333 in equation 5 to 0.897, and we then have the equations for Saturn. For Mars, we can set all these constants equal to one, and the arithmetic becomes quite simple. As before, obtain θ from equation 1; then:

$$B' = B = B'' = \theta + D_e \tag{6}$$

Going back to the procedure, we have measured N and S, we look up D_e in the <u>Ephemeris</u>; and then we apply the above formulae.

The calculations can be done easily on an ordinary slide rule, which will be as accurate as the measures themselves. Lacking a slide rule, we can do the arithmetic by hand and can obtain the sines and tangents with sufficient accuracy from a 3-place trig table. The answers are usually put down to the nearest 0.1 degrees, but luck would be with us if they are consistent to within one degree. There follows a sample of the tabulation of a set of measures, these being from photographs of Jupiter (which appeared on page 11 of the November, 1964 issue of <u>The Galilean</u>).

Conditions of the Observation:

Date: 10/18/64 Time: 10^h45^m U.T. Telescope 12.5" Newtonian
Image Dia. 1.380 $D_e = +3^{\circ}.35$ $D_e^1 = +3^{\circ}.6$ Longitude I = 246°.3
Method: Measurement from print. " " II = 49°.6

Feature	S	N	S+N	S-N	θ	B'	TanB'	B"	B
S.T.B.									
North edge	.28	1.09	1.37	-.81	-36°.2	-32°.6	.639	-34°.4	-30°.9
South edge	.36	1.02	1.38	-.66	-28.6	-25.0	.466	-26.6	-23.6

The above figures are for the north and south edges of the South Temperate Belt on Jupiter, which is the one tangent to the Red Spot at the time of the observation.

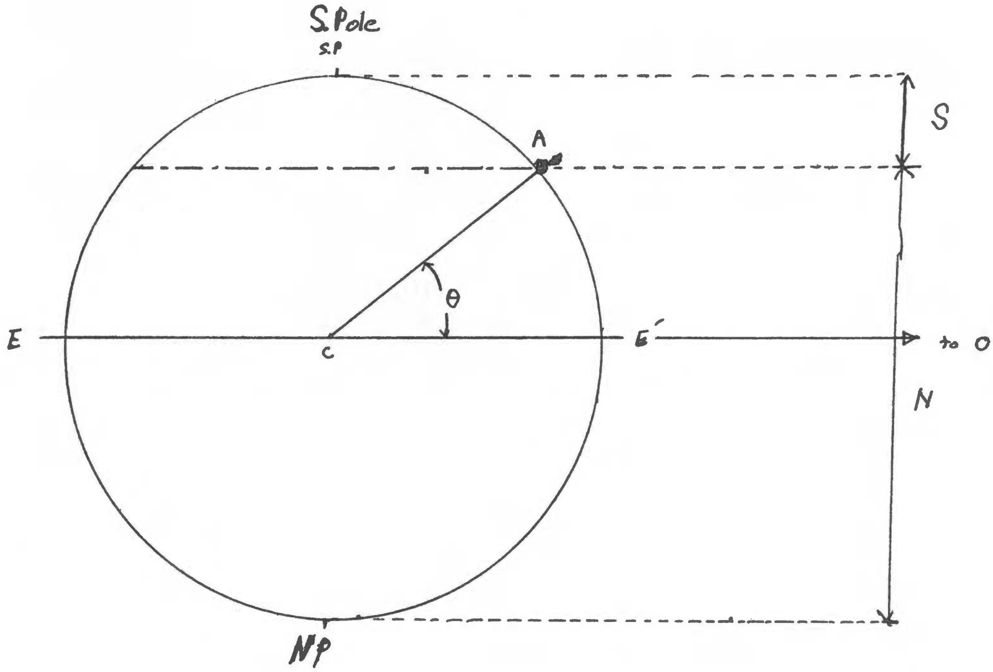


Figure 5. Diagram to show the determination of latitude in the simplified case of a spherical planet with the Earth in its equatorial plane. We measure the distance S of feature A from the south pole and its distance N from the north pole and then compute the latitude θ.

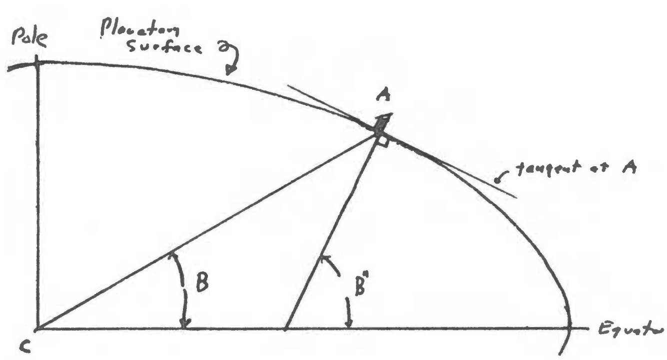


Figure 6. Diagram of an extremely oblate planet to illustrate distinction between planetocentric latitude B and planetographic latitude B" for the feature A on the planet's surface. The angle B" is measured between the equatorial plane of the planet and a line perpendicular to a tangent to the surface at A.

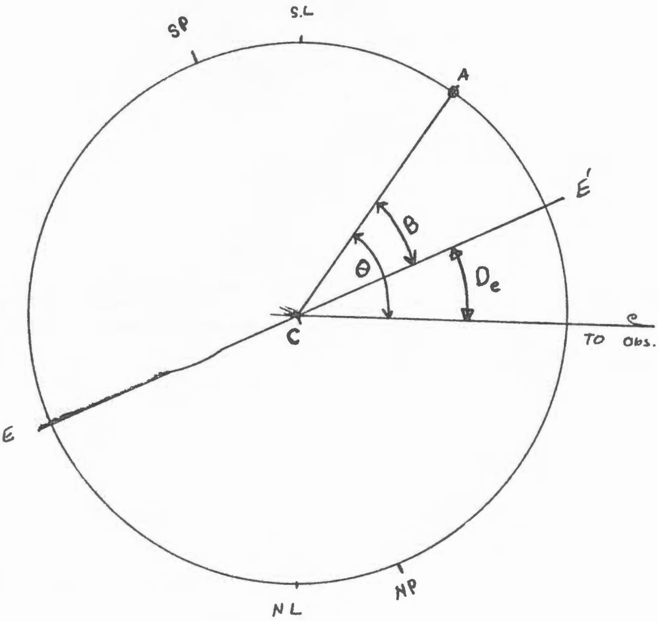


Figure 7. Observer on Earth at an angular distance D_e from the equatorial plane of a spherical planet. N.L. is north limb, N.P. is north pole, S. L. is south limb, S.P. is south pole. The distances S and N are measured from the south and north limbs respectively, as in Figure 5. The latitude of feature A is found by means of the equations on page 188. (B = B" on a spherical planet.)

Before closing, I should like to pursue the problem of the limb darkening a little further. Let us see how the computed latitude is affected by known amounts of reduction of the polar diameter of the planet. Column 1 represents no loss, while the others represent 1%, 5%, 10%, and 20% losses in polar diameter, the latitudes being measured as above.

Correct latitude	1% loss	5% loss	10% loss	20% loss
90°	--	--	--	--
80	84°0	--	--	--
70	72.0	82°0	--	--
60	61.2	66.0	74°8	--
50	50.9	54.0	58.4	73°8
40	40.4	43.6	47.1	54.8
30	30.3	32.4	33.8	38.6
20	20.2	21.2	22.5	25.3
10	10.1	10.6	11.1	12.5
0	0.0	0.0	0.0	0.0

As one can see, the greatest error is at high latitudes, decreasing to nominal values at the latitudes of most of the interesting features of Jupiter. This table was computed for Jupiter, but can apply to any planet. It was assumed the D_e is zero.

If we are concerned with the measurement of longitudes, we can use similar reasoning. The planet's central meridian is substituted for the equator, and the measures N and S are replaced by F and P, the distances from the following and preceding limbs respectively. Then equation 1 becomes:

$$\sin\phi = (F-P)/(F+P) \quad \ldots\ldots\ldots\ldots\ldots\ldots(7)$$

If $\sin\phi$ is negative, we subtract ϕ from the longitude of the central meridian as computed from the Ephemeris; if positive, we add ϕ.

Because the central angle ϕ is in the plane of the planet's equator, or in a plane parallel to this plane, we need not worry about corrections for oblateness since we shall always be working with a circular cross section. Since we are using the "instantaneous longitude of the central meridian" for our reference, we need not be bothered by angles analogous to D_e and D_s. Two things we must be careful of, however, are the aforementioned limb darkening and, particularly, effects due to the phase of the planet. The phase corrections are fairly small for Jupiter and Saturn, but may be extremely troublesome for Mars. They may be ignored for observations made near opposition.

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Note by Editor. Equation 7 falsely assumes that spots move across the disc of a rotating planet along chords parallel to the equatorial diameter. This assumption will often be sufficiently nearly correct, however, when D_e is small (hence always for Jupiter if extreme accuracy is not required) and when ϕ is numerically small near the central meridian (where, of course, any method achieves greatest accuracy).

ADDITIONS TO THE A.L.P.O. LUNAR PHOTOGRAPH LIBRARY---V: SURVEYOR I LUNAR PHOTOGRAPHS AND ONE AMATEUR PHOTOGRAPH

By: John E. Westfall, A.L.P.O. Lunar Recorder

Surveyor I Lunar Photographs

On June 2, 1966, at 06:17:14 U.T., the Surveyor I spacecraft successfully landed in the northern portion of the Flamsteed ghost ring, at 2°.4 South, 43°.4 West (in new IAU sense). Almost immediately, the spacecraft's television camera began transmitting back to earth what are the most detailed lunar photographs yet taken—rock granules as small as 0.5 millimeter in diameter are visible on some of the photographs. N.A.S.A. has supplied the A.L.P.O. Lunar Photograph Library with eleven prints of these photographs, all on an 8 X 10 format, and all of which are available on loan to A.L.P.O. members on the same basis as the previous photographs in the library. These eleven photographs are listed and described below.

Code Number	Format	Description
66-H-597	Narrow-angle composite	Low mountain range, ca. 12 miles NE, possibly Flamsteed Ø.
66-H-783	Narrow-angle	Footpad #2, with adjacent disturbed surface.
66-H-790	Wide-angle assembly	Panorama of N. horizon, with low mountains. Approx. lunar azimuth 322° - 037°.
66-H-794	Narrow-angle composite	0.5 meter long rock SE of spacecraft.
66-H-807	Narrow-angle	SW horizon with rim of large crater.
66-H-808	Narrow-angle	Mountain chain to NE (area also shown in 66-H-597, with opposite lighting).
66-H-813	Narrow-angle	SW horizon, low-sun view.
66-H-824	Narrow-angle mosaic	Low-sun view of surface SW of spacecraft.
66-H-827	Wide-angle mosaic	Strip view of entire horizon.
66-H-832	Wide-angle	Shadow of Surveyor I cast by setting sun. (Colong.: 213°.0).
66-H-833	Narrow-angle mosiac	Area from spacecraft to SW horizon, showing 0.5 meter rock.

Two of these photographs (66-H-824 and -832) accompany this paper as illustrations,

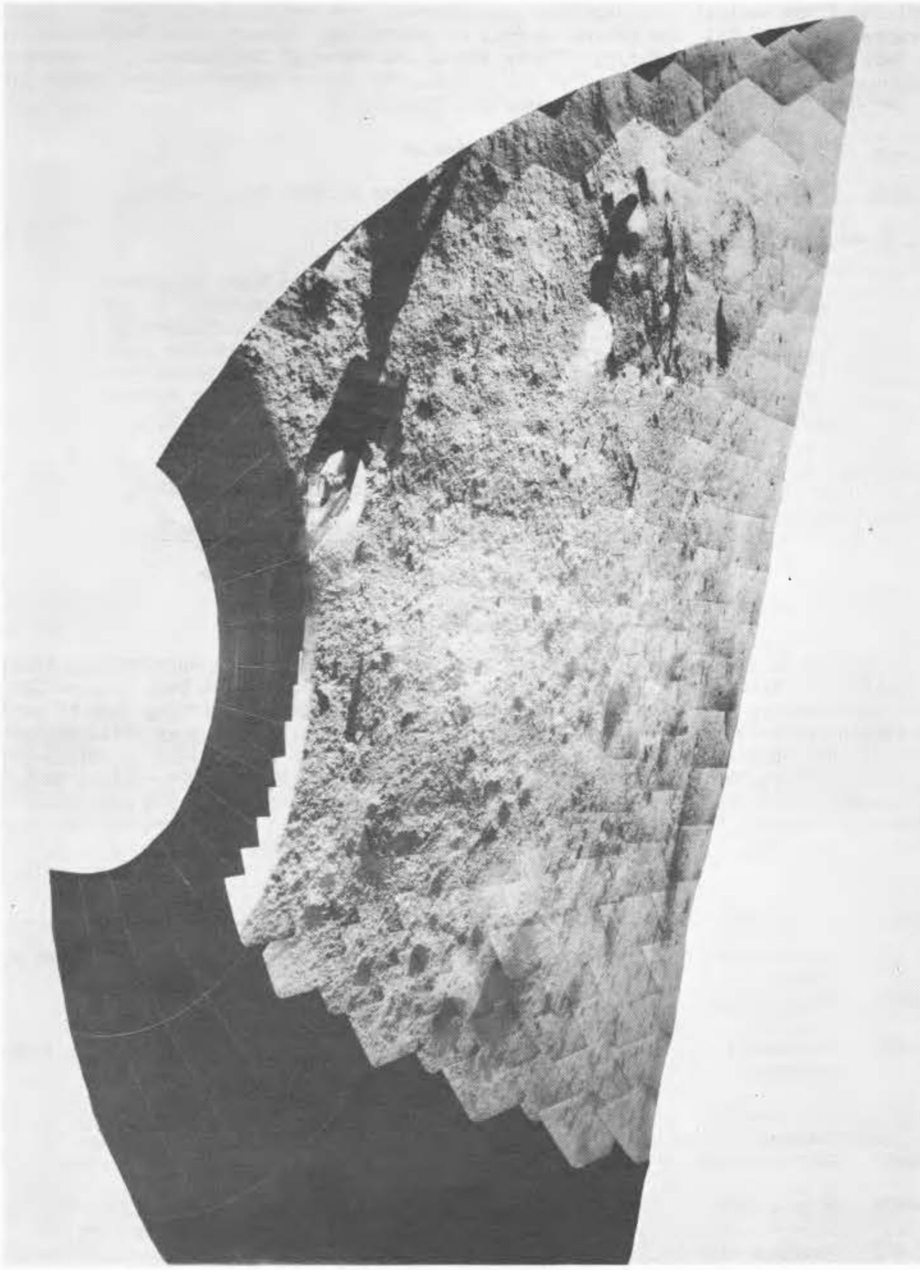

Figure 8. A mosaic of wide-angle photographs to the southwest (IAU sense) of the Surveyor I spacecraft. The low lighting of the late afternoon sun highlights numerous small craters and rock blocks. This photograph is 66-H-824 in the A.L.P.O. Lunar Photograph Library.

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Figures 8 and 9. Readers wishing more information about the Surveyor I mission should consult these two sources:

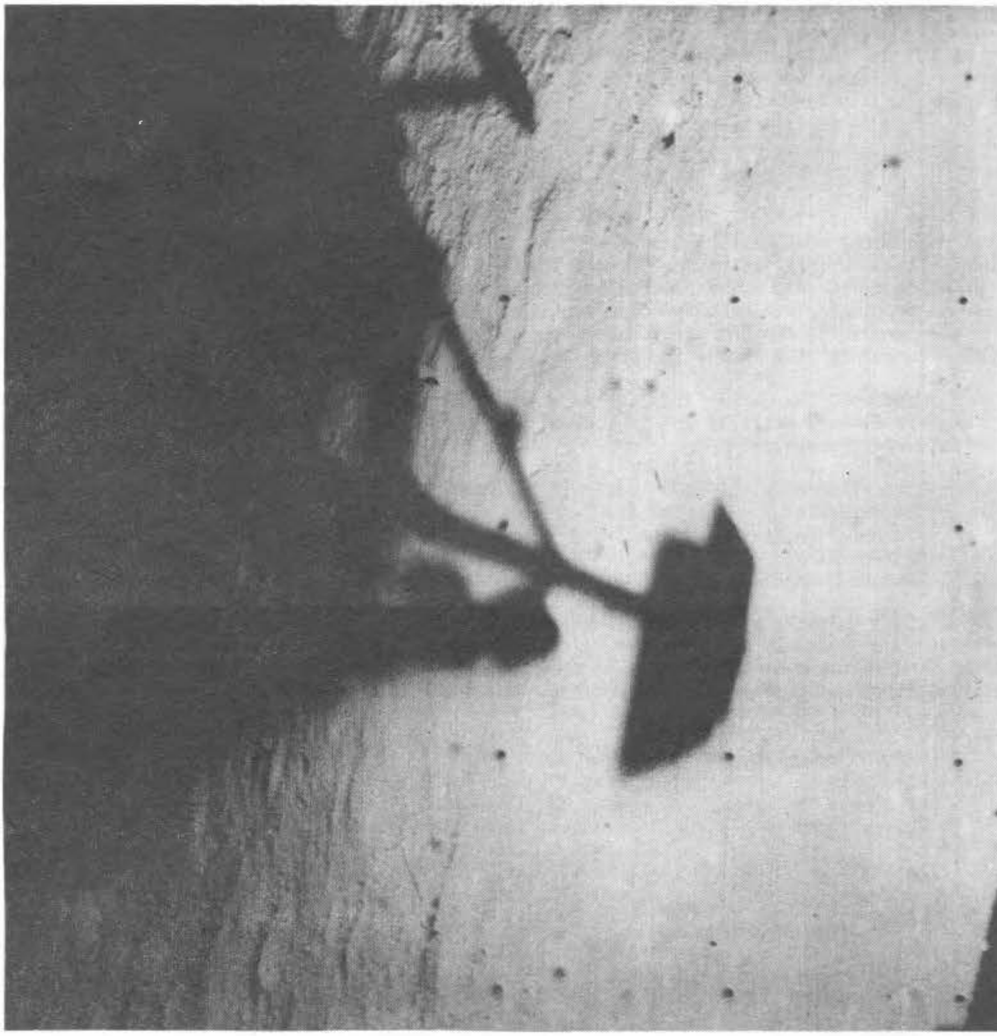

Figure 9. The setting sun casts Surveyor I's shadow towards the (IAU) eastern horizon as the spacecraft's first day on the moon nears its end. This photograph, 66-H-832 in the A. L.P.O. Lunar Photograph Library, was taken on June 13, 1966, 18^h 55^m U.T., at colongitude 213°0.

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Anon. "Pictures From the Moon." Sky and Telescope, 32, 1 (July, 1966), pp. 16-20.

Jaffe, L. D., et al. "Surveyor I: Preliminary Results." Science, 152, 3730 (24 June, 1966), pp. 1737-1752.

Amateur Photograph

As far as loan requests are concerned, interest in the A.L.P.O. Lunar Photograph Library has quickened lately. Unfortunately, on the other hand, only one amateur photograph of good quality has been received since the last report. This photograph is available for loan, and was taken by Alan Kiplinger of Concord, Tenn., with a 12½-inch Newtonian working at an effective f/160. Details are:

Code Number	Area Covered	Date & Time (U.T.)	Colongitude	Approximate Scale
AK-1	Plato-Aristoteles-Archimedes	17 Aug., 1965, 09:55	153°.1	2.8M.

LUNAR TRANSIENT PHENOMENA: A.L.P.O. PARTICIPATION IN RECENT NASA ALERT

By: Charles L. Ricker, A.L.P.O. Lunar Recorder

On May 11, 1966, a letter was written to Walter Haas by Mrs. Winifred Cameron of NASA concerning a request by Dr. Jack Green that certain features which have been reported in the literature as exhibiting temporary anomalies should be observed around the time of minimum perigee. Dr. Green provided a list of the features along with the date when the sunrise terminator would be two days past the feature. These observations were requested for the purpose of testing his tidal stress hypothesis; and as Mrs. Cameron said, it provided amateurs a good chance to help test and check a theory.

Copies of the letter and list were sent by Prof. Haas and the writer to about 20 ALPO members who are actively interested in such phenomena. Observations were received from the following observers:

John Bortle	22" Mak. (Stamford Observatory)	Mt. Vernon, N. Y.
Rev. Kenneth Delano	12½" Refl. (Red Filter)	New Bedford, Mass.
Clarke Hewitt	6" Refl.	Newton, N. C.
Frederick Jaeger	6" Refl.	Hammond, Ind.
Charles Ricker	6" Refl. (Red & Blue Filters)	Marquette, Mich.
Kenneth Schneller	8" Refl. (Slit Spectroscope)	Cleveland, Ohio

It is felt that this response was quite good considering the fact that the observers received the data only a day or two before the first listed dates. Following is a summary of the observations by U.T. dates and times. Only two anomalies were noticed. More detail will be given about these anomalies below. All other listed observations were completely negative.

Promontory Agarum	1966, May 26, 1:00-1:30
Alpetragius	May 30, 1:45-1:47
Alphonsus	May 30, 1:40-2:05; May 31, 2:30; June 3, 2:23
Aristarchus	June 1, 1:58; June 2, 2:25-3:30; June 3, 2:26-2:31; June 4, 2:40-3:35
Bartlett	May 30, 1:45-1:47
Copernicus	May 30, 1:45-1:47, 2:10-2:20; June 3, 2:24
Eimmart	May 26, 1:00-1:30
Gassendi	May 31, 1:15; June 1, 2:30; June 2, 2:25; June 3, 2:00-
Godin	May 27, 1:13-2:15; May 30, 1:19-1:23, 1:47-1:50 /3:50
Graham	May 27, 1:30-2:28
Herodotus	June 1, 1:58; June 2, 2:25; June 3, 2:26-2:31
Hyginus N	May 27, 1:13-2:15; May 30, 2:35-2:38
Kant	May 27, 1:18-2:18; May 30, 2:35-2:38
Kepler	May 31, 1:25; June 1, 2:45; June 3, 2:00-3:50; June 4, 2:40-3:35
Linné	May 27, 1:13-2:15; May 30, 2:35-2:38
Littrow	May 27, 1:25-2:33
Macrobius	May 27, 1:25-2:33
Petavius	May 26, 1:00-1:30
Picard	May 26, 1:00-1:30
Pickering (Messier A)	May 26, 1:00-1:30; May 27, 1:00-2:28
Plato	May 30, 1:25-1:40, 1:45-1:47; May 31, 2:15; June 1, 3:07
Ross D	May 26, 1:00-1:30; May 27, 1:18-2:18
Schickard	June 3, 2:00-2:30; June 4, 2:40-3:35
Thales	May 26, 1:00-1:30; May 27, 1:25-2:33
Thaetetus	May 30, 2:35-2:38
Timocharis	May 30, 1:45-1:47
Tycho	May 30, 1:13-1:17, 1:45-1:47; June 3, 2:00-2:30

Anomalous observations: On June 2, at 3:05-3:35, Kenneth Schneller, using his 8" Refl. and slit spectroscope, scanned the crater Lichtenberg and found the west wall enhanced in red light. He regards this as normal sunrise reddening, an opinion which is not shared by this writer. The subject of "normal" sunrise reddening in itself would make an interesting study. While it is true that this observation may not be a "transient phenomenon"as the term is now used, it is also true that such reddening is variable, and thus technically "transient". Comments from the readers as to the interpretation of this aspect would be most welcome. On June 2, 1966 at 4:00-4:30 U.T., Frederick W. Jaeger observed a brownish-yellow edge on the south rim of Aristarchus. The whole southern wall of Aristarchus is known to display anomalous color phenomena, according to many observers. It is significant, though, that Aristarchus was being observed on the same night by two other observers, and they reported nothing unusual.

As stated above, ALPO participation in this alert was an unplanned, hurried affair; and the methods of observing and reporting by different observers were far from uniform. It is also evident that in some cases examination of various features was far too cursory. This writer feels that such surveys can be of value under certain conditions:

1. That each area be thoroughly studied, and not merely scanned, since it is doubtful that a subtle anomalous appearance would be noticed with just a cursory examination.

2. That the program be carried out over a sufficient number of lunations to allow each observer to become thoroughly familiar with the chosen areas. It is doubtful that one will recognize an abnormal appearance if he is not familiar with the normal appearance.

3. That a degree of uniformity in reporting observations be attained. As a minimum, the following data should be given: (A) Date, by U.T. (b) U.T. at the beginning AND end of the study of each feature. (c) U.T., and duration of any anomalies noticed. (d) Telescope-Type, Aperture, Magnification, Color filters used. (e) Seeing, Transparency, Wind conditions. (f) A full description of any anomalous appearances.

We are not sure that there is sufficient observer interest in such surveys to warrant a formal program, i.e., a concentrated survey at each apogee and perigee, with complete reports submitted to this Recorder at the end of each lunation. The writer will welcome comments on this article, and expressions of interest in this type of program. Whether or not such programs are continued on a formal basis will depend upon observer response. Of course, if any observer wishes to pursue such studies on his own, he should communicate his results to the Recorder, whether or not there is a formal program under way.

THE TOBIAS MAYER - MILICHIUS - HORTENSIUS DOMES

By: José Olivarez

On all the lunar surface there is probably no more observation material for a night's observing of lunar domes than in the Tobias Mayer-Milichius-Hortensius area. This large area just east of Copernicus is the richest known area for lunar domes in the lunar sphere. (East and west are used in this paper in the old selenographic sense, where Mare Crisium is near the west limb.) The dome sizes, types, and structural surface forms vary. Mostly, they are flat to very flat. This flatness makes them hard to identify from the surrounding surface. Most of them also possess a depression on or near their summits as the original of the photograph here published as Figure 10 shows clearly. However, it has been shown that the depressions are just that and not "blowholes" as on the famous Milichius and Kies domes.

The accompanying sketch (Figure 11) was traced from the photograph (Figure 10) accompanying this article and was constructed to serve as a guide in identifying the domes in the photograph. All of the domes identifiable in the photo are numbered according to an earlier numbering system devised by the BAA Lunar Section[1]. The letters on the sketch are my additions and are for "domes" that have not been seen or definitely identified by the BAA Lunar Section. The BAA Lunar Section also numbered some hills as possible domes so that the numbers on the sketch are not in continuous sequence since I omitted these hills and changed the numbers of those domes identified by the BAA Lunar Section on photographs but NOT actually observed, to capital letters.

Of particular interest is dome number 8, which was recently discussed by Mr. S. R. B. Cooke[2]. The photograph suggests that the area is more complex than Mr. Cooke presented it. There is an apparent dome (labeled E on Figure 11) just south of No. 8 and probably connected to it. There is also a suggestion of two swellings southeast of No. 8. Indeed,

Figure 10. Photograph of Tobias Mayer-Milichius-Hortensius Area of Moon with McDonald Observatory 82-Inch Reflector. Lunar south at top, lunar west in older selenographic sense at left. Photograph taken under low evening illumination. Original of this photograph given to the writer, José Olivarez, in 1963 by Mr. Ewen A. Whitaker of the Lunar and Planetary Laboratory, University of Arizona.

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this small area immediately around Dome No. 8 deserves further attention to supplement Mr. Cooke's recent investigation.

Figure 11. Sketch of domes and other objects shown in the photograph (Figure 10) and traced from the photograph by José Olivarez. The nomenclature here used and a number of the individual domes are discussed in the text of his paper.

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A detailed sketch and discussion of the dome just east of Wagner has been published by Mr. Cooke.[3] He shows the depression on the dome with three tiny craterlets within it.

The area that is immediately challenging to the lunar observer is that just south of Tobias Mayer which contains some obviously fine specimens that unfortunately have not yet been recorded enough times. Domes A, B, C, and D (Figure 11) are the immediate "observing problems". Dome enthusiasts would do well to make a detailed study of this interesting cluster. Domes A, B, C, and D are obvious in the acompanying 82-inch photograph (Figure 10) but are hard to observe at the telescope, presumably because of shadow from the mountainous masses to their west at grazing morning lighting. It would be best to search for them at evening lighting shortly after the Last Quarter, when the shadows of the mountainous masses are on their western side instead of on their east side where the domes are.

A cluster of three small domes just south of Tobias Mayer is labeled G in Figure 11. They are the smallest dome-like features in the area, and there is a chance that they might be hills. However, the BAA Lunar Section observers consider them "domes".

The summit depression on object 19 has been seen as a double craterlet, while object 21 is connected to a mountainous mass. All of the domes may be studied in detail at around colongitude 34°5 several days after First Quarter. The next good opportunity for observers in the United States to study this area at that solar lighting will occur near 4 hrs., Universal Time on November 23, 1966 (11 P.M. on November 22 by E.S.T.).

References

1. Rae, Leslie W., "Hortensius, Milichius, Tobias Mayer Area", The Moon, Volume 10, No. 4, pg. 74.

2. Cooke, S. R. B., "An Unusual Lunar Dome", Sky and Telescope, Volume XXXII, No. 2, pg. 111, 1966.

3. Cooke, S. R. B., "Lunar Domes Near Wagner and Birt", Journal of the British Astronomical Association, Volume 66, No. 6, pg. 216, 1956.

BOOK REVIEWS

A.C.I.C. Mars Map, published in 1966 by the Air Force's Aeronautical Chart and Information Center (A.C.I.C.), St. Louis, Mo. Available from Supt. of Documents, Washington, D.C. Price, 50¢.

Reviewed by Rodger W. Gordon

This map was prepared in collaboration with the late Dr. E. C. Slipher of Lowell Observatory. It is based on drawings and photographs made by Slipher over a period of many years and also on 32 drawings by Dr. G. de Vaucouleurs in 1958. Positional reference was based on this material and also on the Lowell Observatory Mars Globes by P. Lowell. This map is an expansion of the map which appeared on the inside back cover of Slipher's book, Mars, the Photographic Story, which was reviewed by the writer in the Sept.-Oct., 1963 issue of The Strolling Astronomer.

This map is in full color. Color intensities were derived from tri-color photographs of the planet made by Slipher during favorable apparitions and also on visual work. The scale is 1:35,000,000 on a Mercator projection. Six full globe views augment the main map. They show Mars at northern summer and southern summer, with the pole tilted 21° to the observer. These six views will greatly help orient the beginner to Mars observation.

This reviewer compared the map with several others in his possession and in particular with the map issued in 1962 by North American Aviation, which was prepared under the guidance of Dr. A. Dollfus of Meudon. In the reviewer's opinion, the ACIC map is more reliable positionally and also in detail. A comparison, for instance, of Mare Sirenum and Mare Cimmerium shows that the ACIC map agrees with what is seen visually and photographically, while the North American map shows two non-existent small "coastlines". Trivium Charontis is also rather badly mauled on the North American map.

The ACIC map also shows the "canals", "as they have been drawn by many prominent observers of Mars", comments ACIC. This reviewer failed to find one canal on the map which was not shown photographically in Slipher's books, Mars and Brighter Planets.

Only one adverse criticism can be made of the map. It is printed "astronautically" instead of "astronomically". This means that north is at the top and west is counterclockwise rotation. It will be a while until we set foot on the Red Planet so that conventional directions as seen in normal astronomical observation would have been a wiser choice. However, one can always turn the map upside down and use it.

Not all the names of the surface features have been printed on the map. In the Slipher book, Mars, almost all named formations are represented in print. Although ACIC says that the names on the map correspond to those suggested by the I.A.U. Mars subcommittee on Martian nomenclature, this reviewer found "Eden" and "Lunae Lacus" in place of the now accepted "Moab" and "Palus". I have always preferred the former version, and I suspect present-day A.L.P.O. observers of the Red Planet do also.

Since next year (April, 1967) Mars will be starting a new cycle of closer oppositions, interest in the Red Planet will undoubtedly rekindle itself among amateurs and professionals. This map belongs in the possession of every amateur and professional who observes Mars.

The Origin and Evolution of the Universe, Evry Schatzman, Basic Books, Publishers, 404 Park Avenue South, New York. Hardback, 280 pages, price $8.50.

Reviewed by Russell C. Maag

Originally published in France in 1957 as L'Origine et Evolution des Mondes, this book has been revised by Professor Schatzman for this first English translation from the French by Bernard and Annabel Pagel, dated April 29, 1966. Now on the staff of Mount Stromlo Observatory, Canberra, Australia, Dr. Schatzman was formerly Professor of Astrophysics in the Faculté des Sciences de Paris and is a specialist in theoretical astrophysics.

The contents of this book are divided into four main sections, beginning with a discussion of the present state of knowledge concerning the Solar System, the stars, and the interstellar matter. The second part deals with the origin and evolution of stars and stellar systems, going into thermonuclear reactions and sources of energy, changes in composition, and the evolution of stars with changes of structure in evolution involving loss of matter and accretion. Gravitational condensation, the formation of stars in groups, and the origin of multiple stellar systems is very well theorized. The third section concerns extragalactic nebulae and cosmology, with a statement of the problems involved, the observational data which introduces Olbers' paradox, extragalactic and intergalactic matter, and the red shift and spectral lines. Several cosmological theories involving the foundations of general relativity, many cosmological models, and modifications of relativity are dealt with.

The fourth section, which should be of interest to the lunar and planetary astronomer, and therefore to members of the Association of Lunar and Planetary Observers and readers of The Strolling Astronomer, deals with the origin of the Solar System. This includes an introduction to various theories and the observational evidences of the age of the earth and other bodies in the Solar System. The nebular theory is dealt with, in particular the problem of angular momentum; so are the structure of the primeval nebula and the formation of the planets and other objects in the Solar System. Some theories are also given concerning other ideas of such formation. The well-written book ends with an appendix which concerns the origin of the chemical elements, the characteristics of their abundance curves, and their formation in and out of equilibrium states. Thermodynamics and cosmology are briefly discussed. The book has a comprehensive bibliography for those readers desiring to go into the source material, as well as some of the mathematical basis for such a study.

This reviewer found the book very interesting reading. It supplies in logical and analytical sequence the many theories and observational data which have been, and are being, dealt with in Man's understanding of the Universe in which he finds himself. I would recommend the book to readers of The Strolling Astronomer and to those engaged in lunar and planetary work. The advanced amateur with some background in mathematics will derive a more thorough understanding of its contents. The several drawings, illustrations, and tables appear to be in good order; and no typographical errors were noted.

THE 1966 TUCSON CONVENTION OF THE A.L.P.O.

By: Richard E. Wend

The 14th convention of the A.L.P.O. was held on August 26-28, 1966 at the Steward Observatory, University of Arizona, Tucson, Arizona. Sponsors were the Steward Observatory, the Tucson Astronomical and Astronautical Association, and the Lunar and Planetary Laboratory of the University of Arizona.

The convention was a resounding success, and it was all - A.L.P.O.; we did not meet in conjunction with the W.A.A. or the Astronomical League, as we have often done in the past. It was, therefore, particularly gratifying that registrations totaled 104, with a few additional people attending some activities without registering. Of course, Tucson was the ideal place for an A.L.P.O. meeting. As Dr. George Van Biesbroeck of the Lunar and Planetary Lab pointed out in his welcoming speech, the large array of research telescopes in the Tucson area is unique and has brought a concentration of astronomers that will make Tucson the astronomical capital of the world.

The ALPO exhibit opened Thursday morning, August 25th, and featured a large number of photographs and drawings. Dennis Milon was in charge of this exhibit. To mention only a few items, Comet Ikeya-Seki produced some spectacular color photographs at sunrise, Saturn's edgewise ring presentation was shown, and a large collection of astronomical stamps of the world was shown. In another room, Ewen Whitaker's collection of rare lunar maps was exhibited.

Registration at the Kaibab-Huachuca Dormitory began in the afternoon; and coffee, punch, and cookies were served in the evening. The 21" reflector at Steward Observatory was available that evening for observing, but variable cloudiness gave only a low-contrast view of the Moon. Better nights were to come.

Friday's session began in the auditorium at the Steward Observatory with welcoming remarks by Dr. Robert Noble of the Steward Observatory and by Walter Haas, A.L.P.O. Director. Dr. George Van Biesbroeck of the Lunar and Planetary Lab gave a talk on ASTRONOMY IN TUCSON, explaining how AURA (the Association of Universities for Research in Astronomy) selected Kitt Peak in the Papago Indian Reservation, 45 miles southwest of Tucson, for the site of the National Observatory. While there is an impressive array of instruments on the mountain now, the largest one is just beginning its construction stage: the 150" telescope to be placed on the highest point of the mountain. Already in operation is a 50" telescope remotely controlled in Tucson. Ewen Whitaker of the Lunar and Planetary Lab then spoke about THE LUNAR SURFACE. He discussed the effects of volcanic action in producing different colors on the Moon, and other phenomena like pressure ridges and grid effects.

After we had lunch at the Student Union Cafeteria, two air-conditioned buses brought us up the steep road to the 6800' Kitt Peak National Observatory. Dr. Arthur Hoag escorted us to the McMath Solar Telescope, which dominates the peak with its triangular aspect. This is the busiest instrument on the mountain, working the Sun during the day and doing pioneer work at night in selected fields. A side door in the main shaft permitted us to see the beam of sunlight slanting down to the 60" paraboloid at the bottom. At the control center at the top of the vacuum spectrograph, occasional glimpses of the projected image of the Sun could be seen between the clouds by a fortunate few. Before we left the peak, the sky cleared; and at the museum a projected image of the Sun through a 3" lens showed the sunspots very clearly. We were also shown the 84" and 36" of the Kitt Peak Observatory and the Steward Observatory's 36" reflector, which used to be on the campus of the University of Arizona.

After our dinner, the business meeting began with a discussion of the ALPO Observing Manual, in preparation for many years and now nearing completion. Tom Cragg of Mt. Wilson Observatory offered technical advice for those members protesting municipal overlighting with mercury-vapor systems. It was voted to have our 1967 and 1968 conventions with the Western Amateur Astronomers at Long Beach, California and with several groups at Las Cruces, New Mexico respectively.

After the business meeting, there was informal observing at the 21" telescope at Steward Observatory. A short wave radio hook-up produced a demonstration of the Argus-Astronet observing program as a report of activity in the crater Alphonsus was received and investigated (not confirmed).

The Saturday morning (August 27) activities began with a tour of the Kitt Peak Tucson offices, and the optics shops where the new flat for the McMath solar telescope is being finished, and where the 150" mirror will be made, and tested in the vertical tower dominating the area.

Dr. Joel Goodman of the University of California School of Medicine presided over the morning paper session and also gave the first paper, THE COMING QUEST FOR LIFE ON MARS. He described an unmanned station called Gulliver, which would collect surface samples by means of sticky ropes and analyze chemically the material thus drawn in. Radio-

(text continued on page 205)

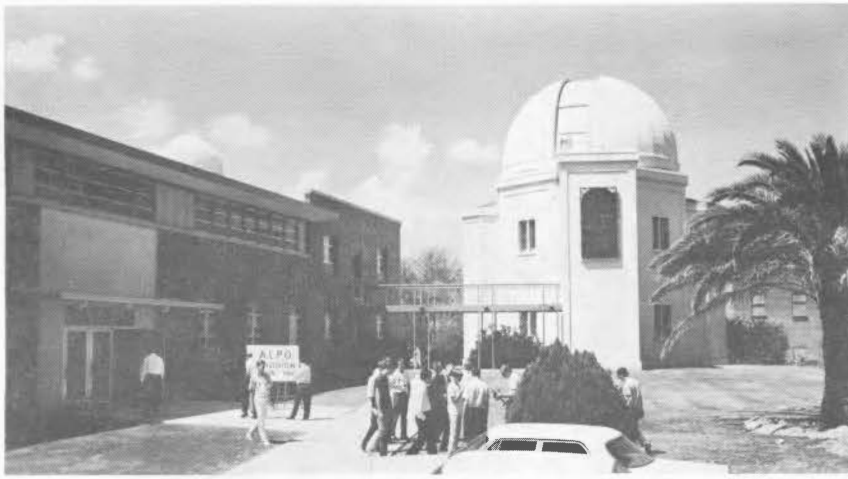

Figure 12. Steward Observatory on the campus of the University of Arizona, Tucson. Paper sessions and exhibits were at the Observatory during the Fourteenth A.L.P.O. Convention, August 26-28, 1966. The dome houses a 21-inch reflector, which was used by the A.L.P.O. for three nights. All photographs on pages 201-204 were taken and contributed by Dennis Milon, unless otherwise noted.

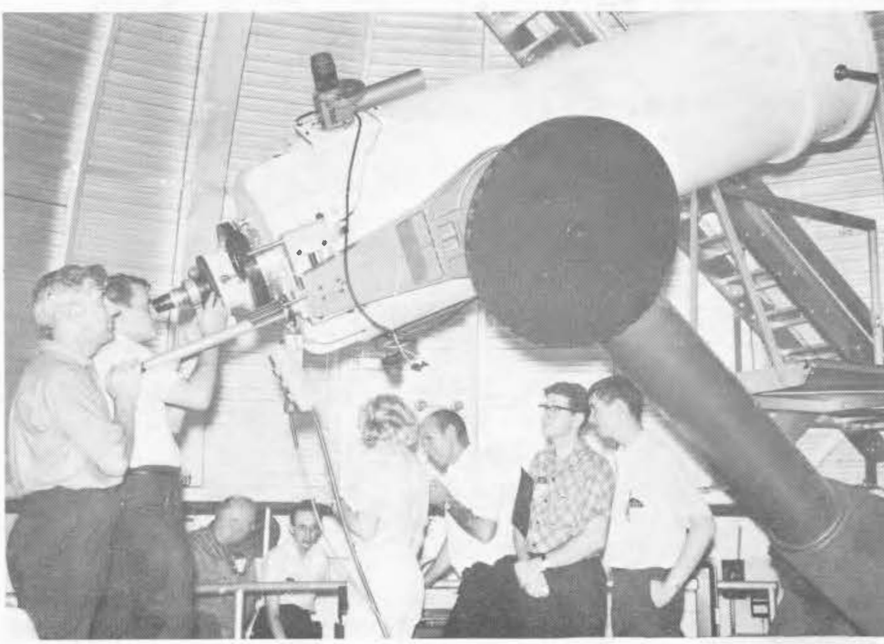

Figure 13. The 21-inch reflector was linked by the ham radio Astronet with other observers watching for unusual occurrences on the moon. In two nights 14 stations were in contact with the Steward Observatory station, operated by Larry Bornhurst and Walter Rieke. In this photograph observers are trying to confirm sightings in Alphonsus reported over the net. Left to right: Ewen Whitaker, Chuck Wood, Dave Thompson, Ken Thomson, Mrs. Winifred Cameron, Larry Bornhurst, Daniel Harris, and Steve Larson.

Figure 14. Dr. Arthur Hoag conducting the tour of Kitt Peak on August 26.

Figure 15. On the Kitt Peak tour. In the foreground are Tom Pope, Richard Wend, Kay Pope, and others.

Figure 16. Don Strittmatter of the Tucson Astronomical and Astronautical Association serving punch during a break in the paper sessions.

Figure 17. Informal gabfest at the Kaibab-Huachuca Dormitory during the 14th A. L.P.O. Convention. Left to right: Fred Jaeger, Tom Cragg, Alika Herring, Leif Robinson, Ron Thomas, Mary Cragg, and Joel Goodman.

Figure 18. The "Stump the Experts" panel. Left to right: Ewen Whitaker, Tom Cragg, Dale Cruikshank, Mrs. Winifred Cameron, Reverend Kenneth Delano, Professor Paul Engle, and master-of-ceremonies Walter Haas.

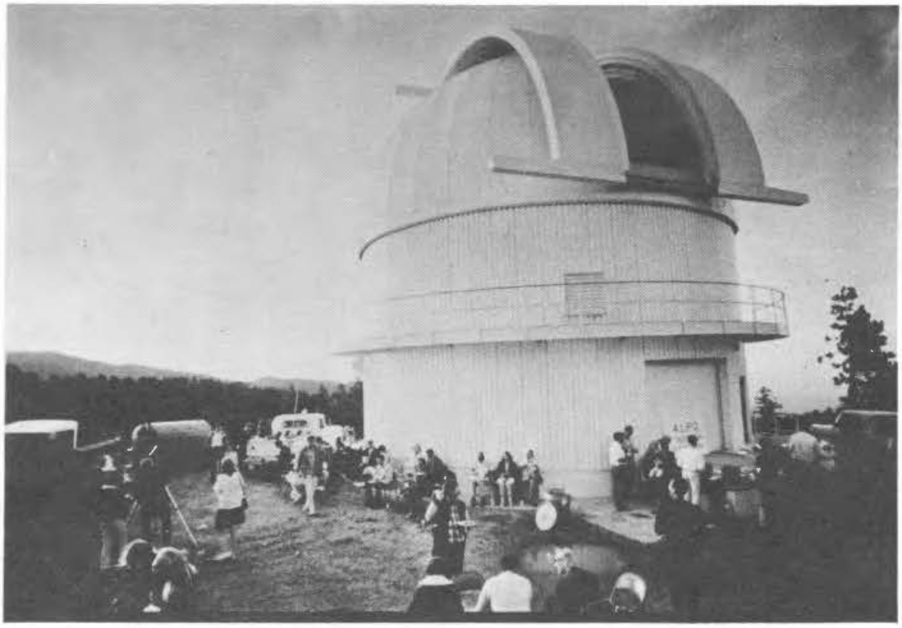

Figure 19. Barbecue supper at the dome of the Lunar and Planetary Laboratory 61-inch reflector on Mount Lemmon, altitude 8,230 feet. An evening of observing with the 61-inch followed. Photograph by Don Strittmatter.

Figure 20. Walter Haas observes the Moon in the Lunar Lab 61-inch while Joel Goodman watches Jack Eastman compare the view in his 1-inch Mickey Mouse reflector. The A.L.P.O. Conventioneers used the 61-inch for five hours.

active CO_2 would be formed if life were present. This paper appears on pp. 181-183 of this issue. Rev. Kenneth J. Delano, ALPO Lunar Recorder, presented MERSENIUS, A MAJOR CRATER OF PLUTONIC ORIGIN. A dome on the floor, inside two concentric features, provided the key to his discussion. SOME REMARKS CONCERNING THE ORIGIN OF PLANETARY MAGNETISM, by Péter Hédervári of Budapest, was read by Dale Cruikshank of the Lunar and Planetary Lab, who added some comments of his own. Phase differences in planetary interiors and field reversal phenomena were discussed. PROGRESS REPORT ON THE ALPO OBSERVING MANUAL, by Dale Cruikshank of the Lunar and Planetary Lab, and ALPO Venus Recorder, continued the discussion begun at the business meeting. Within a year, some copies of the manual should be forthcoming. ALPO COMETS SECTION ACTIVITIES, by Dennis Milon of the Lunar and Planetary Lab, and ALPO Comets Recorder, explained how comet discoveries are communicated to interested observers. Slides of instruments and comets were shown. IKEYA-SEKI - EAST, by John Bortle of Mt. Vernon, N. Y., was read by Michael McCants; he explained how a formula for predicting the magnitude of comets was derived.

The afternoon paper session was presided over by Richard Wend of Chicago, and it began with a paper by Thomas R. Cave of the Cave Optical Company entitled OBTAINING OPTIMUM OPTICAL PERFORMANCE FOR MEDIUM-SIZED VISUAL TELESCOPES. Mr. Cave recommended long focal length Newtonian reflectors, with as small a secondary as one can get by with, and high quality eyepieces. Dr. Joel Goodman again took to the rostrum to present SOME UNUSUAL OBSERVATIONAL OPPORTUNITIES DURING COPLANARITY OF EARTH AND SATURN'S RINGS. Also discussed was the value of observing the dark side of the ring system to learn about spacing of the components of the rings. PRELIMINARY NOTE ON A METHOD OF DIRECT VISUAL ESTIMATION OF LATITUDES OF PLANETARY FEATURES, by Walter H. Haas, ALPO Director, pointed out that, with practice, visual estimates can be consistent, and not nearly so tedious as micrometer measures. SOME INTERESTING ASPECTS OF THE 1965-66 JUPITER APPARITION, by Phillip W. Budine of Binghamton, New York, presented the results of a group of New York observers who noted detail within the Red Spot (with modest apertures) and charted various currents. A STUDY OF PHASE ANOMALIES IN RESPECT TO THE PLANET VENUS, by Fred Lazor of Victoria, Texas, noted how various filters affected the appearance of the Venusian terminator. LUNAR AND PLANETARY PHOTOGRAPHY - SOME RANDOM THOUGHTS, by Joseph P. Vitous of Chicago, Illinois, recommended commercial processing for those who don't have access to a darkroom. The paper was read by Dennis Milon. WIDE FIELD PHOTOGRAPHY, by R. B. Minton and Gordon Solberg, both of the Research Center of New Mexico State University, was read by Mr. Minton. They used a Moonwatch scope backwards, a reflecting sphere, and a glass hemisphere behind a pane of glass in order to obtain extremely wide field views of the sky. LUNAR AND PLANETARY PHOTOGRAPHY WITH SMALL APERTURES, by Thomas Pope, New Mexico State University Observatory, illustrated with slides of Venus, Jupiter, and the Moon that considerable detail can be recorded with apertures as small as 3½" - provided that the film is properly selected, equipment steady, and development correct. TERRESTRIAL SATELLITES: SOME DIRECT AND INDIRECT EVIDENCE, by John P. Bagby of the Hughes Aircraft Company, discussed perturbations of the Telstar satellite and other orbital considerations which might indicate natural Earth satellites nearby. ADVANCED AMATEUR RESEARCH PROJECTS, by Clark Chapman, ALPO Lunar Recorder, was read by Charles A. Wood of the Lunar and Planetary Lab. Analyzing lunar crater systems and following Jovian spots through several apparitions were some of the suggestions.

Saturday evening began with Open House at the Lunar and Planetary Laboratory. In addition to exploring the Lab and its equipment, we viewed the instrument package of the 24" Polarimetric balloon program.

A "Stump the Experts" program followed, with Walter Haas as moderator and Ewen Whitaker, Tom Cragg, Dale Cruikshank, Winifred Cameron, Kenneth Delano, and Paul Engle as "experts". Questions submitted from the audience were fielded by the panel and provided an interesting session. At its conclusion, Tom Cragg, on behalf of the ALPO members, presented founder and director Walter H. Haas with a 35 mm. camera, in appreciation of his many years of service in the A.L.P.O.

Informal observing at the 21" Steward Observatory concluded the evening.

The Sunday morning paper session on "lunar transient phenomena" was presided over by Walter H. Haas, who noted that not too many years ago it wasn't considered respectable to mention such things in print. THE ARGUS-ASTRONET OBSERVING PROGRAM, by Wallace Calkins, Dr. Gerald Guter, and Larry Bornhurst, was read by Mr. Bornhurst. He explained how radio amateurs make a "phone patch" to enable lunar observers to make simultaneous observations and quickly to call others to their telescopes when a transient phenomenon is noted. AN ARTIFICIAL-STAR PHOTOMETER FOR MONITORING BRIGHTNESS VARIATIONS ON THE EARTHLIT MOON, by

John E. Westfall, ALPO Lunar Recorder, was read by Walter Haas, and reported an average stellar brightness of $7\frac{1}{4}\pm\frac{1}{4}$ magnitude for earthlit Aristarchus. A COLORATION PHENOMENON IN THEOPHILUS, by Eugene W. Cross, Jr. of La Mirada, California, was read by Jack Eastman. Slides showed the evolution of the red marking. INVESTIGATION OF A TRANSIENT LUNAR PHENOMENON, by Daniel H. Harris, Pico Rivera, California, centered about the small object Ross D, which was recorded to vary in visual appearance. ANOTHER LOOK AT TRANSIENT PHENOMENA, A NEW ALPO PROGRAM, by Charles L. Ricker, ALPO Lunar Recorder, was read by Ken Thomson. Standard forms for a survey were suggested. OBSERVING LUNAR TRANSIENT PHENOMENA, by Barbara Middlehurst of the Lunar and Planetary Laboratory, urged cooperation between professionals and amateurs. OBSERVATIONAL RESULTS FROM THE FIRST 1½ YEARS OF THE MOON BLINK PROJECT, by Winifred Sawtell Cameron of NASA, Goddard Space Flight Center, discussed possible correlation of coloration phenomena and other factors which might have a bearing on causing these spots.

After lunch, the Lunar and Planetary Laboratory paper session began with COMETS - AN OBSERVATIONAL VIEW, by Dr. Elizabeth Roemer. Comet nuclei were discussed, and it was suggested that perhaps asteroids like Icarus, which cross the orbits of the Earth and Mars, are old comet cores. During the coming close passage of Icarus, it should be examined for a halo.

SOME CURRENT PLANETARY RESEARCH AT THE LUNAR AND PLANETARY LABORATORY, by Dale P. Cruikshank, itemized several projects, such as Jovian satellite atmospheres as evidenced by brightness variation as the satellite emerges from eclipse, and comparisons of limonite, a common mineral on the surface of the Earth, with planetary surfaces.

The last paper, ADVANCES IN LUNAR MAPPING, by Charles A. Wood, had to be eliminated because of lack of time. Many of the papers mentioned here will be published in future issues of The Strolling Astronomer, and surely this will be one of them.

The field trip to the Lunar and Planetary Lab's Observatory on Mt. Lemmon took us up to the 8300' level in the Catalina Mountains, where an informal picnic lunch was enjoyed along side the dome of the 61" telescope in a surrounding of pine trees. Early clouds disappeared, and the magnificent 61" telescope was trained on Saturn and the Moon for all to observe.

The general Chairman of the Tucson committee for the convention, Mr. Charles A. Wood, and his hardworking staff are to be congratulated and heartily thanked for the outstanding job which they did in preparing and piloting this convention. It must have taken many long nights of preparation and planning to be able to produce (with the help of those who presented papers) what many considered the best convention the ALPO has had to date.

A.L.P.O. COMETS SECTION REPORT: DAYLIGHT OBSERVATIONS OF COMET IKEYA-SEKI (1965f)

By: Dennis Milon, A.L.P.O. Comets Recorder

Excited speculation followed the September 24th, 1965 announcement by the IAU at Cambridge that Comet Ikeya-Seki would nearly graze the surface of the sun. A brightness exceeding -9 was predicted by Michael McCants on the basis of A.L.P.O. visual magnitude estimates in September and October. A comet of -9 would be visible in the daytime sky -- a first in the observing experience of most A.L.P.O. members. Observers wondered whether the comet would disintegrate at such a close solar passage. Perihelion took place on Oct. 21st, 1965 at 4:15 UT. The sun had set for the continental U. S. at this time so that observers farther west were relied on to report what had become of the comet.

During the daytime of Oct. 20th and 21st several A.L.P.O. members observed the comet with the naked eye and with telescopes. Photography was even more of a challenge so close to the sun! The most successful observations occurred at mid-day when there was less chance of haze near the sun. Those at high altitudes with an exceptionally blue sky were able to see finer detail in the coma and a longer tail.

Here is a list of observers who reported their daylight sightings of the comet -- observations that will remain one of the most interesting experiences of an amateur astronomer.

Chick Capen, Wrightwood, California and Flagstaff, Arizona
Walter Haas, Las Cruces, New Mexico
Craig Johnson, Boulder, Colorado
David Meisel, Flagstaff, Arizona
Alika Herring, Mauna Kea, Hawaii
Lee McDonald, Tucson, Arizona
R. B. Minton, El Paso, Texas

John Pazimino, Brooklyn, New York
Tsutomu Seki, Kochi, Japan
Jim Young, Wrightwood, California
Elmer Reese, Las Cruces, New Mexico
Gordon Solberg, Las Cruces, New Mexico

Table 1. Tail lengths of Comet Ikeya-Seki as observed by the A.L.P.O. Comets Section on Oct. 20, 1965 U.T.

Time UT	Naked eye	Binoculars	Telescope	Observer
16:30	½°	1°		Reese, 7X35
17:00	½°			Reese
17:45		20'		Johnson, 7X50
18:00			3/4°	Solberg, 20X120 refractor
18:30		20'	10'	Johnson, 7X50, 4" reflector
19:10	1½°			Capen
19:10			0.°6	Solberg
19:10	25'			Johnson
19:15	½°			Reese
19:15		30'	10'	Johnson
19:45	½°			Haas
20:07		1°		McDonald, 7X35
21:30	3°			Capen
21:45	¼°			Minton
21:55	1½°			Herring
22:00	2¼°			Meisel
22:00		½°		Solberg, 8X50

Table 2. Observations of the head of Comet Ikeya-Seki on Oct. 20, 1965 UT

Time UT	Coma	Nucleus	Observer
18:30		10"	Johnson, 4", 65X
19:00	1'		Johnson, 4"
19:10	1'		Solberg, 20X120 refractor
19:15	1'	10" to 15"	Johnson, 4"
19:20	3'		Pazimino, 7X35
19:35	45", nearly invisible	7" X 9" ± 2"	Johnson, 4", micrometer at 135X
21:30	1'		Johnson, 4", 65X
21:55	3'		Herring, naked eye
22:00	2'		Meisel, naked eye
22:00	getting larger		Solberg, 20X120
22:15	1.'3		Minton, micrometer on 4", 45X, 90X

Table 3. A.L.P.O. magnitude estimates on Oct. 20, 1965.

Time UT	Magnitude	Observer and instrument
16:30	-6	Reese, naked eye
17:00	-8	Reese, eye
17:45	-6	Johnson, 7X50
18:00	considerably brighter than Venus	Solberg, eye
18:48	-6	Johnson, 7X50
19:10	-8 to -11	Capen, eye
19:15	-8	Reese, eye
19:20	-7 or -7½	Pazimino, 7X35
19:35	-6 to -7	Johnson, eye
19:45	-8	Haas, eye
20:00	-8	Reese, eye
20:07	-6	McDonald, 7X35
21:30	brighter than -10	Capen, eye
21:55	-9	Herring, eye
22:00	-6.7 visual -8.1 K2 filter -6.4 Wratten 27	Meisel, eye
22:00	-8	Solberg, 8X50
22:15	-6 to -8	Minton, eye

Table 4. Observations on Oct. 21, 1965 UT

Time UT	Tail	Coma	Magnitude	Observer
14:00	1°.5		-5 to -7	Minton, 4"
14:00	1°5		-8 to -10	Capen, Young, eye
14:30	2' - 3'	10" or less	-4	Solberg, 2½"
17:15	½°		-5	Reese, 6X30
21:05	1°		-5	Seki, 3"

Structure of the comet on October 20

The observers kept a close watch through the day for a possible break-up of the comet. Measurements of the head and tail are given in Tables 1 and 2.

The double nucleus reported by Gordon Solberg (Figure 21) was not seen by others. However, Chick Capen at Flagstaff described "sparkling fragments in yellow light in the coma and the near part of the tail". (Figure 22). Both Capen and Solberg were watching at 19:10 UT, when the comet was about 1½° from the sun. Craig Johnson, observing in Boulder with a 4", said that there was no doubling in the coma from 17:45 to 21:30 UT. Alika Herring described the coma as crescent shaped at 21:35. He observed from 13,600 feet on Mauna Kea, Hawaii, where he had a very clear sky.

The only photos received for Oct. 20th were contributed by Craig Johnson. His color slides with a 4" (Figure 23) look very much like a sketch by R. B. Minton with a 4".

The widely different values obtained for the dimensions of Ikeya-Seki (Tables 1 and 2) can be explained by referring to the various instruments used and observing localities. Sky transparency was an important factor in tail length determinations. The foregoing are the causes for the wide range in recorded values rather than any physical change in the comet. Capen reported the greatest tail length (3 degrees +) while observing from an altitude of about 7,000 feet at Flagstaff, with excellent transparency. Here he had a distinct advantage over other A.L.P.O.'ers. All the observers saw a ½° or longer tail. Both Capen and Reese recorded a bright upsweep on the following (right) edge of the coma. See Figure 24.

The coma was seen larger with the naked eye and through binoculars than through telescopes. In Table 2 Johnson, Minton, and Solberg, using 4- and 5-inch telescopes, obtained a coma diameter of about 1'. The naked eye view gave a coma diameter of 2' -3'. At 20^h UT, 3' would be 125,700 kilometers. Craig Johnson measured the nucleus as about 10" (6,984 kms.) with a micrometer on his 4". (These linear values were computed by Gordon Solberg.) There was agreement among the observers that the nucleus had a very tight degree of condensation. Johnson called it about as sharp as Venus in bad seeing.

Changes on October 20

From the first reported observation by Reese at 16:30 UT to the last of the day by Capen at 01:00 on October 21, no trend of contraction or expansion of the coma can be found from the data. One of the major changes in the coma was seen by Solberg, but this change was not reported by other observers. Capen's drawings show a change in a pointed area in front of the main coma at 19:10-19:50 UT to a smooth coma edge at 21:30-22:30 UT. The sparkling fragments seen by Capen must have been a most interesting sight.

Color on October 20

The coma was essentially white; but it had a tinge of either blue, orange, or yellow, depending on the observer describing it. Gordon Solberg called the coma yellow in a 120 mm. refractor at 19:20 UT. He noted that the sky was blue to within 2° of the Sun. Alan McClure suspected an orange tint in a 3½" Questar. Reese observed with 7X35's and described the comet as "fluorescent white against a blue sky". Johnson saw it as a "blue-white spike" in 7X50's. In his 4" it was "white with a trace of blue, just as Venus is white with a trace of yellow". Johnson's visual filter observations indicated a blue tinge. His Ektachrome X slides (a sketch from one of these is Figure 23) show the comet to be white, to the Recorder's eye.

David Meisel's naked eye drawings at 21:30 UT (these were published in The Strolling Astronomer, Vol. 19, Nos. 3-4, p. 65.) show that the leading edge of the tail was

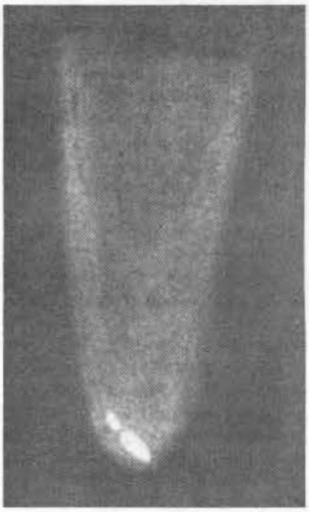

Figure 23. Sketch by Steve Larson of a daylight photograph by Craig Johnson, Boulder. 20^h25^m, U.T. on October 20, 1/125 sec. exposure on Ektachrome-X with a 4-inch reflector. A drawing by R. B. Minton at 22^h15^m, U.T. with a 4-inch shows a very similar appearance.

Figure 21. Daytime drawing of Comet Ikeya-Seki (1965f) by Gordon Solberg, Las Cruces. 20X120 refractor. Note split nucleus. Tail length 3/4°. Oct. 20, 1965. 18^h10^m, U.T.

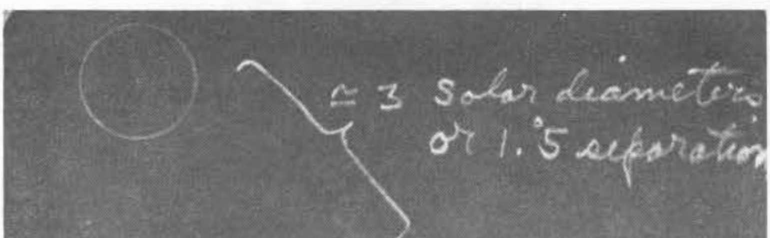

Figure 22. Daytime drawing of Comet Ikeya-Seki by Chick Capen, Flagstaff at 19^h10^m–19^h50^m, U.T. on October 20, 1965. 7X50 binoculars and 4-inch refractor at 60X. Narrow passband sodium D lines, yellow region. The coma and lead-off tail contiguous to the bright silvery nucleus were filled with sparkling mobile fragments in sodium yellow light, in which light the blue sky appeared black. Tail length 1.5°. Rough magnitude estimate -8 to -11. Note the pointed area in front of the main coma.

The main coma had become normally round by 21^h30^m, U.T.

brighter in yellow light. He observed through a Wratten 27, a Wratten K2, and a neutral polaroid. His observations indicate that the comet was 1.4 magnitudes brighter in yellow light with a K2 filter as compared to the no-filter magnitude.

It has long been known that comets with small perhelion distances take on a yellow color. In 1919 W. W. Campbell wrote in an article "What We Know About Comets" (in the Adolpho Stahl Lectures in Astronomy):

> "The comets which have approached very close to the Sun turned to a yellowish orange in color and remained so while in the vicinity of the Sun, because the yellow light of sodium then developed strongly in them, apparently by virtue of the intense heating of the cometary matter by the Sun's rays. This happened with the Wells comet of 1882, the great comet of September and October, 1882, the brilliant comet in January, 1910, and others."

Magnitude on October 20

Estimating the magnitude of such a bright object in daylight was extremely difficult. Observers could only remember that Venus reaches -4.4 and that the full moon is about -12. Unfortunately, Venus was not nearby for comparison. The magnitude guesses are given in Table 3. No trend toward brightening or fading is discernible.

Only Meisel determined the magnitude with some precision. His method was to use a Christmas tree bulb photometer. This process is familiar to observers of lunar eclipses as a method of seeing both the eclipsed moon and comparison stars reflected in a bulb. At Flagstaff Meisel used a frosted light bulb and neutral density filters. He measured in three color regions: 1. visual, 2. yellow with a K2 filter (peak visual transmission at 5700Å), and 3. red with a Wratten 27 filter (peak at 6300Å). The K2 filter was most sensitive to sodium D line emission, which appears to have been present. His results are:

	Δ M from solar magnitude.	Apparent magnitude.
Visual	-20.1	-6.7
K2 filter	-18.7	-8.1
W 27 filter	-20.4	-6.4

Meisel found the total range of surface brightness to be only 1 magnitude after correction for eye-adaptation effects. The magnitudes shown in Figure 25 give the filter factors.

Between sunset of October 20 and dawn of October 21

There had been wide publicity that the comet's tail might provide a spectacular sight by sweeping over the western horizon as the coma rounded perihelion. Virtually all the observers watched the horizon that Wednesday evening, but nothing was reported by the A.L.P.O. observers that could be definitely ascribed to the comet. Jet contrails proved confusing to some.

Dr. George Van Biesbroeck of the Lunar and Planetary Lab in Tucson did spot something. Flying at 40,000 feet near Hawaii, he saw a glow on the horizon to the north of the Zodiacal Light. This glow was observed for about 20 minutes, and it set with the Zodiacal Light cone.

In the Philippines it was still day when the comet reached perihelion at 4^h15^m, U.T. on October 21. From here Leo Boethin looked with binoculars and a 3" refractor, but was unable to find the comet. Ikeya-Seki was very close to the Sun at this time, and passed within about 15 seconds of arc from the Sun's surface, as seen from the Earth at 5:25 U.T., Oct. 21st.

Using the coronagraph at the Nokikura Corona Station in Japan, Hirayama and Moriyama watched from 3:50 U.T. on. At 4:37 "... the head was divided into three segments." Their photos show the remarkable way in which the tail of the comet lagged behind the radius vector. (These photos are published in the Publications of the Astronomical Society of Japan, Vol. 17, No. 4, 1965.)

At Las Cruces, sunrise on Thursday, Oct. 21, was at 13:14 U.T. Beginning at 12:25 Walter Haas saw for 5 minutes what may have been a fragment of a tail. It was about 7° long and was inclined about 45° to the horizon. This fragment would have been 14° long

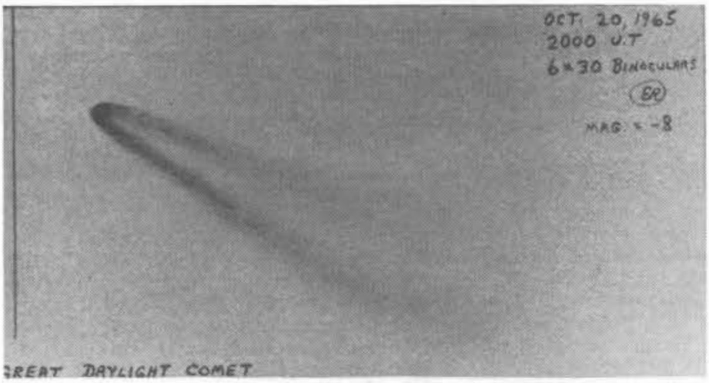

Figure 24. Daytime drawing of Comet Ikeya-Seki by Elmer Reese, Las Cruces, at 20^h0^m, U.T. on October 20. Note the upward sweep at the end of the top part of the tail.

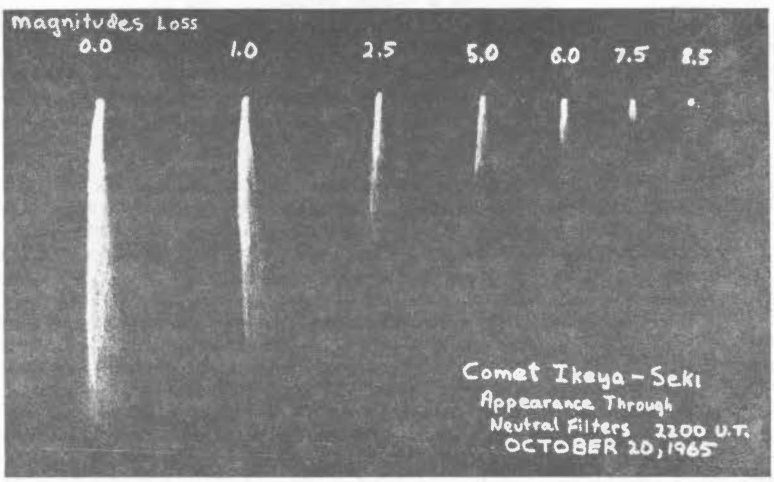

Figure 25. October 20, 1965, 22^h0^m, U.T. Observations by David Meisel at Flagstaff through neutral density filters show the relative brightness of the head and the tail.

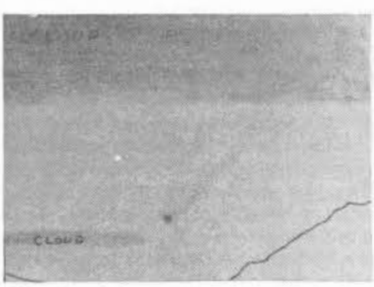

Figure 26. Sketch by Elmer Reese showing the comet some minutes before sunrise at Las Cruces. October 21, 13^h, U.T., 6X30 binoculars. Comet very difficult to see in orange sunrise glow.

Figure 27. Drawing of comet from composite photograph by R. B. Minton with 4¼-inch reflector. October 21, 16^h45^m, U.T. Note spine and bright sunward side of coma.

if it had extended to the horizon. Gordon Sooberg was observing at the same time as Haas, but did not see this object. Elmer Reese's sketch (Figure 26), made just before sunrise, shows a bifurcated tail at an angle of about 45° to 50° to the horizon.

Daylight observations on October 21

Fewer observers reported the comet in daylight on Oct. 21st. The brightness, tail size, and coma size are given in Table 4.

On Oct. 21st photos were taken by R. B. Minton in El Paso and also by Capen and Young at the Table Mountain Observatory in California. R. B. Minton photographed a bright spine extending from the coma into the tail. His sketch from a composite photo (Figure 27) also shows an elongated nucleus, which is tilted from the tail axis. This asymmetrical nucleus appears to be shown in a photo taken 25 minutes later in California by Jim Young and Chick Capen. Capen and Young estimated the tail to be 1½ degrees long. At 17:15 U.T. Reese sketched an extra tail jutting upward. At 18:20 Capen sketched a short third tail with the aid of a 6-inch refractor and a 16-inch Cass and two yellow filters. Observers agree that the comet was two or three magnitudes fainter than on October 20.

Color on October 21

Photos on Oct. 21st by Chick Capen with a 6-inch refractor show the comet brighter in yellow light. He used Panatomic X film and a Wratten 21 filter. In a photo with an orange Wratten 23a, the head looks larger. On IV-n infrared film with a W 70 filter, no tail structure was recorded. These colors correspond to the appearance in the pre-dawn sky beginning about August 26th U.T. The comet was then seen to have a yellow nucleus and a bluish tail.

Final daylight observation

Tsutomu Seki saw his comet again in daylight on Oct. 22nd at 20:50 U.T. with the naked eye. The size was the same as on Oct. 21st (1° long, 8' wide), but the magnitude had faded to -3. No other A.L.P.O. observer saw the comet on Oct. 22nd or 23rd. The next report we have is by Craig Johnson, who saw the head on Oct. 24th from 12:40 to 12:50 U.T. (in a bright dawn sky) at about magnitude +1.5 in 7X50's.

The daylight spectacular of the great comet was over; now the before-dawn show of a huge tail was beginning.

SATURNIAN SATELLITE DIAMETERS FROM ECLIPSE PHENOMENA

By: Thomas A. Cragg, A.L.P.O. Saturn Recorder

During the edge-on apparition of Saturn's ring a large number of inner satellite phenomena occur since the orbits of those satellites are so nearly coplanar with the ring system. Many such events have occurred already during this apparition, but the evidence is that they are not being adequately observed. When a satellite goes into, or comes out of, eclipse in the shadow of Saturn an opportunity exists to determine the satellite's diameter. Basically, the diameter is proportional to the time to enter, or to exit from, the primary's shadow. The length of the dimming (or recovery) light curve is what is measured.

One must realize that only six satellites in the Solar System have had their diameters determined directly by actual measurement of their disk size. The rest have all been determined indirectly; by measuring the magnitudes and assuming albedos, their disk sizes have been calculated. Those who have attempted measuring the magnitudes of satellites know only too well the difficulty of estimating magnitudes with a bright planet nearby, which can indeed result in errors in the estimates of as much as two magnitudes (a factor of about 6). Modern photoelectric techniques coupled with proper background correction is perhaps the only method available which has a chance of yielding proper results. The albedo problem, however, is really grim. We have examples of albedos between 0.07 for the moon and 0.75 for Venus. This range shows an error factor of about ten to be easily available. Coupled together, these two obvious error sources could conceivably amount to an error factor of 60. No one really thinks that our presently determined satellite diameters are that poor, but clearly errors of the order of a factor of 10 are certainly not inconceivable.

Admittedly, timing the dimming of a satellite when entering, or exiting from, the shadow of its primary is wrought with several error sources; but it appears that these will amount to less than a factor of five and would therefore constitute a significant improvement in diameter determinations. The atmospheric dimming associated with the Saturnian atmosphere can be corrected by making a similar set of observations of Titan, whose diameter has been determined micrometrically. Now, realizing the necessary correction factor for the atmosphere, a similar correction can be made for the smaller satellites considerably to improve the diameters thereby determined.

The following table lists those eclipse phenomena which are applicable to observers in the United States; and observations of as many of them as possible is strongly recommended, especially of Titan which we intend using as a needed control on the others. The table is from The Handbook of the British Astronomical Association for 1966.

Abbreviations used are: Di, Dione; Rh, Rhea; Te, Tethys; Ti, Titan; O, occultation disappearance; Ee, eclipse emersion or reappearance. All dates and times are by Universal Time. Since Saturn is past its opposition of September 19, 1966, occultations will occur at the west limb of Saturn (left in a simply inverted view with south at the top); the satellites will reappear from eclipse east of the planet, and almost in line with the major axis of the rings. The eclipse reappearance times are not given directly in H.B.A.A. but rest upon an interpolation, or even extrapolation, of duration times performed by the writer. They are uncertain on this account, and observers would do well to begin watching at least 15 minutes before each predicted eclipse reappearance.

1966, Nov.	2	06^h	13^m	Di O		10^h	12^m	Ee
	4	23	53	Di O	5	03	53	Ee
	5	10	07	Te O		13	34	Ee
	6	05	01	Rh O		09	51	Ee
		10	07	Di O		14	08	Ee
	7	07	25	Te O		10	53	Ee
	9	04	43	Te O		08	12	Ee
	11	02	02	Te O		05	31	Ee
	12	23	20	Te O	13	02	50	Ee
	13	04	56	Di O		08	00	Ee
	14			Te O	15	00	08	Ee
	15	05	48	Rh O		10	47	Ee
		22	37	Di O	16	02	42	Ee
	21	09	59	Di O		14	05	Ee
	22	08	31	Ti O				
		09	53	Te O		13	26	Ee
	24	03	40	Di O		07	48	Ee
		06	37	Rh O		11	45	Ee
		07	11	Te O		10	44	Ee
	26	04	30	Te O		08	03	Ee
				Di O	27	01	28	Ee
	28	01	49	Te O		05	23	Ee
				Rh O	29	00	15	Ee
	29	23	07	Te O	30	02	42	Ee
Dec.	1			Te O	2	00	01	Ee
	2	08	44	Di O				
	3	07	29	Rh O				
	5	02	25	Di O		06	38	Ee
	8	07	18	Ti O				
	11	C7	01	Te O				
	13	04	20	Te O		07	59	Ee
		07	33	Di O				
	15	01	39	Te O		05	19	Ee
	16	01	15	Di O		05	33	Ee
		22	58	Te O	17	02	38	Ee
	18			Te O		23	58	Ee
	24	06	21	Di O				
		06	30	Ti O				
	25			Rh O	26	03	29	Ee
	27	00	06	Di O		04	28	Ee
	30	04	12	Te O				

Postscript by Editor. I heartily endorse Mr. Cragg's plea for an intensive effort at observing the duration of these satellite eclipse reappearances. Observers are also urged to use on these phenomena as large a telescope as is available.

ANNOUNCEMENTS

Because of lack of space in the remaining pages of this issue, certain announcements not of immediate interest are being deferred to the next issue.

Note from A.L.P.O. Librarian. Mrs. Walter H. Haas, the A.L.P.O. Librarian, communicates the following note: "The Library acknowledges with thanks 'A Collection of Maps of Mars', by Reverend Kenneth J. Delano. It is a beautifully bound volume of maps of Mars, arranged by the donor. The Librarian can now supply upon request lists of the books which are available."

Uranus Section Notice. The Uranus-Neptune Recorder requests this announcement to be made: "All observers who have observed, or who have attempted to observe, transits of the Uranian satellite shadows are requested to submit reports of their observations to the Recorder. All reports should include dates and times of observations, seeing conditions, telescopes and powers used, and copies of sketches if any were made. All attempts should be reported, even those in which no positive sightings were made. Reports should be sent to Leonard B. Abbey, 3204 La Vista Road, Decatur, Georgia 30033."

Note on A.L.P.O. Lunar Photograph Library. Lunar Recorder John E. Westfall communicates this announcement: "A master list of Lunar Photograph Library holdings is available to any member who writes me to ask for a copy. Borrowers are now asked to contribute 25 cents in postage. The earlier, lower figure has been found to be too low to cover expenses. Some Orbiter photographs are now available in the Library."

Request for Back Issues. The Library of New Mexico State University needs these two back issues to complete their files before binding: Vol. 17, Nos. 5-6 (May-June, 1963)
Vol. 18, Nos. 5-6 (May-June, 1964)
Persons having these issues and wishing to give them or sell them to the New Mexico State University Library are requested to communicate quickly with the Editor.

Zip Codes. We wish to thank all those members who have helpfully given us their zip codes. If the mailing envelope containing this issue still lacks your zip code, we would appreciate being given this information.

A.L.P.O. Staff and Personnel Changes. The new address of Mr. John E. Westfall is: 1530 Kanawha St., Apt. 110; Adelphi, Maryland.

Mr. Geoffrey Gaherty has resigned the Mercury Recordership, having long found it impossible to give sufficient time to Mercury studies because of the press of other duties. We appreciate Mr. Gaherty's help in leading the Mercury Section and are sorry to see him leave our staff. We wish him success in his graduate studies and shall be glad for his continuing contributions to A.L.P.O. projects. The new Mercury Recorder is: Reverend Richard G. Hodgson, Janacres; Colchester, Vermont 05446. Reverend Hodgson is already known to many of our members, and he will outline his plans for the Mercury Section in an article in the next issue.

It is with great regret that we announce the resignation of Mr. Philip R. Glaser as Jupiter Recorder. His services to the A.L.P.O. in directing Jupiter studies have been considerable in the past, and many found his leadership inspirational. Probably few readers have any concept of how much time can be expended in supervising an amateur observational program on the Giant Planet when it is well placed in the summer sky. We earnestly hope that "Phil" will remain a valued and needed participant in Jupiter studies. The new Jupiter Recorder, who is already on the staff, is Mr. Richard E. Wend. All current observations of Jupiter should be sent to Mr. Wend. Another Assistant Jupiter Recorder has been added to the staff. He is: Paul K. Mackal, 7014 W. Mequon Road, 112 North, Mequon, Wisconsin 53092. Mr. Mackal has been an active observer of Jupiter for some years and has already begun his new duties.

Mr. Wend is resigning as Assistant Mars Recorder.

Greetings from Patrick Moore. The famous English lunar and planetary observer and writer expresses his thanks for a card sent to him from the Tucson Convention by a number of A.L.P.O. members and asks to say "greetings and thank you" from Armagh, Northern Ireland.

LUNAR, PLANETARY, AND COMETARY PROSPECTS: NOVEMBER-DECEMBER, 1966

By: Walter H. Haas, A.L.P.O. Director

Mercury. This planet will be at inferior conjunction on November 17 and at greatest elongation west on December 4. It will thus be a morning sky object.

Venus. It will be at superior conjunction on November 9 and will be a poorly observable evening sky object in December.

Mars. This planet is now well placed in the morning sky but is still distant from the earth. On December 1, 1966 the angular diameter will be 5".4, the tilt of the axis to the earth will be 24°N., and the season will be almost two Martian months past the vernal equinox of the northern hemisphere.

Jupiter. This planet is extremely favorably situated for observation as it nears the opposition of January, 1967. Winter apparitions are always poorly covered, and systematic observations are much desired. Jupiter Recorders Wend and Mackal will be glad to furnish the needed guidance to intending observers.

Saturn. The present 1966-7 apparition is of special interest because of the edgewise presentation of the rings. Observers should review the article in Str. A., Vol. 19, Nos. 5-6, pp. 73-75. The earth will be on the unilluminated side of the rings from October 29 to December 17.

Uranus. This distant planet is well placed in the morning sky. On December 1 its coordinates are: right ascension 11 hrs., 39 mins., declination +3°. A number of the Uranian satellite shadow transits predicted by Craig L. Johnson occur in November and December (Str. A., Vol. 19, Nos. 5-6, pg. 89).

Neptune. In conjunction on November 14 and thus hardly observable.

Moon. Lunar Recorder Charles Ricker invites correspondence from persons wishing to participate in the purposeful observation of "lunar transient phenomena". The following objects, which are illuminated over the stated intervals, might be watched for such events: Messier-Pickering, November 17-December 2; Alphonsus, November 21-December 6; Eratosthenes, November 22-December 7; Plato, November 22-December 7; Kepler, November 24-December 8; and Aristarchus-Herodotus, November 24-December 9.

Lunar Recorder Kenneth Delano has supplied a list of lunar domes and dates on which they will be favorably illuminated for observation, as follows:

Date (local civil time)	Dome xi eta	Longitude	Latitude	Remarks
Nov. 9/10	−885+046	−62°21'	+02°40'	1 of 3 East of Hevelius.
15/16	+777−318	+55°03'	−18°35'	Large dome E. of Vendelinus.
17/18	+519+186	+31°42'	+10°44'	One of several near Sinas.
20/21	−138+447	−08°53'	+26°37'	Close to Beer. Small and round.
21/22	−301−233	−18°02'	−13°32'	South of Bonpland. Large.
22/23	−496−062	−29°48'	−03°34'	SW of Landsberg.
22/23	−502+227	−31°02'	+13°08'	One of many S. of T.
23/24	−611+451	−43°13'	+26°50'	North of Prinz. /Mayer.
25/26	−931−071	−68°58'	−04°05'	On Grimaldi's floor.
Dec. 2/3	+537+204	+33°16'	+11°47'	One of 7 domes N. of Sinas.
3/4	+363+130	+21°20'	+07°30'	Large & prominent. N. of Arago.
3/4	+339+107	+19°56'	+06°09'	Large & prominent. W. of Arago.
3/4	+358+149	+21°13'	+08°35'	N. of Arago.
3/4	+353+155	+20°56'	+08°55'	N. of Arago.
3/4	+349+161	+20°42'	+09°16'	N. of Arago.
6/7	−301+019	−17°32'	+01°05'	West of Gambart.

Three New Comets. This section is based upon a large number of communications from Comets Recorder Dennis Milon. Comet Kilston (1966b) was discovered on August 8 at the Lick Observatory, and by September 12 the Comets Section had already received about 60 observations. Perihelion will occur on October 28. The following ephemeris is extracted from IAUC 1973.

Date	Right Ascension (1950)	Declination (1950)	Δ	r	Mag.
1966, Nov. 11	$19^h\ 44^m.26$	-9° 02'.0	2.560	2.390	10.3
Nov. 21	20 03.55	-10 44.2			
Dec. 1	20 23.40	-12 04.5	2.798	2.415	10.6
Dec. 11	20 43.59	-13 04.2			
Dec. 21	21 03.95	-13 45.3	3.038	2.459	10.8
Dec. 31	21 24.33	-14 09.8			
1967, Jan. 10	21 44.60	-14 20.0	3.267	2.522	11.1

Comet Barbon was discovered on August 15 with the Palomar 48-inch Schmidt. It had passed perihelion in April, 1966 and in November is predicted to be 13th magnitude and fading.

Ikeya-Everhart 1966d was the third discovery in a month! It was seen by Ikeya on September 8, 1966 and by Everhart on September 12. It is moving east and south.

John Bortle, Walter Scott Houston, and others have made magnitude estimates of Comet Kilston using comparison stars from A.A.V.S.O. charts. On September 7 Bortle and Houston independently recorded a brightening of the comet. Observers can obtain a catalog of A.A.V.S.O. charts for 25¢ and postage by writing to: A.A.V.S.O., 187 Concord Ave., Cambridge, Massachusetts 02138. Comet report forms are available from the Recorder, Mr. Dennis Milon, for 25¢ in stamps.

New comet information and observations are discussed on Astronet, an active ham radio net. It is on single sideband each evening from about 3^h, U.T. to 6^h on a frequency of 3885 K.C. Comet observers who are not hams can be phone-patched onto the net.

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STAFF