Geoffrey Gaherty, Jr.,
636, Sydenham Avenue,
Montreal 6, Quebec.
June 12, 1959.

Sales Service Division,
Canadian Kodak Co., Limited,
Toronto 9, Ontario.

Dear Sirs:

On page 452 of the June, 1959, issue of *Sky and Telescope* there is a note announcing publication by you of a free 16-page booklet entitled *Astrophotography with Your Camera*. Could you possibly send me about half a dozen copies of this booklet for distribution amongst the members of the Astrophotography section of the Montreal Centre of the Royal Astronomical Society of Canada? They would be very much appreciated.

For the past couple of months I have been experimenting with your various commercial emulsions. I am very pleased with the resolution obtained with Panatomic-X. I have obtained a negative on this film of the Moon which has been enlarged to 8 x 10" without showing any grain detectable at normal viewing distance.

Would you also please send me data on the new Ektachrome films as I think these should be useful in planetary photography. I only wish it were possible to have this film developed by Kodak as I have found local photofinishers to be highly unreliable. I am continually amazed at the consistancy of your Kodachrome processing and still use this film in preference to faster emulsions because the results are so dependable.

Hoping to receive the above information, I am,

Sincerely yours,

JUN 18 REC'D

CANADIAN KODAK SALES LIMITED

TORONTO 9. ONTARIO

June 17, 1959

Mr. G. Gaherty, Jr.
636 Sydenham Avenue
Montreal 6, P. Q.

Dear Mr. Gaherty:

We are pleased to comply with your request for complimentary literature entitled, "Astrophotography with Your Camera," and we are forwarding to you, under separate cover, six copies for distribution amongst your members of the Astrophotography Section of the Montreal Centre of the Royal Astronomical Society of Canada.

Also, please find enclosed a Kodak pamphlet describing the new Kodak High Speed Ektachrome 135 Film. We are sorry that the Canadian Kodak Co., Limited, does not offer a service of processing this Ektachrome Film, however we feel you should receive quality finishing from your local photofinisher.

We thank you for your interest in our products, and trust this meets with your satisfaction.

Yours very truly,

G. Hughes

GHughes:JS

Sales and Service Department

SKY AND TELESCOPE; January, 1956; P. 140.

ASTROPHOTOGRAPHY FOR THE AMATEUR - I

Many amateur astronomers want to photograph what they observe, and perhaps use their pictures to make slides to show to their friends. The writer has developed methods for obtaining negatives suitable either for standard-sized lantern slides or those used in 2-by-2 projectors.

The various objects in the sky may be divided into four groups, each requiring a different plate scale. The first consists of large areas of the sky, including such extensive constellations as Ursa Major and Orion. The next includes smaller star groups, such as Cassiopeia, Lyra, and the Hyades. The third is comprised of most individual open star clusters, nebulae, and nearby galaxies - the Double Cluster in Perseus, the Orion nebula, and so on. Finally, requiring the largest plate scale of all, are the planets, portions of the moon, the Ring nebula in Lyra, and most galaxies.

My experience is based on photography with my 5½-inch refractor, which has an f/15 objective. It has a good sidereal drive, which is a prime requisite for successful photography. For this work a good 4-inch to 6-inch telescope is needed, and at least one of the cameras I shall describe.

For the first group of sky objects, an f/3.5 lens of 3-inch focus is about right to obtain negatives that will make 2-by-2 slides directly. The picture shows a simple camera that is attached to a dovetailed bracket near the front end of the telescope tube. The dewcap is removed to avoid obstructing the field. The telescope is used for guiding, and since the exposures with fast lenses such as a Zeiss Tessar are short, 10 to 15 minutes, the strain of guiding is bearable.

For the second group, the same arrangement is used, but my camera has an f/4.5 lens of 6-inch focal length.

To open and close the camera shutter, I use a short cable release, the button of which is inserted in a barrel fastened to the dovetail bracket on the telescope and held in by a knurled and threaded bushing around the cable. Into the other end of the barrel there is fixed a 1/8" brass rod that extends to the eye end of the telescope through holes in the saddle pieces. Near the barrel, the rod has an adjustable split stop-ring that determines how far the rod can be pushed - this protects the cable release from strain. The shutter is set at bulb; pushing the rod opens the shutter; pulling the rod closes it - no mistake possible.

The field of good definition for a long-focus refractor permits excellent focal-plane photographs to be taken of the third group of objects, by means of a special attachment which is exchanged for the observing tailpiece of my instrument. It is made up of a triple-leaved shutter as shown in the picture, pressure-vacuum operated for 1/30 second and time exposures. The field of view is 3" in diameter on 3¼-by-4¼ cut film.

Since at f/15 the exposures are relatively long, guiding is important. Therefore, the finder is converted to a longer focus by means of a Barlow lens.

Using this prime-focus camera for objects in the fourth group is very difficult. Mars, for instance, has an image 1/5 millimeter in diameter, and Saturn's ring is only half a millimeter. Therefore, recourse had to be taken to projection through an eyepiece. I shall describe the camera developed for this purpose next month.

HANS PFLEUMER
596 First Ave.
New Brunswick, N. J.

Photo captions:

1. This is the attachment for taking pictures in the third group of sky objects.
2. The camera of 3-inch focus is here not pushed down to its final position, to show the dovetail bracket on the telescope tube as well as the cable-release and push-rod combination for remote shutter control.
3. For photographing objects of the second group, this 6-inch camera is used. Its back takes 3¼-by-4¼-inch cut film. The same bracket and shutter control mechanism are used as with the 3-inch camera.

Strolling Astronomer, The; July-August, 1956; P. 73.

SOME BASIC PROCEDURES IN PLANETARY PHOTOGRAPHY

Philip R. Lichtman

(Paper read at the A.L.P.O. Convention at Flagstaff on Sept. 1, 1956)

Planetary Photography, at least as practiced by amateurs, is usually dependent upon "trial-and-error" methods for determining correct exposure-times, emulsions, and developing procedures. I have attempted to put these experiments on a more quantitative basis--in effect, to make their results predictable--so that an observer can rapidly select the optimum procedures for his particular telescope and atmospheric conditions.

Disturbances within the atmosphere rather than defects in our telescopes ultimately limit the quality of planetary photographs. As A.L.P.O. members realize, these disturbances manifest themselves in two ways, telescopically speaking: (1) "excursions"--lateral <u>displacements</u> of the entire image under observation; and (2) <u>distortions</u> of the image. Lateral shifts occur with an amplitude and frequency dependant upon "seeing" conditions. If extremely short exposure-times were feasible, planetary photographs would not suffer from lateral displacements of the image during exposure (although image distortions would still be present). Thus, it is advantageous to employ the shortest exposure-times possible. I shall describe a method for selecting emulsions which permit the use of rapid exposures and a procedure for determining correct exposure-time with any given telescope and emulsion.

The characteristic response of a given photographic emulsion to illuminations of varying intensities is revealed by that emulsion's so-called "characteristic curve" (Fig. 1). The characteristic curve is a plot of a negative's darkness against the energy required to produce it--hence its alternative appellation, the "D-logE curve" (density vs. logarithm of exposure). Definitions of photographic "density" and "exposure" are in order. "Density" is a measure of a negative's blackness, equal not to "opacity" (reciprocal of transmittance of incident light), but rather to the <u>logarithm</u> of opacity. Thus, a negative that transmits 1/10 of the light incident upon it has a density of log 10, or 1; if the negative transmits 1/100 of the incident light, its density is log 100, or 2; if 1/1000 of the incident light is transmitted, density equals log 1000, or 3; etc. There are several reasons for using a logarithmic scale instead of a linear one; for instance, it is well known that the human eye's response curve to light of varying intensity (or to negative photographs of varying opacity) is more nearly logarithmic than linear.

"Exposure" is defined not in the ordinary sense as "time of exposure", but rather as the <u>product</u> of <u>intensity</u> and <u>time</u>. If we let E represent exposure, I represent intensity, and t represent time of exposure, then

(1) $E = It$. More conveniently,

(2) $\log E = \log I + \log t$.

Since intensity is expressed in candle-meters, and time in seconds, exposure is in terms of meter-candle-seconds.

If we are given the characteristic curve of some emulsion, and if we know the intensity of our telescopic image, then we can find out how long an exposure-time is necessary to yield a photograph of given density; for density is a function of intensity and time--and knowing two of these factors, we can find the third. The trick, then, is to compute the intensity of our telescopic image. I have derived a formula for this purpose which, although not yet extensively tested, has thus far given me very accurate results: (3)

$$I = \text{antilog}\left(\frac{1-m}{2.5}\right) \times 8.5 \times 10^{-7} \times \frac{R^2}{kr^2} \times .01\,T,$$

where I = intensity (candle-meters);
m = stellar magnitude of planet under observation;[1]
R = radius of telescope's objective;
r = radius of planetary image in the focal-plane;
k = illuminated portion of planetary disk (from the <u>Ephemeris</u>);
T = telescopic efficiency, in percent.

I shall now return to our basic problem--selecting emulsions and image-sizes which permit the use of short exposure-times. Suppose the "seeing" is such that exposure-times of over 1/5 second would result in undue blurring from "excursions." (A more realistic figure would be 1/20 second; however, planetary images are rarely brilliant enough to be photographed in such a short time by small telescopes.) We must employ an image small enough that its intensity (which is proportional to the square of its radius) is sufficient to blacken the negative to an average density of, say, 0.80 with an exposure-time of 1/5 second. By referring to the characteristic curves of several emulsions, we observe that to produce a density of 0.8, the "fastest" emulsion (the one which we shall use) requires a log-exposure value of -2.3, while the "slower" ones require greater amounts of energy. We have decided upon an exposure-time of 1/5 second, whose logarithm is - 0.70. It is required to compute the image intensity necessitated by the foregoing conditions. According to equation (2),

$\log E = \log I + \log t$. Substituting and solving for I,

$$\begin{aligned} \log I &= \log E - \log t \\ &= -2.3 + 0.7 \\ &= -1.6. \\ I &= .025 \text{ candle-meters.} \end{aligned}$$

All that remains to be done, is to determine by equation (3) what size image will produce an intensity of .025 candle-meters. This is done by solving formula (3) for r (radius of focal-plane image) rather than for I.

I have found the following procedure to be extremely helpful in choosing the best emulsion for a given set of circumstances:

(1) Determine the longest exposure-time that is permissable from the point of view of blurring from "excursions";
(2) Examine all available characteristic curves to ascertain which emulsion yields the greatest density for small log-exposures (I consider as "small" log-exposures of less than -2.50);
(3) Knowing the exposure-time to be employed and the density required (I find that for planetary photographs, 0.80 is a good average density), determine the intensity necessary to fulfill these conditions;
(4) Find out the resolving-power of the chosen emulsion to tell whether detail upon an image of the size predicted by the previous step will be lost in emulsion diffusion or grain. If this is the case, then it is necessary to enlarge the image and increase exposure time in spite of "seeing" effects. The entire process must then be repeated, in order to arrive at a new value for r.

Now, suppose it is absolutely necessary (because of instrumental limitations) to use an image of some definite radius, regardless of the problems an image of such size might introduce by way of increased exposure-times. Then, it is a simple matter to calculate from equation (3) the intensity of an image that size; after which, the necessary exposure-time may be found by examining the characteristic curve of the emulsion to be used.

It may be said that planetary photographers are divided into two camps; one advocates the use of large images and fast, low-resolution plates; the other advocates small images and high-resolution plates. Results seem to be equal in these two cases, since they require approximately equal exposure-times.

"Plate-scale" is a term that tells, for a given telescope, what linear size image will be formed of an object of given angular size. It is easy to determine plate-scale at a telescope's prime (or secondary) focus:

$$\text{PS, in inches per degree} = \frac{F}{57.3}, \qquad (4)$$

where F = equivalent focal-length of telescope.

Unfortunately, the smaller amateur instruments yield planetary images at the direct focus that are far too small to be successfully photographed. Therefore, it is usually necessary to resort to magnifying devices such as the barlow-lens or the projection-camera. When a barlow lens is employed, plate-scale is arrived at by multiplying the primary plate-scale by the barlow's magnification factor. Plate-scale is more difficult to compute when using a projection-camera, whose workings I shall now review.

Most observers have noticed that when viewing a brilliant object such as the sun or the moon, a highly-magnified image may be projected back from the ocular onto a ground-glass or a sheet of paper. The projection-camera is, in essence, merely a rigid tube carrying (at opposite ends) an ocular (and often a camera-shutter) and a plate-holder. (Fig. 2). It is not necessary to use a camera lens with such an arrangement.

The plate-scale of a projection-camera system is equal to the product of the telescope's primary plate scale, and the camera's magnification factor. The latter is given by the formula:

$$(5) \qquad m = \left(\frac{p}{f} - 1\right) \text{, where}$$

m = magnification factor of projection-camera;
p = distance from ocular to plate;
f = focal-length of ocular.

At this point I might mention the photographic materials with which I have had most success. Among the readily available commercial emulsions, I have found Kodak Royal Pan sheet film and Kodak Tri-X 35 mm. film to yield excellent results. I develop these two emulsions (which are nearly, if not completely, identical) in Kodak Developer D-11 for twelve to fifteen minutes at a temperature of approximately 75° F. Lower temperatures require longer developing times, as determined by the manufacturer's time-temperature chart. Kodak Acid Fixer is a satisfactory hardening and fixing agent.

For photographs in blue light, I have used Kodak Wratten Filter #47; for the green, #58; for the red, #25 (A). These filters may be obtained in square gelatin sheets, or (preferably) as gelatin squares cemented between sheets of good-quality glass. When using filters, exposure-times must be increased by an amount that depends on the light-curve of the planet under observation, and the transmittance-curves of the individual filters. <u>Approximate</u> filter factors for Mars and Jupiter are given below:

FILTER FACTORS

	FILTER	MARS	JUPITER
red	25 (A)	4	-----
green	58	7	6
blue	47	9	3
orange	23 (A)	-----	3

Kodak spectroscopic emulsions are now available in 35 mm. rolls. I have not attempted using these emulsions for planetary photography, but would highly recommend the trial of Spectroscopic Emulsion I-O for "blue" photographs, and Spectroscopic Emulsion I-E for "red" photographs. Probably planetary photographs in "blue" and "red" light can be made without the use of filters with these emulsions. I can see no advantage in using spectroscopic emulsions when it is not desired to isolate some region of the spectrum since the ordinary commercial panchromatic emulsions are generally "faster" over wide spectrum bands.

As for optical components: I use Brandon orthoscopic oculars--especially the 16mm. and 32mm. sizes--and a Goodwin barlow lens (see Fig. 3).

APPENDIX: NUMERICAL EXAMPLES

(1) It is desired to photograph Mars on the evening of September 1, 1956, with an eight-inch reflector whose constants are: F = 65"; T = 50% (refer to equations in text for meaning of these and following symbols). From the <u>Ephemeris</u>, it is seen that on September 1, m = -2.6; k = .99; radius (angular) = 12".3. A projection camera is available; its constants are: p = 13".5; f = 16mm. = 0".63. If more magnification is needed, a barlow lens, which has a magnification factor of 2, may be introduced into the system; in this case, p decreases (because of mechanical considerations) to 12".5. The fastest emulsion obtainable on this occasion is Kodak Tri-X Pan. Our usual limiting-magnitude is 6.0; on this night, however, it drops to 5.0.

It is first required to determine whether the extra magnification afforded by the barlow lens is required. We compute primary plate-scale with equation (4): Primary PS = 65/57.3 inches per degree, or, .000314 inches per second.

Next, the magnification factor of the projection camera is computed (both with and without the barlow lens) from equation (5):

$$\text{(without barlow)}\quad m = (13.5/.63) - 1$$

$$\text{(with barlow)}\quad m = (12.5/.63) - 1$$

Overall plate-scale is equal to the product of primary plate-scale and all magnification factors; thus,

$$\begin{aligned}\text{(without barlow)}\quad PS &= .000314 \text{ x } (13.5/.63 - 1)\\ &= .0064 \text{ inches/second;}\\ \text{(with barlow)}\quad PS &= .000314 \text{ x } 2 \text{ x } (12.5/.63 - 1)\\ &= .012 \text{ inches/second.}\end{aligned}$$

In the first case, the linear diameter of the image of Mars is:

$$\begin{aligned}d &= .0064 \text{ x } 24.6\\ &= 0.16 \text{ inch;}\end{aligned}$$

in the second case,

$$\begin{aligned}d &= .012 \text{ x } 24.6\\ &= 0.30 \text{ inch.}\end{aligned}$$

We decide to use the barlow because of the larger image afforded--with the reservation, of course, that exposure-times will not be prohibitive. The next step is to determine the intensity of an image 0.30 inch in diameter produced by our eight-inch telescope. By equation (3),

$$\begin{aligned}I &= \text{antilog } \frac{1 + 1.6^{x}}{2.5} \text{ x } 8.5 \text{ x } 10^{-7} \text{ x } \frac{16}{1.0 \text{ x } .023} \text{ x } .50\\ &= 11 \text{ x } 8.5 \text{ x } 10^{-7} \text{ x } 700 \text{ x } .50\\ &= 3.3 \text{ x } 10^{-3} \text{ candle-meters.}\end{aligned}$$

It is now required only to determine t, which may be done through equation (2). From the characteristic curve of Tri-X Pan we find that a density of 0.8 requires log E = -2.3, assuming a developing procedure of 25 minutes in Kodak developer D-76 at 68° F. Thus,

$$\begin{aligned}-2.3 &= \log(3.3\text{x}10^{-3}) - \log t\\ \log t &= 2.3 + \log(3.3\text{x}10^{-3})\\ &= -0.2. \text{ Therefore,}\\ t &= \text{approximately } 3/5 \text{ second}\end{aligned}$$

(2) Object: Venus, May 12, 1956. From the Ephemeris, m = - 4.2; angular radius = 17".4; k = .31. Instrument: 15" refractor; F = 270"; T = 70%. Primary plate scale, therefore, = .00131 inches/second. Limiting magnitude on this night = 6.0. t = 1/25 second, in order to reduce blurring from "excursions". Problem: How large an image is necessary to effect a density of 0.8 on Kodak Royal Pan film; and what optical units are required in the projection camera to accomplish this?

By observing the characteristic curve of Royal Pan, we find that log E = -2.2 renders D = 0.8, assuming a developing procedure as follows: Kodak Developer Dk60a, 68° F., 12½ minutes.

Thus, by equation (2),

$$\begin{aligned}-2.2 &= \log I + \log(1/25)\\ \log I &= -.80\\ I &= 0.16 \text{ candle-meters.}\end{aligned}$$

Solving equation (3) for r:

$$\begin{aligned}0.16 &= \text{antilog } \frac{1 + 4.2}{2.5} \text{ x } 8.5 \text{ x } 10^{-7} \text{ x } \frac{56}{\substack{.3r^2\\ .3r^2}} \text{ x } .70\\ 0.16 &= \frac{120 \text{ x } 8.5 \text{ x } 10^{-7} \text{ x } 190 \text{ x } .70}{r^2}\\ r^2 &= (.014/.16)\\ r &= 0.30 \text{ inch.}\end{aligned}$$

This corresponds to a plate-scale of 0.30/17.4 = .017 inches/second. Since primary plate-scale = .0013 inches/second, the magnification factor of the projection camera must be .017/.0013 = 13. Therefore, by equation (5),

$$13 = (p/f - 1); \text{ so that}$$

$$p = 14f.$$

Thus, if an ocular 32 mm. (1".26) focal length is used, p must = 17".6; if a 16mm. (0".63) ocular is used, p must = 8".8.

(3) The next-to-last term in equation (3) does not hold true for Saturn, since its shape is irregular. For Saturn, revise equation (3) as follows, which gives good approximations (see Fig. 4):

$$I = \text{antilog}\ \frac{1 - m}{2.5} \times 8.5 \times 10^{-7} \times \frac{R^2}{ab - a'b' \quad r^2} \times .01\ T.$$

(4) If filters are used, their factors must be incorporated into equation (3). In such cases, append the following multiplicative factor:

$\frac{1}{X}$, where X = filter factor.

I would be happy to correspond with any observers interested in planetary photography; the material presented above is admittedly sketchy and incomplete, due to lack of space. My address is 4320 45th St., N.W., Washington 16, D.C.

FOOTNOTES

1. Taken from Ephemeris, assuming a clear night, with limiting magnitude = 6.0. If the limiting magnitude is, say, 7, then we should insert m as one magnitude brighter than the Ephemeris value; if the sky is overcast so that the limiting magnitude = 5.0, then m is considered as one fainter than the Ephemeris value. The limiting magnitude discussed here is assumed to be unaffected by city lights, but rather, only by true atmospheric conditions; when artificial lighting is involved, a planet may *appear* faint because it does not contrast well with the bright sky, whereas its *actual* brightness remains constant.

x See footnote (1). m_{lim} usually is 6.0, but tonight has dropped to 5.0. Thus, Mars appears not at the Ephemeris value of m = - 2.6, but at a corrected value of m = - 1.6.

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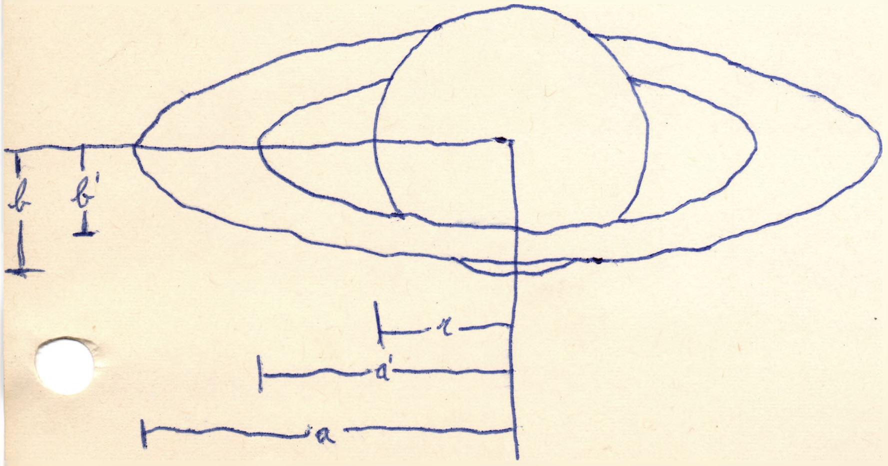
Illustrations:

Fig. 1: 'TYPICAL "CHARACTERISTIC CURVE"'
Fig. 2: 'PROJECTION CAMERA'
Fig. 3: 'MAG. FACTORS OF GOODWIN BARLOW LENS'
Fig. 4: 'ANGULAR DIMENSIONS OF SATURN'
Figs. 5-8: 'PHOTOGRAPHS OF JUPITER'

FIG. 4: ANGULAR DIMENSIONS OF SATURN



15 mm Retina (R)

NO. OF PLATE	ROLL NO.	FRAME NO.	FILM	DEVELOPER	TIME OF DEVELOPMENT	TEMP OF DEVELOPMENT	REMARKS
1	B4	8	TX	PROMIGROL	7·5 min	70° F.	
2	B4	11	TX	PROMIGROL	7·5 min	70° F.	
3	B4	12	TX	PROMICROL	7·5 min	70° F.	
4	B4	13	TX	PROMICROL	7·5 min	70° F.	
5	B4	14	TX	PROMICROL	7·5 min	70° F.	
6	B4	15	TX	PROMICROL	7·5 min	70° F.	
7	B4	16	TX	PROMICROL	7·5 min	70° F.	
8	B4	17	TX	PROMICROL	7·5 min	70° F.	
9	B4	18	TX	PROMICROL	7·5 min	70° F.	
10	B4	19	TX	PROMICROL	7·5 min.	70° F.	
11	B5	2	TX	PROMICROL	7·0 min	72° F.	
12	B5	3	TX	"	"	"	
13	B5	4	TX	"	"	"	
14	B5	5	TX	"	"	"	
15	B5	6	TX	"	"	"	
16	B5	7	TX	"	"	"	
17	B5	8	TX	"	"	"	
18	B5	9	TX	"	"	"	
19	B5	10	TX	"	"	"	
20	B5	11	TX	"	"	"	
21	B5	12	TX	"	"	"	
22	B5	13	TX	"	"	"	
23	B5	14	TX	"	"	"	

R
1

INSTRUMENT: 15 mm Retina IIC S/TX(R) DATE: January 11/12, 1958

NO. OF PLATE	REGION	DETERMINED R. A.	POSITION DEC	BEGIN EXP.	~~E.S.T.~~	END EXP.	~~E.S.T.~~	SKY	REMARKS
1	VENUS SETTING	——	——	~~17:59~~ 22:59		~~18:49~~ 23:49		CLEAR	——

R
2

INSTRUMENT: 15 mm Retina ~~M~~ S/TX(R) DATE: April 26/27, 1958

NO. OF PLATE	REGION	DETERMINED POSITION		BEGIN EXP.	END EXP.	SKY	REMARKS
		R.A.	DEC.				
2	CIRCUMPOLAR STAR TRAILS	———	90°	4:25	5:25	Clear	———

INSTRUMENT: 15 mm Retina IIS/TX (R) DATE: April 27/28, 1958

NO. OF PLATE	REGION	DETERMINED POSITION R.A.	DETERMINED POSITION DEC.	BEGIN EXP.	END EXP.	SKY	REMARKS
3	MOON IN LEO	10:30	+15°	1:10	1:11	HAZY	Attempt to photograph
4	MOON IN LEO	10:30	+15°	1:13	1:15	HAZY	Moon halo.

INSTRUMENT: 15 mm Retina [illegible]f/TX (R) DATE: May 12/13, 1958.

NO. OF PLATE	REGION	DETERMINED POSITION R.A.	DEC.	BEGIN EXP.	END EXP.	SKY	REMARKS
5	JUPITER, VIRGO	12:40	−15°	2:05	—	CLEAR	EXP. 1 sec
6	+ CORVUS	12:40	−15°	—	—	DO.	" 5 sec
7	DO.	12:40	−15°	—	—	DO.	" 20 sec
8	DO.	12:40	−15°	—	—	DO.	" Unknown
9	DO.	12:40	−15°	—	—	DO.	" 60 sec
10	DO	12:40	−15°	—	2:10	DO	" 120 sec

R
23

INSTRUMENT: 15 mm Retina S/TX(R) DATE: June 6/7, 1958

NO. OF PLATE	REGION	DETERMINED POSITION R.A.	DETERMINED POSITION DEC.	BEGIN EXP.	END EXP.	SKY	REMARKS
11	AURORA	—	—	2:45	—	CLEAR	20 sec exp. for most plates. ●
12	DO.	—	—	—	—	DO.	
13	DO.	—	—	—	—	DO.	DO. ●
14	DO.	—	—	—	—	DO.	DO.
15	DO.	—	—	—	—	DO.	DO.
16	DO.	—	—	—	—	DO.	DO. ●
17	DO.	—	—	—	—	DO	DO. ●
18	DO.	—	—	—	—	DO.	DO. ●
19	DO.	—	—	—	—	DO.	DO. ●
20	DO.	—	—	—	—	DO.	DO.
21	DO.	—	—	—	—	DO.	DO.
22	DO.	—	—	—	—	DO.	DO.
23	DO.	—	—	—	3:00	DO.	DO.

29 mm Takumar (T)

NO. OF PLATE	ROLL NO.	FRAME NO.	FILM	DEVELOPER	TIME OF DEVELOPMENT	TEMP. OF DEVELOPMENT	REMARKS
1	T45	3	SA	(ETCO)	—	—	
2	T45	4	SA	(ETCO)	—	—	
3	T45	5	SA	(ETCO)	—	—	
4	T49	4	SA	(ETCO)	—	—	
5	T49	5	SA	(ETCO)	—	—	
6	T49	6	SA	(ETCO)	—	—	
7	T49	7	SA	(ETCO)	—	—	
8	T49	8	SA	(ETCO)	—	—	

II
3

INSTROMENT: 29 mm Tahumar B/SA(T) DATE: August 14/15, 1958

NO. OF PLATE	REGION	DETERMINED POSITION		BEGIN EXP.	END. EXP.	SKY	REMARKS
		R.A.	DEC.				
1	URSA MAJOR	12h 35m	+58°	2:33	2:35	LIGHT CLOUDS	
2	SPUTNIK III IN HERCULES	17h 20m	+26°	2:45	——	MODERATE CLOUDS	2 min exp. approx
3	SPUTNIK III IN AQUILA	19h 15m	+ 5°	——	2:50	HEAVY CLOUDS	2 min exp. approx

T
8

INSTRUMENT: 29 mm Takumar S/SA (T) DATE: December 30/31, 1958

No. of Plate	Region	Determined Position		Begin Exp.	End Exp.	Sky	Remarks
		R.A.	Dec.				
4	ORION			~~21:10~~ 2:10	—	CLEAR	2 min exp. [illegible]
5	MARS IN TAURUS			—	—	DO.	DO.
6	AURIGA			—	—	DO.	DO.
7	ORION			—	—	DO	DO
8	SIRIUS			—	20:25	DO.	DO

108 mm Reflector (G)

NO. OF PLATE.	ROLL NO.	FRAME NO.	FILM	DEVELOPER	TIME OF DEVELOPMENT	TEMP. OF DEVELOPMENT	REMARKS
1	T49	1	SA	(ETCO)	—	—	
2	T49	2	SA	(ETCO)	—	—	
3	T49	3	SA	(ETCO)	—	—	
4							
5							
6							
7							

INSTRUMENT: 108 mm Reflector S/SA (G) DATE: October 20/21, 1958

NO. OF PLATE	REGION	DETERMINED POSITION R.A.	DETERMINED POSITION DEC.	BEGIN EXP.	END EXP.	SKY	REMARKS
1	MOON			23:55	—	CLEAR	1/10 sec 16 mm ext 32 mm EFL
2	MOON			—	—	DO.	1/25 " " " "
3	MOON			—	00:00	DO.	1/50 " " " "

INSTRUMENT: 6½" Refractor (J)   DATE: May 16/17, 1959

PLATE	ROLL	FRAME	FILM	OBJECT	BEGIN EXP.	LENGTH EXP.	END EXP.	SKY	OBS.	REMARKS	DEVELOPMENT
1	8	6	F	Moon	3:25	1/100 sec	—	0	1	Pentax body	X-22 13 min 64°F (17/5/59)
2	8	7	F	Moon	—	1/50 sec	—	0	1	"	"
3	8	8	F	Moon	—	1/25 sec	—	0	1	"	"
4	8	9	F	Moon	—	1/10 sec	3:30	0	1	"	"
5	8	10	F	Jupiter	3:35	1/25 sec		0	1	"	"
6	8	11	F	Jupiter		1/10 sec		0	1	"	"
7	8	12	F	Jupiter		1/5 sec		0	1	"	"
8	8	13	F	Jupiter		1/2 sec		0	1	"	"
9	8	14	F	Jupiter		1 sec	3:40	0	1	"	"

¼" SQUARES