

KG
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930

Photographic measurement
of light.

KB 11365.930

Intensity of Various Luminous Sources

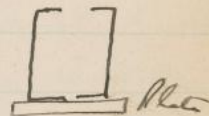
The object of the investigations to be described below is to determine the scale photometric intensity of various sources of light upon a uniform scale. This scale will be that of the meridian photometer in which a Venus (Polaris) has the magnitude 2.15 and one unit corresponds to the retina, where luminance is 0.400 .

Luminous points may be compared directly with stars. In the case of surfaces the light emitted by a circle having a diameter of one minute of arc will be employed.

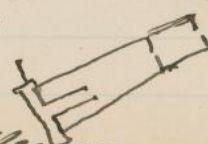
In general, ~~then~~ a portion of a photographic plate one or two centimeters square will be exposed to the source of light for a given time 1^s or 1^m and the darkening measured by a photographic wedge.

I Surfaces.

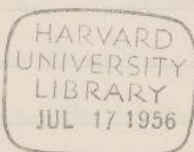
Measure intensity of sky in zenith during twilight. In clear and cloudy days. On dark and on moonlight nights. Compare when sky with white cumulus clouds. Intensity of Milky Way, Aurora, Zodiacal light. For very faint lights very large apertures will be needed e.g. 60° or 120° .



Height of sky at different distances from Sun. Use small apertures with lenses. Determine brightness of edge of Moon by cutting off light of sky by distant screen.



HC 11365.934



For small angles from Sun change when nearly
minute and measure distances by direct
method.

II Luminous Points.

Concentrate light by lens.

Thus form images and of
focus and exposure to Plate then
capture light stars, & planets. In case of
Venus or Mercury, exposure also to adjacent part
of sky to eliminate effect of background.

In case of Moon stream image much along
focus so as to eliminate effect of form. Also
use direct light as in case of landscape



III Length of Sun

This is a very important but difficult problem.
Reduce light by direct lens of short focus
by refract and reflection and compare with
~~the~~ standard light similarly reduced but
at less distance. Determine effect of distance
with setting Sun.

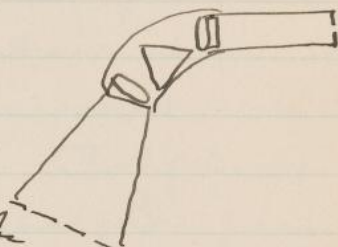
Reduce light by combination of lenses like
telescope which enlarges or reduces object
or can look through one or other end. Thus
compare Sun and standard light, both by
absorption or by the same method.

IV. ~~III~~ Spectra.

Measure intensity of portions
of spectrum of sun & stars
4800, 4700, ... - 3700.

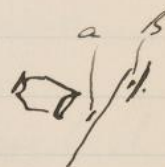
Carbon using lens of
light. Sun, Moon, Sky, Clouds

December 22, 1897.



V Measurement of Results.

All measurements may be made by a
photographic wedge by direct comparison.



A much more satisfactory way could
be to compare the absorption by means of a bolometer
or thermopile. Let A, B, be two bolometers of a
bolometer ^a protected from a lens of heat by the
image to be measured. The other, B, protected from the
direct light. The latter is moved until the needle is
at zero. The plate is moved until each ~~from~~ surface
in turn is covered the ~~thermo~~ bolometer as shown by
the eyepiece. The image of a star may be used in the
same way or a contact print from it. In this way
error of the eye may be eliminated and comparisons
made entirely automatically.

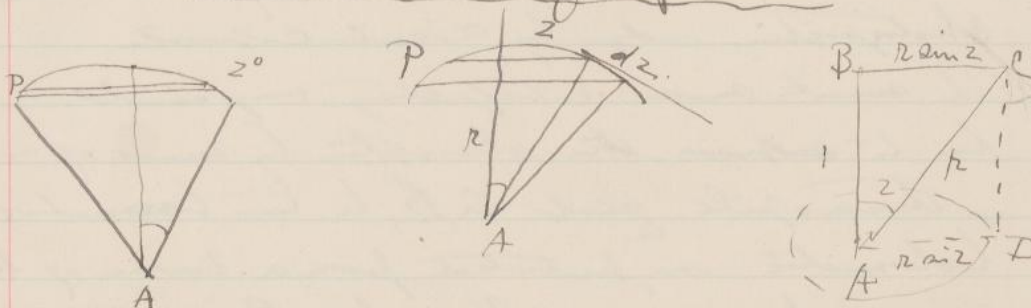
December 28, 1897.



Measures upon Sky.

Measures upon sky could be made by an apparatus similar to that employed in making photographic wedges. This would ensure some portion of the darkened plate of a density suitable for measurement. By using an automatic device to shift plate & make exposure, ~~we~~ should obtain ~~results~~ ^{photo} results, accurate, uniformly distributed, and measurable.

Consideration of Apertures.



Determination of illumination at A when circular aperture is used on zenith.

If. at A from zone P of width dz is equal to

$$2\pi r \cdot r \sin z \, dz \cdot \cos z$$

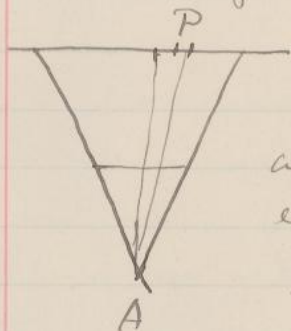
$$= 2\pi r^2 \sin z (\cos z \, dz)$$

$$\text{Illum at A} = \int_0^z 2\pi r^2 \sin z (\cos z \, dz) = \pi r^2 \sin^2 z$$

This is equivalent to saying that the amount of illumination at A is ^{proportional} equal to the projection of the horizon of the sky seen from A. Since this law is the same as the law of the cosine it does not depend on the above work.

Hence we may derive the result more simply for triangle ABC. The projection is circle having $r \sin z$ for radius. Its area then is $\pi r^2 \sin^2 z$. which measures the light ratio. (See bottom of page) *

Same principles apply to flat surface



Area of annular element at P at an angle of z for center is ~~$2\pi z$~~ equal to $2\pi \tan z \sec^2 z dz$. Illumination at A from such element is equal to $2\pi \tan z dz$.

$$\text{Total ill. at A} = 2\pi \int_0^z \tan z dz$$

Z. S. K. Jan 8 1898.

Upon reconsideration a flat surface ought not to differ from a spherical since the amount of light emanating from it is measured by the ^{including} solid angle, which in turn is measured on the surface of the sphere having its center at A & its radius = unity.



* The rule for circular apertures may be stated thus, that the measure is the square of the ratio of the linear diameter to the distance from edge to center of plate. Thus it is proportional to $\frac{a^2}{d^2}$; not $\frac{a^2}{f^2}$.

Z. S. K. Jan, 11, 1898.

Computation of circular apertures to be used in zenith

If ϕ = our standard angular aperture (= 1' of arc. See page 1) & θ = a desired angular aperture giving in turn the light, the equation is

$$\sin \frac{\theta}{2} = \sqrt{m \sin^2 \frac{\phi}{2}}$$

& the linear aperture is = $2f \tan \frac{\theta}{2}$

$$\begin{aligned} \log \sin \frac{\theta}{2} &= \frac{1}{2} \log \sin^2 \frac{\phi}{2} + \frac{1}{2} \log m \\ &= \log \sin \frac{\phi}{2} + \frac{1}{2} (\log m) \end{aligned}$$

(m expressed in magnitudes)

Values for $m = 10, 12, 14, 16, 18$ ^{magn.}
 & $f = 20$ c.m. $\log 2f = 1.6021$

	$\log \sin \frac{\phi}{2}$	$\log \tan \frac{\theta}{2}$	$\log 2f \tan \frac{\theta}{2}$	Diam. of aperture at 20 c.m. ^{Voliot.}
	$\frac{6.1626}{2.0000}$			
10	$\frac{8.1626}{.4}$	8.1626	9.7647	~~5.8~~ 0.58 c.m.
12	$\frac{8.5626}{.4}$	8.5629	0.1650	1.46
14	$\frac{8.9626}{.4}$	8.9644	0.5665	3.70
16	$\frac{9.3626}{.4}$	$\frac{9.3745}{9.0656}$	0.9766	9.48
18	$\frac{9.7626}{.4}$	9.8512	1.4533	28.4
20	$\frac{10.1626}{.4}$			

2.8.11. Jun 12 1898

Relation of Time and Aperture.

Time is the most troublesome factor entering into photographic measurements of light. Hence it is desirable, that it should be eliminated as far as possible by exposing for equal intervals & varying the aperture. &c. However to obtain a comparison between lights of ~~each~~ ^{great} differing by perhaps 25^{to 30} magnitudes, it will probably be necessary to ~~consider time as~~ employ exposures of different lengths.

We have assumed thus far, three fundamental principles, as follows.

- 1st Inv. Square of distance.
- 2nd Cosine of inclination to normal incidence
- 3rd Orthogonal section of element of illumination surface.

These will need to be tested but at present let us consider them as proved beyond question.

Aperture has already been treated in this manner. Its correction maintains the same character so long as the illumination surface fills the field or a large part of it. It is applicable then to measures made with Standard Light. Therefore a correction may be necessary for aperture even with Standard Light Squares. The angular aperture at which this correction becomes

appreciable way be thus found. The difference ~~consists in the~~ is that between the squares of the sines and tangents of $\frac{1}{2}$ the angular aperture.

$$\tan^2 \frac{1}{2} \theta - \sin^2 (\tan^{-1} \frac{1}{2} \theta) = \text{Difference}$$

$$\frac{\tan^2 \frac{1}{2} \theta - \sin^2 (\tan^{-1} \frac{1}{2} \theta)}{\tan^2 \frac{1}{2} \theta} = \text{Per ct. of error} = \epsilon \text{ p.}$$

$$1 - \frac{1}{\tan^2 \frac{1}{2} \theta + 1} = \epsilon$$

$$\tan^2 \frac{1}{2} \theta = \frac{\epsilon \tan^2 \frac{1}{2} \theta + \epsilon}{\epsilon}$$

$$\tan^2 \frac{1}{2} \theta = \frac{\epsilon}{1 - \epsilon}$$

If $\epsilon = .00\frac{1}{2}$	$\theta = 8^\circ.1$	$\frac{1}{28}$ approx
$\epsilon = .01$	$\theta = 11^\circ.5$	$\frac{1}{10}$ "

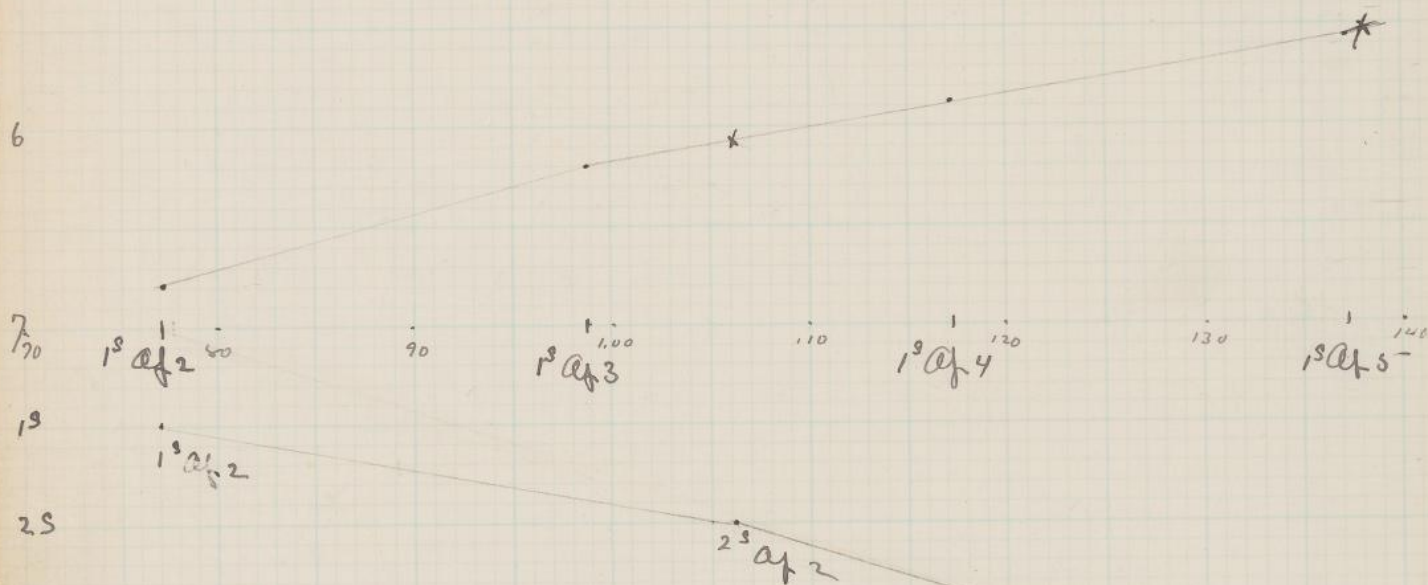
These limits are easily maintained in any apparatus where the Standard Light is now used.

E.S.K. Jan 13 1898

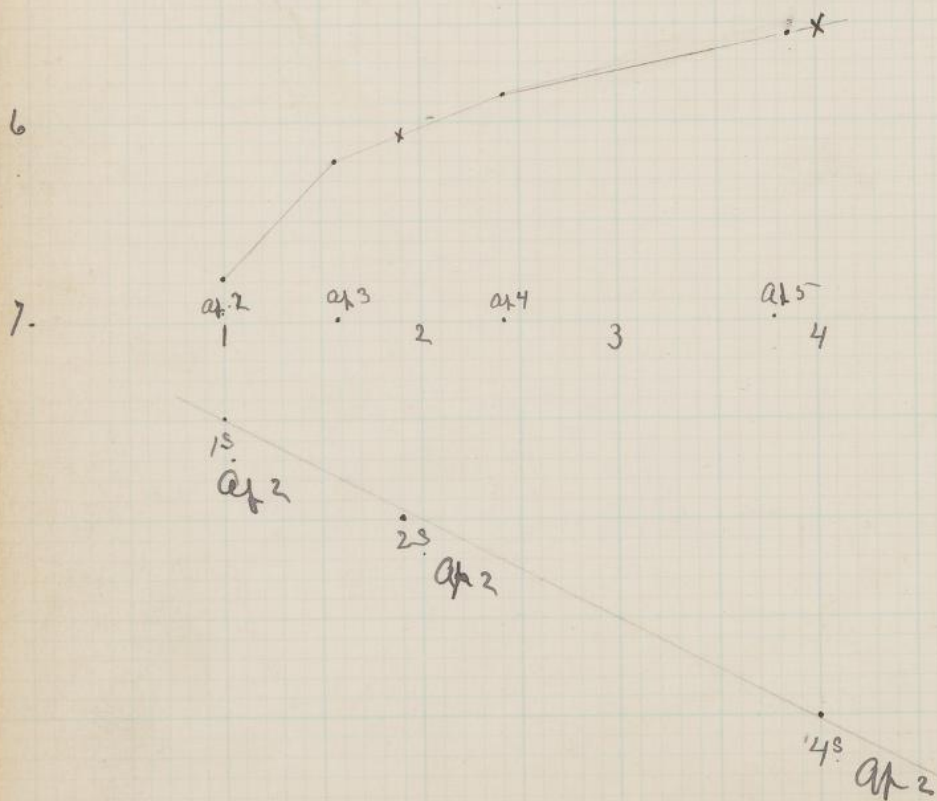
Using the Standard Light, let us expose for equal intervals of time, obtaining a set of squares 1, 2, 3 &c with ~~a~~ differing from each other by $\frac{1}{2}$ magnitude determined by aperture. On the same plate expose a set of squares with one of these apertures for 1, 2, 3 &c times the unit of time. These squares when measured with a wedge, furnish a means for plotting a curve showing the relation between time

Relation of Time & Aperture.

I Abcissa = Log. of Aperture.

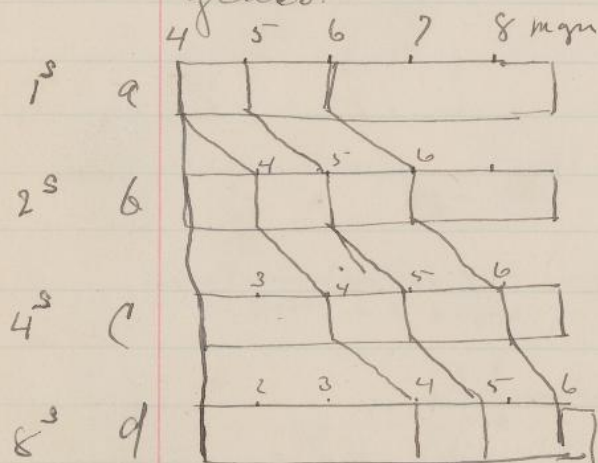


II Abcissa = Aperture. (Square)



I also that particular light & aperture.
 Such a curve is shown on opposite page. One is plotted with log of aperture for abscissa & other with (square of) aperture simply. The curve below the axis of X shows the time required with the given aperture to produce the density of any part of the wedge & corresponding to that of 1^s for a larger aperture. The deviation of the upper curve is (I) from a straight line is a measure of the accuracy of the wedges ^{graduations}. That the lower curve of (II) is nearly straight shows that in this particular case the time ratio is more nearly proportional to the aperture than to its logs.

If long exposures were required, we can reduce the light by interposing neutral tinted glass.



Another method would be to make wedges a, b, c, etc on the same plate & using the same aperture, but varying the exposure.

Now measure portions of a taken at equal intervals, using wedges b, c, d, etc in turn. The results plotted give a system of contour lines which can be made to come as near to getting as many

be desired.

E. S. K. Jan 14 1898

Experiment to determine deviation from law of cosines of inclination.

From measures recorded in Book E. 8 p 22 we derive the following light ratios of apertures in disc A used with Standard Argand.

Aperture	Ratio	angle of incidence
2	$r = 1.00$	0°
3	1.65	52.4°
4	2.52	66.7°
5	3.98	75.4°

Each aperture should give a square of a density of that produced by "2", if received at an angle whose cosine is equal to $\frac{1}{r}$ or $\sec = r$. These angles are given in column "angle of incidence".

It is proposed to make exposures with the several apertures having the plate at the corresponding angle. A comparison of the resulting squares will show the extent of any deviation.

Set made Feb 2 19 1898
Reel Book E 9 Page 177

E. S. K. Feb 3 1898

Apertures for Iky Photometer.

It is thought best to utilize a set of apertures made originally for the 6 inch Deepen Telescope. These are marked by numbers 1-6.

No.	Aperature	Diameter c.m.	Log.	(Dist = 20 ^{c.m.}) Lang. $\frac{\theta}{2}$	Log sin $\frac{\theta}{2}$
1		~~25.89~~ 19.60	0.3201	8.7180	8.7180
2		3.15	0.4983	8.8962	8.8948
3		4.94	0.6937	9.0916	9.0883
4		7.80	0.8921	9.2900	9.2818
5		10.57	1.0241	9.4220	9.4074
6		19.60	1.2923	9.6902	9.6434

	$\log \sin \frac{\theta}{2} - \log \sin \frac{\phi}{2}$	m	Formula on p. 8.
1	2.5548	12.77	
2	2.7322	13.66	
3	2.9257	14.63	
4	3.1192	15.60	
5	3.2448	16.22	
6	3.4808	17.40	

E.S.K. Feb. 7, 1898.

Same subject continued.

Required to find distance with aperature "6" & give
 $m = \frac{16.00}{18.00}$.

From p. 8. $\log \sin \frac{\theta}{2} = 6.1626 + \frac{1}{5} m$

$$= \frac{6.1626}{3.2000} = 9.3626 \quad \frac{\theta}{2} = 13^{\circ} 19.4'$$

Dist = $\frac{\text{Aperature}}{2} \times \cot \frac{\theta}{2} = 16.44$

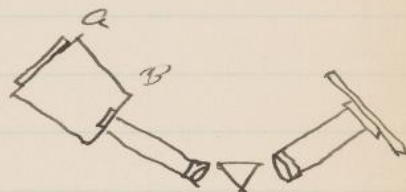
$$\begin{array}{r} 0.8921 \\ 0.3010 \\ \hline 0.5911 \\ 0.6249 \\ \hline 1.2160 \end{array}$$

In this distance of 16.44, aperature
 "6" would have a value $m = 17.70$

E.S.K. Feb. 9, 1898.

December 19, 1899.
Comparison of Sun and Moon.

A, plate of musclevin
diameter 10 cm. distance from
slit B of Spectroscop 10 m.



Photograph of spectrum of Moon
6-6 taken with this apparatus exposure 60" (?)
placing musclevin over slit. Repeat on Sun with
spectrum of musclevin plate of musclevin (1 mm. diam.)
and 1000 mm distance. Length thus reduced
100,000. Photograph also with standard
light on Ubbelohde light through aperture of
1 cm. at distance of 10 cm. Photograph also
with standard light without musclevin and
on sky and cloud. Repeat observations with
sensitive plate instead of slit.

Measure relative intensity of different lines
of spectrum at $\lambda = 5800, 3800, 4000, 4200, \dots, 5800$.
We thus obtain ^{absolute} relative intensity of Sun and Moon
for different wavelengths independent of absorption,
sensitiveness of plate, etc.

List of stars as brighter - brighter than
Polaris Antares for Annals, Vol. ~~XIV~~ page 406.

The times for observation are given when the star
has the altitude of $42^{\circ}5'$

HP.	Star	R.A.	Dec	Mag	HP.	Time	for Obs.
1275	α Canis Maj	~~6-40.7~~ ± 2.0 ~~7-04.3~~	-16.6	-1.4	0 00	6 41	17 29
2400	α Bootis	14-11.1 ± 2.0	+19.7	+0.1	320	3 18 ~~3 20~~	~~11 57~~ 17.31
932	α Antares	5-09.3 ± 2.0	+145.9	+0.2	430	4 32 ~~4 33~~	9 41
936	β Orionis	5-09.7 ± 2.0	-8.3	+0.2	0 00	5 10	
3147	α Lyrae	18-33.6 ± 2.0	+38.7	0.4	4.16	4 14 14 20	22 48
1442	α Cassio M.	7-34.1 ± 2.0	+5.5	0.6	2.14	2 14 5 20	9 48
10915	α Orionis	5-49.8 ± 2.0	+7.4	0.8	2.25	2 26 3 24	8 16
797	α Tauri	4-30.2 ± 2.0	+16.3	1.0	3.08	3 06 1 24	7 36
3429	α Aquilae	19-41.9 ± 2.0	+8.6	1.0	2.32	2 31 17 15	22 17
2764	α Scorpii	16-23.3 ± 2.0	-26.2	1.1	0 00	16 23	
2263	α Virginis	13-19.9 ± 2.0	-10.6	1.2	0 00	13 20	
1409	β Geminae	7-39.2 ± 2.0	+28.3	1.2	3.48	3 46 3 53	11 25
4057	α Pis. Aus.	22-52.1 ± 2.0	-30.2	1.3	0 00	22 52	
1797	α Leonis	10-03 ± 2.0	+12.5	1.4	2.52	2 50 7 13	12 53
3631	α Cygni	20-38 ± 2.0	+44.9	1.6	4 30	4 30 16 08	1 08
1325	β Can. Maj	6-54.7 ± 2.0	-28.8	1.6	0 00	6 55	
1423	α Rheni	7-28.2 ± 2.0	+32.1	1.6	3 57	3 56 3 30	11 26
979	γ Orionis	5-19.8 ± 2.0	+6.2	1.8	2.17	2 19 3 01	7 39
1029	ϵ Orionis	5-31.1 ± 2.0	-1.3	1.8	1.25	1 22 4 09	6 53
1045	δ Orionis	5-35.7 ± 2.0	-2.0	1.8	1.18	1 16 4 20	6 52
978	β Tauri	5-20 ± 2.0	+28.5	1.9	3 48	3 48 1 32	9 06
2338	γ Uro. Maj	13-43.6 ± 2.0	+49.8	1.9	4 40	4 42 9 02	16 26
2932	α Scorpii	17-26.2 ± 2.0	-37.1	1.9	0 00	17 26	

#P	Design	RA	Dec	Mag	HA	HA		
2191	ϵ Urs. Maj.	12-49.6 ^{± 3.6}	+56.5	2.06 ^{7.9}	4.53	4 54	7 56	17 44
1926	α Urs. Maj.	10-57.6 ^{± 4.3}	+62.3	2.0	5.09	5 04	5 54	16 02
541	α Persei	3-17.2 ^{± 3.1}	+49.5	2.0	4.40	4 40	22 37	7 57
1100	β Aurigae	5-52.2 ^{± 2.8}	+44.9	2.0	4.30	4 30	1 22	10 22
1300	δ Canis Maj.	7-04.3 ^{± 2.2}	-26.2	2.0		0 00	7 04	
2379	δ Centauri	14 00.5 ^{± 2.5}	-35.9	2.1		0 00	14 00	
5	α Androm.	0-03.2 ^{± 2.0}	+28.5	2.1	3.48	4 ³ 48	19 ^{2.0} 15	4 ³ 51
213	α Uro. Min.	1-22.6	+88.8	2.1		—	0 00	23 39 incl.
1249	γ Gemini	6-31.9 ^{± 2.1}	+16.5	2.1	3.09	3 06	3 26	9 38
1201	β Can. Maj.	6-18.3 ^{± 2.1}	-17.9	2.2		0 00	6 18	
1648	α Hydrae	9-22.7 ^{± 2.0}	-8.2	2.2		0 00	9 23	
233	α Arietis	2-01.5 ^{± 2.2}	+23.0	2.2	3.32	3 30	22 32	5 32
2264	γ Uro. Maj.	13-19.9 ^{± 2.5}	+55.4	2.2	4.53	4 52	8 28	18 12

θ Sco. 2.1

Wednesday June 20 1900

An experiment for determining the proper times & distances for make a contact of ^{same degree of} ~~photo~~ contrast ^{as} ~~no greater than~~ original.

Light, was Argand Burner.

Original plate was two wedges on A.G. 83-
taken in standard wedge app.

In Sud Process the exposures were 1^s 4^s 16^s & 64^s
at $2'$ & 4^s 16^s 1^m & 4^m at $8'$

In Sud 23 the same exposures were given but with
distances of $4'$ & $16'$

Nos of Plates are D 7486 - 93

When dry, placed each film & film with original
& noted degrees of contrast when viewed against
sky.

Dist	Exp	Sud Process	Dursch	Gradation
$2'$	1^s	Less contrast	Less	Less
$2'$	4^s	Greater "	Greater	Greater
$8'$	4^s	Less "	Less	Less
$8'$	16^s	" "	Less	Less
$8'$	1^m	Greater "	Greater	Greater
$8'$	4^m	" "	"	"
$82'$	16^s	"	"	"
$2'$	64^s	"	"	"

Wednesday June 20 1900

An experiment for determining the proper time & distance for making a contact of ^{plate and} ~~plates~~ contact no greater than original.

Left, was August Bunker.

Original plate was two wedges on A.B. 53.
Later in standard wedge aff.

In Sled 22 the exposure was 1³ 4³ 16³ & 6³
at 2' & 4' 16' 1' & 4" at 8'

In Sled 23 the same exposures were given but with distances of 4' & 16'

W. of Plateau D 7486-93

When dry, placed each photo film with original & noted degree of contrast when viewed again sky.

Dist	Exp.	Sled 22	Density	Gradation
2'	1 ³	Less contrast	Less	Less
2'	4 ³	Greater "	Less	Greater
8'	4 ³	" "	Less	Less
8'	16 ³	" "	Less	Less
8'	1 ³	Greater "	Greater	Greater
8'	4 ³	" "	" "	" "
82'	16 ³	" "	" "	" "
2'	64 ³	" "	" "	" "

Wednesday June 20 1900

Sled 23

Dist	Exp.	Contrast	Density	Gradation
4'	1 ³	Slightly less	Less	Less
4'	4 ³	Very nearly same	Less	Greater
16'	4 ³	Less	Less	Less
16'	16 ³	Slightly less	Less	Less
4'	16 ³	Over exposed	Less	Less
4'	64 ³		—	—
16 ³	1 ³		—	—
16'	4 ³		—	—

"Density" and above was obtained by comparing dark ends of original wedges & contact. Less under "Gradation" means that slope of density when the wedges were compared in the camera was not as steep in contact as original. The two plates were slid along so as to bring parts of equal density together.

Dist	Exp.	Greater Contrast	16' 16 ³ Greater Contrast
Sled 22	8'	1 ³	16' 1 ³ no difference
	2'	4 ³	4' 4 ³ no difference
	8'	4 ³	Other fogged too much for exposure
	2'	16 ³	

These plates were measured with P.D. P.H. for results see P.P. II p. 9

Seed Process

	2ft - 1 ^s	2ft 4 ^s	2ft 16 ^s	2ft 64 ^s	8ft 4 ^s	8ft 16 ^s	8ft 1 ^m	8ft 4 ^m
1	0.06	0.11 0.14 0.63	2 1.73	4.26	0.19	0.09	0.08	0.34
2	0.86	1.71 2.41 3.82	3.82	—	0.09	0.18 0.04	1.29	0.61
3	2.57	6.14 3.23 6.98	—	—	0.27	0.63 0.83 1.81	3.56	2.93
4	3.71	0.17	—	—	0.90	1.14	5.40	1.84
5	3.88	—	—	—	1.15	3.82	—	—

Seed 23

	4ft - 1 ^s	4ft 4 ^s	4ft 16 ^s	4ft 64 ^s	16ft 4 ^s	16ft 16 ^s	16ft 1 ^m	16ft 4 ^m
1	0.06	0.79	—	—	0.17	0.04	—	—
2	0.06	2.40	2.98	1.74	—	0.08	1.36	0.83
3	8.46	0.34	4.72	1.35	—	1.44	1.27	3.56
4	4.80	6.07	—	—	2.71	4.80	—	—
5	4.98	—	—	—	4.63	8.29	—	—

5	0.13
4	0.40
3	1.54
2	3.82
1	6.40

work of page 8th enlarged.

	$\log \sin \frac{\theta}{2} = 6.1627$	$\log \tan \frac{\theta}{2}$	$\log 2f \tan \frac{\theta}{2}$	Diameter at 20 cm dis
	$\log \sin \frac{\theta}{2}$	$\log \tan \frac{\theta}{2}$	$\log 2f = 1.6021$	
	$\begin{array}{r} 6.1627 \\ 2.1 \\ \hline 8.1627 \end{array}$			
10	8.1627	8.1627	9.7648 ³⁷	0.58 (58)
11	8.3627	8.4127	9.9649 ⁴⁰	0.92 (92)
12	8.5627	8.6627	0.1651 ⁴⁴	1.48 ⁶
13	8.7627	8.9127	0.3755 ⁵⁵	2.38 ²⁰
14	8.9627	9.1627	0.5666 ⁸³	3.69
15	9.1627	9.4127	0.7694 ⁸⁵	5.88 ^{correct}
16	9.3627	9.6627	0.9766 ⁴⁸	9.48
17	9.5627	9.9127	1.1959 ²⁴	15.7 ^{cm}
18	9.7627	—	9.8574	
	2696	—	9.85139	

Reduction $4^m = 4.00$

$$\begin{array}{r} 4 \\ 16 \\ \hline 1.60 \\ 2 \overline{) 2.40} \\ 1.20 \end{array}$$

$1.20 = \log 15.85$

			Diameter at 15.85 cm
10		9.9627	
11		9.5628	
12			
13			
14			
15			
16			
17		1.0948	12.44
		0.7938	6.22
18	1.0514	1.0514	11.26
	2.6535		
19	9.9627		
20	10.1627		

Ratio of apertures differing by 0.5 magnitudes

	Magn.	log. ratio	Ratio
4.2	0.5	0.2	1.58
4.3	1.0	0.4	2.51 x
4.4	1.5	0.6	3.98
4.5	2.0	0.8	6.31 x
4.6	2.5	1.0	10.00
4.7	3.0	1.2	15.85 x
4.8	3.5	1.4	25.12
4.9	4.0	1.6	39.81 x
	4.5	1.8	63.10
	5.0	2.0	100.00 x

Magnitudes of Out-of-focus
images with 11-inch.

Foci	Diff. Mag. (See 2.8 Ki Book ~~III~~ ² p. 153). from 10.0	Diff
10.0	.50	.50
12.0	.99	.49
14.5	1.53	.54
18.0	2.02	.49
22.0	2.51	.49
27.0	3.0	.54
34.0		

Aperature Photometer D (affix)

See E.S.K's Book OCT 22 1902 page 68 for correct values

Aperatures indicate Magnitudes,

They are 10 11 12 13 14 15 16 17

Table for reckoning value of Potentiometer Settings.

Values of aperture and distance reckoning in trans. form.
(See ESK # 185 6d)
2

Aperture	Distance										
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
1	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0.0	+0.5	+1.0	+1.5	+2.0
2	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0.0	+0.5	+1.0	+1.5
3	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0.0	+0.5	+1.0
4	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0.0	+0.5
5	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0.0
6	-5.5	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5
7	-6.0	-5.5	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0
8	-6.5	-6.0	-5.5	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5
9	-7.0	-6.5	-6.0	-5.5	-5.0	-4.5	-4.0	-3.5	-3.0	-2.5	-2.0

The Column marked B will answer for Photometer C (when focalism is not used).

Also for ϕ when above apertures are used. Photometer D the brightness is increased by 3.5 mag.

H. P.	Designation	Time of Observations	R.A.	Dec.	Mag.
		R. A.	Dec.	Dec.	Mag.
1350	δ Canis Maj.	0 00			2.0
2379	θ Centauri	0 00			2.1
1201	β Canis Maj.	0 00			2.2
1698	α Hydrae	0 00			2.2
213	α Urs. Min.	always 0 00			2.1
932	α Aurigae	0 37			0.2
3631	α Cygni	1 08			1.6
1100	β Aurigae	1 22			2.0
797	α Tauri	1 24			1.0
978	β Tauri	1 32			1.9
2764	α Scorpii	16 23			1.1
3429	α Aquilae	17 15			1.0
2932	λ Scorpii	17 26			1.9
2400	α BOOTIS	17 29			0.1
2191	ϵ URS. MAJ.	17 44			1.9
2264	ζ URS. MAJ.	18 12			2.2
2338	η URS. MAJ.	18 26			1.9
5	α Andromeda	19 15			2.1
3429	α AQUILAE				
4057	α Aquilae	22 17			1.0
333	α Arctis	22 32			2.2
541	α Persei	22 37			2.0
3147	α LYRAE	22 48			0.4
4057	α Pis. Accs.	22 52			1.3

1.14 2.28
1.29 1.36 2.93
1.24

1.14 2.28
1.29 1.36

1.14

1.14

1.14 2.28
1.14 1.36 2.93
1.29 1.36 2.93
1.24

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