

KG
11365
188

H.34

Equatorial
March 30th 1860
May 2nd 1860

Sold by T. Groom & Co., Stationers, India Building, 82 State St., Boston.

KG11365, 188



KG-11365.188



Photometry. Moon

March 29 1860

Clear

probably about 9^h sid timeBull. B₂ to LampLamp-
4.84 + 0.6 Draughtsman XB₂

"

5.17 + 0.6

Ther 1371

"

5.22 + 0.6

Full Flame (~~and~~ ^{or} 0.14 mean height) 26 paces + 0.6
 Mean height of flame ¹⁵ 0.140 from top of wick -
 highest apex 0.175

West Wing cell

Occultation of ϵ Geminor

March 29. 1860

Obs by W.P.V. with Little Equatorial

236 =	12 ^h	12 ^m	24.5 ^s	Imm.	EC 12	10	0
			59.11-		236 12	7	6.5-
	12	11	25.35-			2	53.5-
	0	29	12.49				
	11	42	12.86		EC 13	18	0
		1	55.04		236 13	15-	6.4
comb m. 2.	11	40	17.82			2	53.6
						2	53.51-
						3	52.70
					236 fast		59.15-

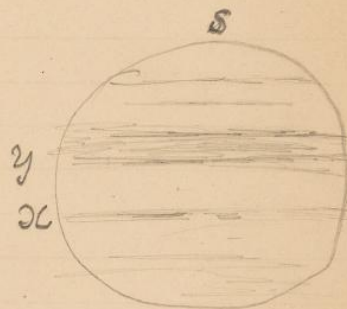
obs by A.W. with Gr. Equatorial, on Spr. Gov.

EC =	12 ^h	15 ^m	18.6 ^s	Imm.	S.L. fast 3	52.7	by J.H.S. obs.
		2	52.7				
	12	11	25.9				
	0	29	12.49		0	28	25.75-
	11	42	13.41				46.74
		1	55.04		0	29	12.49
comb. m. 2.	11	40	18.37				
comp.	11	40	19.00				
Diff.			0.63				

Jupiter

860 March 30

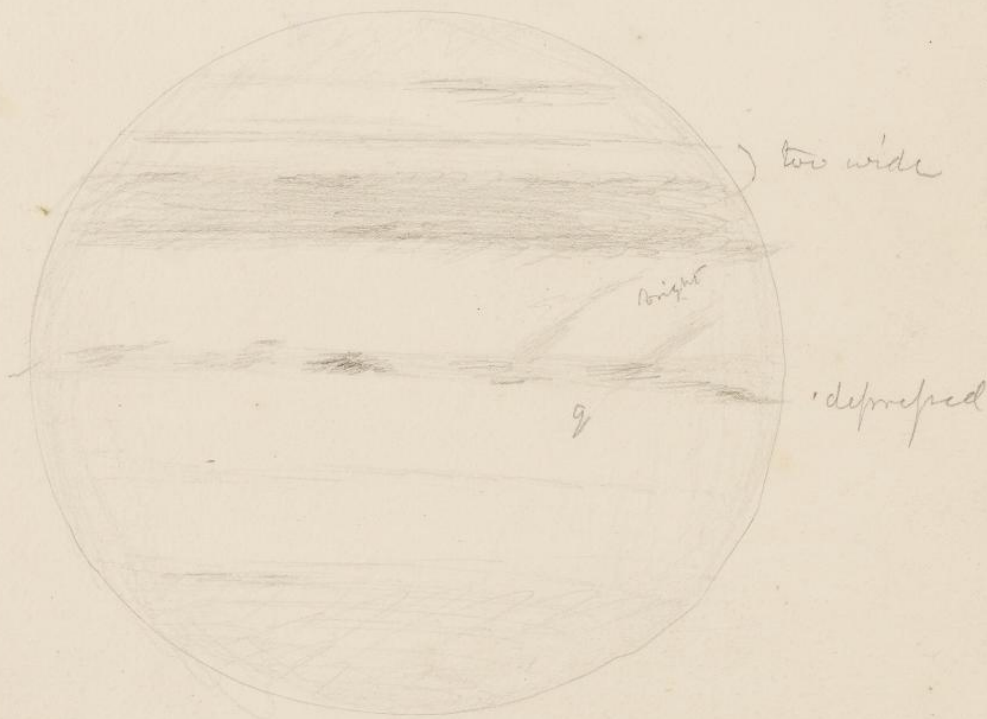
236 6^h 25^m 25 30.16
 Two 28.00



6 30 25. 29.65
 28.00

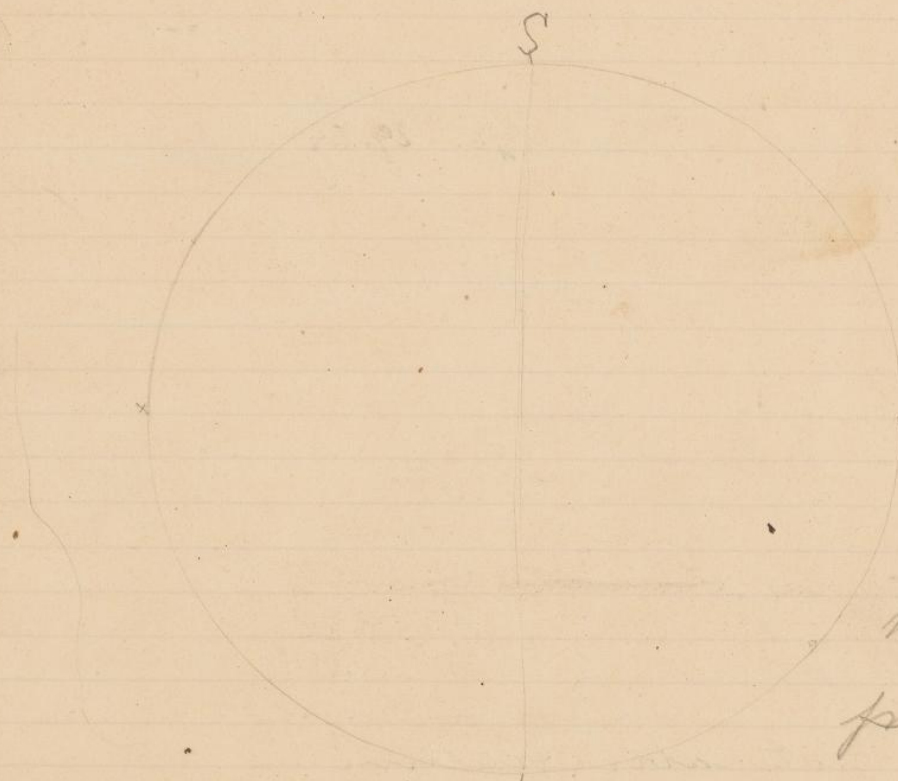
At times seen under
 pretty good definition

March 30 236 7^h 55^m



The brighter region above γ has somewhat difficult
 to discern. I fancy a resemblance here to the solar
 faculae

Jupiter

1860 - March 30th236 not corr
power 14.1at 6^h.40^m (236) being indifferent

& 236 n. corr 6.44

S- ~~XXX~~ 3' 9¹/₂"A A' 2.59¹/₂

doubtful from

faintness 23

N 2' 32"

measures

hard to make

from due as

A
The sun is just ^N setting & belt faint and
wind rising

Last observation made by Sidney Cookidge -
He joined the Observatory as a volunteer assistant in 1854
and continued his services at intervals to the end of
March 1860 - Fell in the Battle of Chickamauga Sept 19
1863 in command of 16th U.S. Infantry.

JUPITER

1860 March 30th Cont236 7^h 50^m

Definition not at all good.



The parallelism of the two belts C and D is quite a noticeable feature

236 = 8^h 12^m

"facile princeps"

Observation of Solar spots Fine foot Equatorial
March 30

Looked at the sun at the sun at 9-10-11-12-1-2-3-4-5

Saw nothing which could have been a planet

Photometry Jupiter & Moon

March 30, 1860

Red haze

Jupiter without diaphragm in Solar focus

236=8 42⁴ 42² Bulb B₃ to Lamp. ~~diaphragm Z~~ ^{diaphragm Z} 19.5

whole disc of planet
Bulb to solar focus - 2.75

236=8 46 Bulb B₂ 2.41

8 49 2.53

Lamp as above

236=8 55 Bulb B₂ 2.60

Moon Diaphragm 0.046 in solar focus

236=9 05 Bulb B₂ to Lamp 18.0

Bright part south of Mare Serenitatis Crisium 2.90 }

236=9 13 B₂ Mare Serenitatis Crisium centre of 2.42
Southern half to Lamp 17.50 }

236=9 17 B₂ Brighter part of Moon, Sun vertical 2.95
Lamp 16.20 }

Mare Tranquillitatis

236=9 20 B₂ darkest part of ~~Mare~~ ^{Mare}, 3 or 4' from Mare Crisium 2.43
towards the centre of Moon
Lamp 18.00 }

Lamp would not have been well adjusted to minimum
or else haze has strong influence
But particular care was taken at later dates

Photometry Moon

March 30. 1860

236 = 9 27 ^{h m} B₂ Bright^{est} part of Moon north of Man ^{Crimson} Sea 2.70
 region evidently brighter to naked eye
 lamp 14.20

236 = 9 31 B₂ 1' from dark edge near center of Moon 1.10
 20.30

236 = 9 40 B₁ 30" from dark edge smooth part of Moon
 not specially brighter than other parts at
 same distance from dark boundary 0.91
 20.30

236 = 9 40 Air hazy, ^{thin} red haze, but no clouds.

Do not anticipate a very marked obstruction of light from haze but should expect it to have a sensible effect

Jupiter is distant but a few degrees only from the Moon.

It is to be considered whether the ^{focus} diaphragm ought not to have been used for Jupiter as well as for Moon - to exclude diffused moon light in atmosphere but after setting telescope on back ground of sky on which Jupiter was projected I could perceive no trace of an image on the bulb & conclude that this can not affect the result. Jupiter however presents a disc larger than 0.32" which is the diameter of diaphragm 0.044

Photometry Jupiter

March 30. 1860
Lamp

Returned to planet without altering

236 = 9 47 B_2 whole disc of Jupiter, without diaphragm μ 2.60
Lamp 21.70

236 = 9 50 B_2 2.90
Lamp 21.70

236 = 9 56 B_2 1.24
Lamp 10.74

236 = 10 1 B_2 1.50
Lamp 10.96

236 = 10 5 B_1 1.41
Lamp 11.0

Moon Diaphragm X

Naked eye?

Lamp to B_1
236 = 10 11 5.91
6.50
6.48

Red haze, will not interfere very much

Photometry

1860 March 31

$$\begin{array}{ccccccc} \text{Diam. Bull. B,} & \text{Silvered} & & & & & \\ 1.802 & 1.799 & 1.800 & = & 1.800 & - 2 \times \tau & \end{array}$$

$$\tau = \text{Thickness} = 0.020$$

$$\text{Diam silvered surface} = 1.800 - 0.040 = 1.760$$

JUPITER

1860 March 31st

Images blurred

236

9^h 20.^m

quite hazy -

faint streaks
indicated

α

very
white

The sudden termination of the white band near α would perhaps have escaped notice at this time but an hour ago it was perfectly distinct

236 9^h 33.^m

1 3 2 4
• • • •

Saw the shadow of 1st satellite near lower edge of large belt not black but dusky & not much darker than belt spots.

gradation pretty regular

Photometry Venus

April 2. 1860 No clouds visible through evening - quite clear -

236 = 8 ^h 20 ^m	Bulb B ₂ to Lamp. diaphragm Z	Venus	44.7 ⁶⁴ + 0.6	Naked eye - Out of focus Lamp in center just being
naked eye	"		43.9 + 0.6	
Jupiter Too faint to be relied upon - for much				
precision				
236 = 8 30	Bulb B ₂ to Lamp dia-	Z	63.9 + 0.6	

1/7 incident light
to be subtracted if this
is compensated with
those through window pane
in west wing

Moon Sun in & beyond further on

236 = 8 50	Bulb B ₂ 371	diaphragm X	3.20 ± 0.0	Naked eye In focus
"	"	"	3.13	
"	"	"	3.60	
236 = 8 55	Bulb B ₃		3.10	

Gt. Refractor - 15 in Ap

Jupiter No focus aperture.

236 = 9 18	Bulb B ₂ to Lamp	Diaphragm Z	20.60
"	"	focus	3.71
236 = 9 30	"	diaphragm (m)	23.44
"	"	focus	5.25
236 = 9 35	"	dia (m)	23.80
"	"	focus	5.91

Lamp I has been used in the preceding obs.

N.B. The chimneys were used for all the lamps were kept each to its proper lamp & the flames adjusted to maximum effect with the condition that shoulders of chimneys should be sufficiently out of range of diaphragm not to interfere with free transmission of light.

Photometry Jupiter & Moon

April 2, 1860.

15 in. ap.

Jupiter

236 = 9^h 43^m Bull B₂ to Lamp S dia (m) 23.90

" to Focus 5.80

236 = 9 49 " Lamp S dia (m) 24.27

Focus 6.05

236 = 10 10 " Lamp B₇ dia (m) 24.60

" Focus 6.95

236 = 10 16 " Lamp B₇ dia (m) 20.60

Focus 5.80

236 = 10 30 " Lamp W.C.B dia (m) 21.30

Focus 5.10

236 = 10 34 " Lamp W.C.B dia (m) 23.60

Focus 5.55

Moon brightest part: Southern hemisphere where
alt Sun is say 60° focus aperture 0.044

236 = 10 48 " Lamp W.C.B 12.70

Focus 5.80

236 = 10 55 " Lamp W.C.B Mare Tranquillitatis 19.70

Focus italis, centre 6.30

Between Crater "Markelyne" & Mare Crisium - Sun alt. say 75° Darker part of Moon which has Sun at high alt.

Photometry Moon

April 2, 1866

Sun's alt. 70°

236 = 11 06

Moon Mars Crisium

is brighter than M. Transjovialis

Bulb B. to Lamp W.C.B. diaphragm (m !)

Apr. 15ⁱⁿ Focus ap 0.044

17.20

Focus

6.20

Lamp W.C.B. was adjusted to throw light
 through larger part of glass chimney_{below shoulder of chimney} - at bottom & is so
 used throughout evening.

Photometry

* April 2 1860 Removed to West Transit Room. Comparisons of the different
Lamps. & lamp-diaphragms

Lamp W.C.B. diaphragm (m) compared with Lamp

R.7.B. The latter adjusted to flame of ray 0.075^{hr} - Constant =

W.C.B. to R.7.B	<u>53.55</u>
B_3 to W.C.B	3.00
1371 to W.C.B	2.90

Diaphragm 2

1371 to W.C.B	3.32
B_3 to W.C.B	3.16

Diaphragm X

1371 to W.C.B	8.05
B_3 to W.C.B	8.03
1371 to W.C.B	8.10

Photometry

April 2 1860

Leamp S compared with R. F. B. Dist ^{lt} 53.5

(n) diaphragm on S* [or I]

Image from R. F. B.	1371 to S	51
on 1371 equal to	" "	2.61
image of S on 1371		2.91

diaphragm 2

1371 to S	3.48
" "	3.41

diaphragm X

1371 to S	6.92
" "	6.88

* Could not tell whether this was S or I. Both are of same make & size but their chimneys differ enough to vary the flame. Flames adjusted as when compared with Jupiter that is at maximum allowing shoulder of chimney to be free of diaphragm.

Photometry

April 2 1860

Lamp I* compared with R.G.D. Dist 53.5^{ft}

(m) Diaphragm on I

1371 to I	3.14
" " "	3.10

Diaphragm 2

1371 to I	3.92
" "	3.90

Diaphragm X

1371 to I	8.13
" "	7.95

* In white I or S side Note on prev. page

Photometry

Apr. 2 1860 L^* adjusted to be equal to R & B & tested
by bringing bulb 1371 $\frac{1}{2}$ way between them & comparing
images

R & B then adjusted to maximum flame
and the following measures taken — diaphragm put on

(m) Diaphragm

1371 to R & B	ft.
"	3.12
"	2.94

Diaphragm 2

1371 to R & B	3.96
"	3.97

Diaphragm X

1371 to R & B	8.30
"	8.34

$$\left. \begin{array}{l} \text{Mean of all Comparisons} \\ \text{of relative light} \\ \text{as above given} \end{array} \right\} \begin{array}{l} \frac{\text{Area X}}{\text{Area m}} = \left(\frac{7.83}{2.97} \right)^2 = 6.95 = \text{rel. brightness} \\ \frac{\text{Area X}}{\text{Area Z}} = \frac{7.83}{3.64} = 4.63 = \text{"} \end{array}$$

These would very well with measured values

in	M diam	0.033
	Z	0.040
	X	0.087

Proving no considerable error from interference

Photometry

Apr. 2. 1860

For Absorption of Bulb B₂

Globe after turned

Lamp R.7.B. with diaphragm ~~H~~ (m)
 & I as on prev. page Dist. from each other
 53 1/2 ft. Observer 3 in from I towards
 R.7.B. Distances are of B₂ from eye
 all in same range nearly -

7.35 } eye alone
 7.90 } ~~telescope~~
 8.15 } Red
 8.15 } green
 8.80 } blue & red
 8.90 }

The two last should
 have double weight because
 they refer to front of Globe men-
 region used in Sun's spectrum

R.7.B.

Eye
 I x
 I

I

The Lamp R.7.B. was adjusted to max. brilliancy after I had
 been adjusted to agreement with it in its brightness as used for
 comparison of other Lamps & diaphragms. The adjust-
 ment of R.7.B. to maximum was made in order to com-
 pare it with I = R.7.B. (as ^{as used for comp. of rest} previous adjustment) & then with other
 Lamps - as well for Jupiter & Moon Comparisons - Excepting
 that in Obs of Moon on next page I was kept at its low adjustment
 as to afford a comparison of all lamps & diaphragms with Moon

Photometry Moon

1860 April 2 Moon O Naked eye Clear

Lamp I not altered from last Oct - as regards height of
wick &c. Used as in experiments = R. T. B. when purposely adjusted to about $\frac{3}{4}$ inch flame but constant =

236 = 13^h 00^m ~~Diaphragm~~ * No diaphragm. $\begin{matrix} 13.80 \\ 14.60 \end{matrix} + 0.60$

Lamp ^{in position} at used earlier in exp. for Venus & Jupiter that is in
cellar of West Wing. 0.60 from window - the latter rubbed clean before the
earlier experiments - the same precautions taken in all
previous experiments

April 1 Sun observations Fine foot Equatorial

Looked at the sun at 9-10-11-12-1-2-3-4-5

Photometry - Wyeth's House

1860 March April 3rd

Distance measured from Object glass of Gr. Refractor
to window in Wyeth's House where bulb is placed

To Trellis April 3
March 24

1338 ft

1336

1337

Cor. to glass

1

1338 ft

Cor. trellis to window

- 2

Object glass to Bulb B. at Wyeth's House

1336 ft

1860 April 3

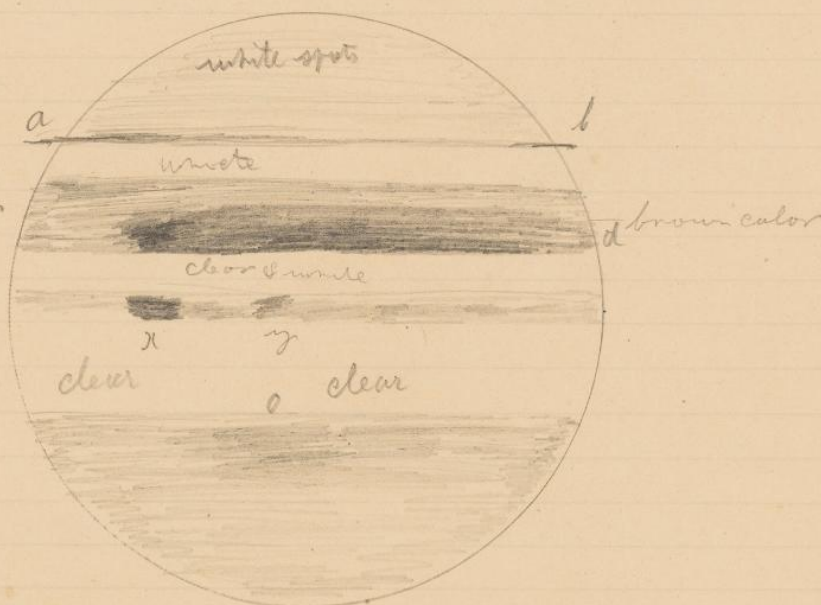
Jupiter

9^h 20^m Sid. Time

Saw Jupiter under better definition than ever before

Most all of the disc north of a & b was covered with small white spots
but unfortunately the sky became cloudy before I could make a drawing
of them

The upper edge of the
belt c d was very
straight, and so was
the lower edge of
the belt a b



The belt c d was very brown. x was the darkest spot
on the disc; y the next darkest. Under o there appeared
to be a dark spot.

H. P. I.

April 3 1860 Photometry

Chalk from globe 4 feet 40

44 ft 70 from chalk to light

(1)

Bull's B₂ to Lamp I & S 49^{ft}.1 } of equal brightness
Chalk Globe to Lamp 44.7

B₂ to Lamp 29^{ft}.2 { 2 feet .72 chalk from globe

Chalk Globe = 4. 26.5

{ 26 feet .46 chalk from light

(2)

B₂ to Lamp 54.1

Globe = 4. 44.1

but. wt = 2

{ Chalk from globe 10 feet

{ Chalk from light 44 feet 10

(3)

D

Disc to Lamp 31.1

Globe = 4. 32.5

Chalk from chalk 14 inches

flat chalk from light 31 feet 10

(4)

D

Disc to Lamp 42.2

Globe to Lamp 42.9

Chalk from chalk = 7 inches

flat chalk from light 42 feet 20

(5)

The first of above were made for purpose of comparing quantity of light reflected from Bull B₂ (silvered) & that reflected from the Chalk globe. which was made as white as possible with white water color.

2nd White Chalk globe (same as above) was compared with white flat disc of same material = D.

Diame of Chalk Globe =	1.62	1.63	1.59	1.63	= 1.62
" " disc =	1.16	1.17	1.15	1.16	= 1.16

Photometry

1860 April 3 Moon. E O 2 days from full

To naked eye think the "Mare's" contrast with rest of surface
much as Jupiter's belts with rest of disc

1860 April 4 Photometry

Three lamps in equilateral triangle shining upon chalk globe G & disc D

Chk globe	G	to lamps	~~28.7~~	¹¹ 29.4
Disc	D	"		¹¹ 28.7

Viewed with Var Tr.	Objct glass to	D	49.2
		G	49.9

All in same range

 G & B_2

From light to chalk globe 29 feet .4, from = 29.4

chalk globe to glass ^{bulb B_2} 2 feet .6 32.0

Eye = Telescope	Objct glass to	G	= 49.0
		B_2	= 51.6

Lamps	to	G = Chalk globe	¹¹ 27.9
"		Bulb B_2	30.0

Viewed by eye through lens 50.5 from G to eye

Eye	Lamps	G	B_2
		0	9
	175.		
	Screen		

Subsequent Experiments April 30 showed very much greater ratio of light from B_2 compared with Chalk disc.

Photometry

1960 April 4th

For absorptions of Chalk bulb

G 2 of B₂
 Drain of Chalk Globe G 1.62
 Dr. 1.16

 I Diaphragm (m) compared by
 equalization of images on B₂ Observed
 paired with S 1/2 inch blase
ft
2.12

Globe G. brought near S dist	ft	8.3
when its image seen on B ₂ was	"	8.2
equal to ~~image of I~~ ^{I also seen on bulb B₂ using} diaphragm (m)	"	8.0
Distant 53 ft from S	"	8.2
~~(equal S)~~	"	8.3

 } Very good
 } Stray light
 } well guarded
 } from bulb.

A good method - both as points in bulb.

I Diaphragm (m) comp. with S

ft
2.3
2.5

Distances I to S throughout 53.0 ft

B ₂ Dist from S	ft	10.0
equal with I (m) by eye	"	11.2
	"	10.5

 Eye probably
 at same dist
 as S from B₂

 On returning to I found its flame had somewhat
 shortened since previous comparisons of I with S

Photometry

Note That in the comparisons made by viewing the images in bulbs of Venus, Jupiter, Sirius & Moon on different dates with lamp placed in porch or cellar windows in West Wing the light of flame passed through a pane of window glass which intercepts, according to Rumford's experiments. Young's Nat. Ph. Exp. 294 about $\frac{1}{4}$ of incident light.

Of course when the comparisons are merely relative no correction on this account will be needed.

April 5th Viewing full Moon through thin cirrus was struck with the distinctness of the bright rim entirely round its circumference & nearly of equal breadth in all parts - say 2' or 3' broad. Its filling entire circumference surprised me as this seems to make it less probable that the phenomenon is caused by difference of absence of the darker regions the "Mare" near circumference.

Jupiter

1860 April 5th

8^h 00^m Sid time

Photometry Jupiter & Moon

1860 April 5. Looking at full moon with naked eye soon after seeing Jupiter with telescope. I think the contrast between the bright & dark belts of planet as great as that between brightest & darkest regions of Moon.

Red of obs on next page

G. P. B.

Apr 5

11" Comb in 15	α. hor par	60' 28"	= 3628"	= 3.5597	by 2	dist 1.0	^{17.9} ~~0.7125~~	= 1.2528
At Mean dist	"	"	3422.32	= 3.5343	"	at Op. s.d.	22.7	= 1.3564
				9.9746				1.036
11480 =	4.060			9.8964				9.8964
	9.742			9.8710		3.5343		Mean
6340	3.802			2		1.3564		At 1.0. 2.9707
				9.7420		2.1779		4 1.3564
								1.6143
								1693 = 3.2286
								= 4.3558

Reducing the results at foot of next page (already corrected for relative extinction of light) to mean distance of Moon & opposition distance of Jupiter we find

$$\frac{\text{Light of } J}{\text{Light of Full Moon}} = \frac{1}{6340}$$

$$\frac{\text{Area } J \text{ at op}}{\text{Area } \alpha \text{ mean dist}} = \frac{1}{1693}$$

Photometry Moon & Jupiter

1860 April 5 Full Moon not unexceptionably clear though the
 here is not run near ~~the~~ Equal images on 1371 to Lamp I

at alt 33°?

Wick of I adjusted to constant flame of 736 = 11.34 ft
 0.08 height from Wick & in Cellar 11.37 = 18.6 ft
 Window of West Wing 11.40 = 18.7 ft

I retaining same adjustment over flame 0.08 was removed
 to W. Transit Room & it was compared with S - diaphragm
 m S being adjusted to flame of 1.25 Images equal on
 on 1371

S. (m) to I 53.5 = 1371 from (m) $\left\{ \begin{array}{l} 2.09 \\ 2.12 \\ 1.86 \end{array} \right.$

S Z diaphragm 1371 from Z $\left\{ \begin{array}{l} 2.78 \\ 2.52 \end{array} \right.$

S with Diaphragm X 6.00
 Comp. like the others with I as used 6.20
 for Moon

There was a thin haze about the horizon with
 cirri when the above were taken for Moon. But
 the sky near the Moon was clear though not as perfectly
 transparent as we often have the atmosphere

$$\frac{I}{S Z} = \left(\frac{53.50 - 2.65}{2.65} \right)^2 = 19^2 = 361 \quad \frac{4}{a} = \left(\frac{97.0}{18.8} \right)^2 \frac{1}{361} = \left(\frac{18.8}{97.0} \right)^2 \frac{1}{361} = \frac{1}{9861} \quad \times 1.194 = \frac{1}{11480}$$

$\frac{0.082}{0.077} = 1.194$ cor for extinction
 $\frac{0.082}{0.077}$

Photometry Moon

1860 April 6 Clear. Moon on Meridian

S without diaphragm low flame.

Images equal on 1371 $236 = 13^h 40^m$

Through cellar window West Wing

$$\begin{array}{r} 17.4 + 0.6 \\ 13.2 \\ 12.8 \\ 13.1 \\ 13.3 \end{array}$$
I to S 53.5^{st} West Transit room.I diaphragm Σ Comp with S
$$\begin{array}{r} 3.34 \\ 3.70 \end{array}$$
I m

$$\begin{array}{r} 2.16 \\ 2.43 \\ 2.60 \end{array}$$

Photography Moon

560 April 6

Mr Whipple photographed Moon
near meridian 14^h to 15^h Sid-timeSelect Time for best images $\frac{2}{3} \frac{\text{hr}}{8} = 5.3$ good negativeTook weak negative in 3^s . This surprised
me as the Moon was only about 25° or 30° high &Moon 1 day from full - sky apparently quite clear
between masses of cumulo-stratus.Used for Stereoscope with Feb 7 $\alpha = 164^\circ$ & 166°

Photometry

1860 April 7 B₂ at Vryetys.

From Diaphragm at Focus - 0.044 to 1371
 236 1^h 5^m Lamp I S Diaphragm Z to 1371

↑
 5.85
 6.90

Chalk Globe G Z Phased O Lamp S

5.85
 9.85

Diaphragm M
 Put on Lamp II. Globe G

5.85
 9.60

" I M Bulb B₂

5.85
 6.50

Lamp I Diaphragm X Bulb B₂

5.85
 20.4

" I " X Bulb B₂
 236 = 2400

5.85
 20.10

Lamps in good adjustment = Good sky

Photography

1860 April 7th 5ⁱⁿ ap. Clear. Full sun light

Sun alt 45°

Photographed Wyeths house at 3^h 10^m P.M.side facing Sun took in 10 beats (about as strong as Moon did on 6th in 3^s with full ap)

A.

Wyeths House - Coated plate with same colloids as used last evg.

x found in 10 beats = $\frac{2}{3} 10 = 7^s$ image of bright side of house = average of Moon's brighter parts in $\frac{7}{4} (\frac{5}{15})^2 = 4 \frac{1}{5} = \frac{\text{Moon}}{\text{House}}$

Changed to 9ⁱⁿ aperture

House

7 beats = 5^s too short Artist thinks that 11 beats would be about right for sun side of house

Chemicals in town working very well today.~~Full~~ aperture ~~to~~ 9ⁱⁿ13 beats = 9^s Photographs of bright side of Wyeths

House at 236 = 4^h 54^m is just about in right time & corresponds to the 5.3 photograph of Moon

Full ap 15ⁱⁿ 236 = 5^h 5^m

Judge Phillips field, 180° az from Sun horizontal = Old grape field - old fence - water 20

Distant 1200 feet

10 beats found too short for strong negative.

Photography

Compare also
 for in June

15 beats ~~10~~ 10^s was too short by $\frac{1}{3}$ (on old

field-focus trees at 1300 ft off sun as (sun) for strong negative

sun alt 42°
 236 $5^h 20^m$

20 beats = 13^s was too short by 5^s for field
 trees, fences, &c on Somerville hill dist = $1\frac{1}{2}$ miles
 Artist thinks 30 beats = 20^s would make the picture
 as strong a negative as the moon last night. Did with $5^s.3$
 both by full aperture and equally good atmosphere.

The sun's alt being nearly the same with that of moon
 makes the comparison the more favourable.

The az. from sun was 180° about - & the field
 mostly the side of a hill, facing sun, with a large
 bare cliff of clay presented almost point blank to sun.
 There was a house & 2 or 3 Savin trees & distant sky compressed
 in the view - sky took strongly - compressed with field.

I conclude from foregoing that the ^{dead} pure-white painted
 side of der Tryet's house distant 1386 ft. with sun shining
 on it at only about 10° ^{45°} 15° from perpendicular incidence
 acts ~~as~~ acts on plate with $\frac{1}{10}$ intensity of moon $1\frac{1}{2}$ day past
 $\frac{53}{25} \frac{90}{9} = \frac{5.3}{9.0} \left(\frac{15}{9} \right)^2 = \frac{1315}{810} = 1.6 \frac{1}{10}$ $\frac{1}{3} = \frac{a}{\text{House}}$
 Mean of all about $\frac{1}{3} = \frac{a}{\text{House}}$

full on April 6th But allowance must be made for
 the difference of focus which is 28 divisions of focus scale
 $= 4.5^m$

$$\left(\frac{270.0}{274.5} \right)^2 = \frac{1}{30} \approx 1 - \frac{1}{30}$$

Fields, dull sunset. not green

Jupiter

1860 April 7th

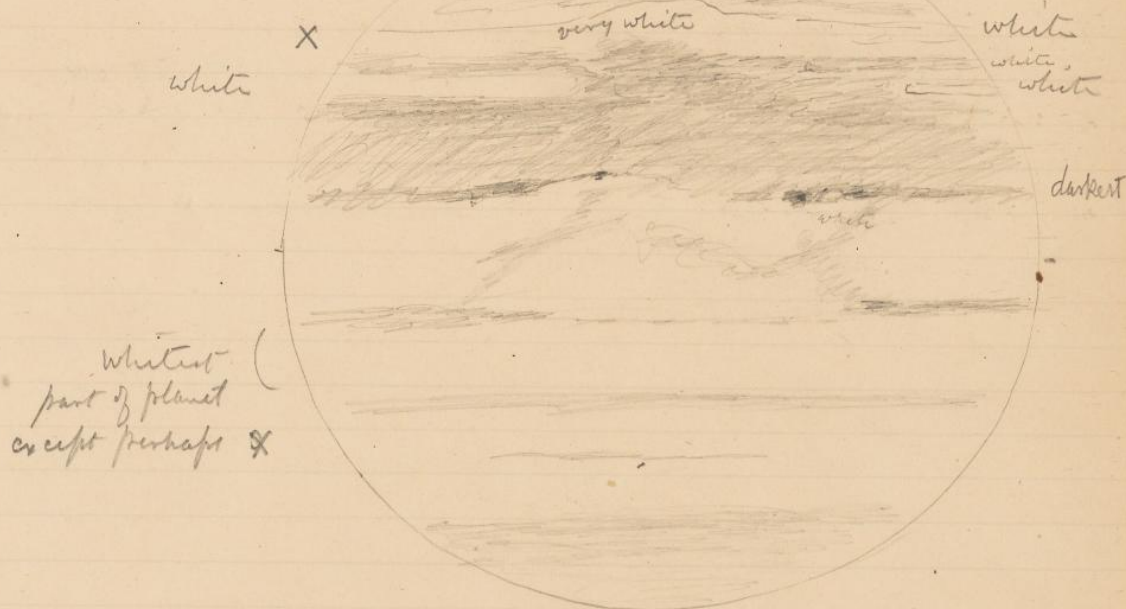
Very fine definition

Commenced at 236

Finished

8^h 3^m

8 15



1st Satellite is on disc near lower margin of the principal belt but is not visible

3

1

2



Internal contact of shadow of 1st satellite

236 8^h 40^m

Vision has greatly deteriorated

Jupiter

April 7th 236 10^h 5^mAt times good
definition

The structure of the
large belt is
quite remarkable
I do not recall
the same aspect
in prev. obs.

v. white



Photography Sun

860 April 12th

Fine clear sky with a few Cumuli.

Put on diaphragm ^{in 0.021} 0.021 and ascertained time of exposure required for a strong negative of Sun

Plate exposed 14.5 beats of Clock = 9.7^s
 There was much stray light on plate & no image - Moisture

Exposed 45 beats only an outline found
 Moisture on Object glass

Exposed 80 beats strong image may be
 too strong

Examined for moisture none found - warmed &
 cleaned. 55 too strong
 Above

Plate A Clear between Cumuli

236- 3^h 37^m Exposed 15 beats = 10 a good image
 seems about right time but sky quite clear -
 artist thought 10 beats = 6.7 would be sufficient

Plate B Clear between Cumuli

236 3 52 Exposed 5 beats = 3.3 evidently too short
 though a distinct image. The right time would be
 between A & B say in 8 to 10 beats = 6^s To give us a
 photograph of Sun of equal intensity with aperture 0.022
 as Moon with 15th

The above A & B were quite conclusive - sky clear - Collodion
 & chemicals same as used for last pictures of Moon =

The Cover of Object glass had, besides velvet outside = 3 sheets of thick
 paste board - 1 of thin ditto - 6 thickness of black linen & about aperture
 a daguerreotype plate - the aperture was in a plate of brass. Light perfectly
 excluded excepting at aperture of this I am perfectly confident. as the cloth
 fitted on all sides & would have been sufficient without the pasteboard.

Sun

Next put on aperture $\frac{1}{3} \times \frac{1}{10} 12^{\text{in}} = 0.462$ [8th ?] wool same as used in Feb.
 Plate C $236 \quad 4^{\text{h}} \quad 12^{\text{m}} \quad \text{Clear}$
 Exposed at 6³⁰ $\frac{1}{10}$ second - Just right time

Clouded = Probably a thin haze scarcely yet perceptible

It very soon grew dense enough to prevent further experiments but it evidently came over from West in a body & did not interfere with previous experiments.

Jupiter

1860 April 12th236 8^h 40^m to 8^h 55^m

Good definition

~~Compare of Feb. 20th~~whitest
region

The dark spot near x is very conspicuous although so near the limb - It is the darkest part of the planet. It extends below the lower edge of belt.

The delineation of m is not satisfactory - I doubt whether the large belt is not too broad. s and r should be nearer or to each other - & yet on same width enough.

At p I fancy the belt rises

Moon

860 April 11/12

Noted at 7 AM the marked increase of brightness
in Moon near its sunward edge - a narrow rim - 2' broad -

55	65
90	26
35	26

Photometry

1860 April 12/13 Measures with Microscope H of
Transit Circle of diaphragms used in photometry

Focus diaphragm designated as 0.044

$6^{\text{th}} \frac{13}{60}$

$6 \frac{17}{60}$

$$6 \frac{15}{60} \times 0.0069 = 0.0431$$

Object glass diaphragm designated as 0.022

$3^{\text{rd}} \frac{3}{60}$

$3 \frac{0}{60}$

$$3 \frac{15}{60} \times 0.0069 = 0.0209$$

Diaphragm

0.011

$1 \frac{41}{60}$

$1 \frac{26}{60}$

$1 \frac{35}{60}$

$$1 \frac{34}{60} \times 0.0069 = 0.0108$$

measured chord of $60^\circ = 2 \frac{42}{10}$ Tr Circle

39.8

39.7

37.5

35.0

37.7

38.7

35.2

36.2

$$5' = 5 \frac{7 \frac{15}{60}}{60}$$

$$5' = 5 \frac{7}{60}$$

$$100' = 0.69$$

Jupiter

1860 April 13

236 - 74 30 ~

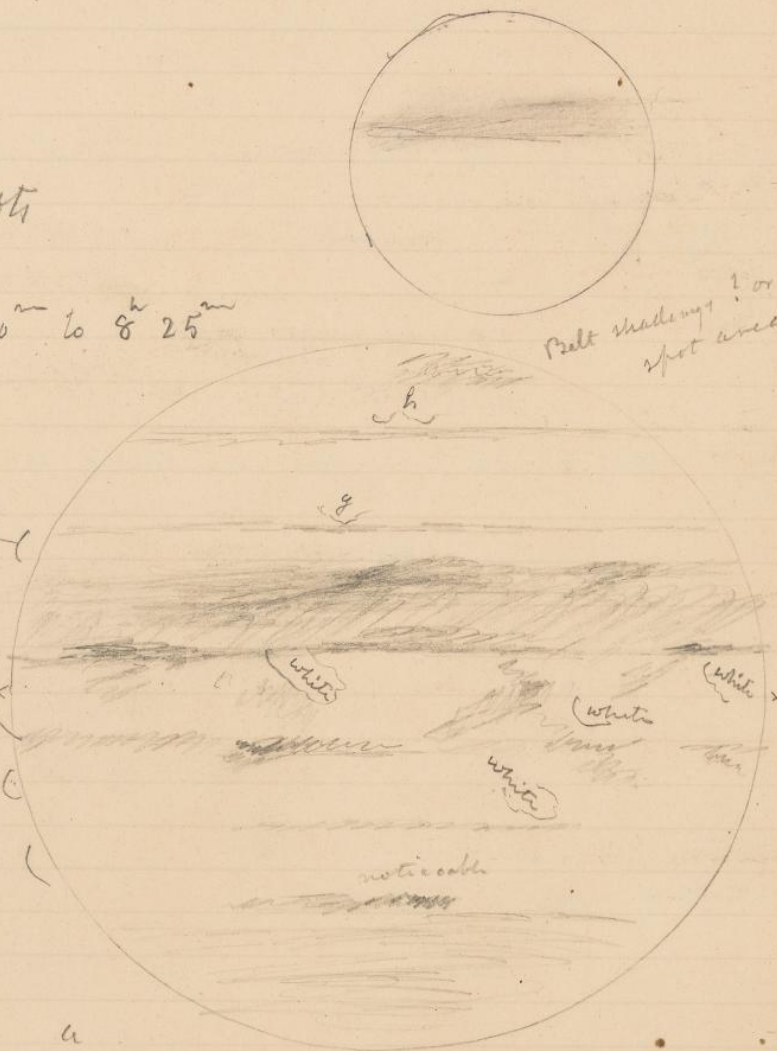
g & h bright white spots

236 8^h 10^m to 8^h 25^m

very narrow bright streak
 whitest part except the
 small spots g & h ?
 lower part too near equator ?
 a good deal shaded
 & mottled not white

white

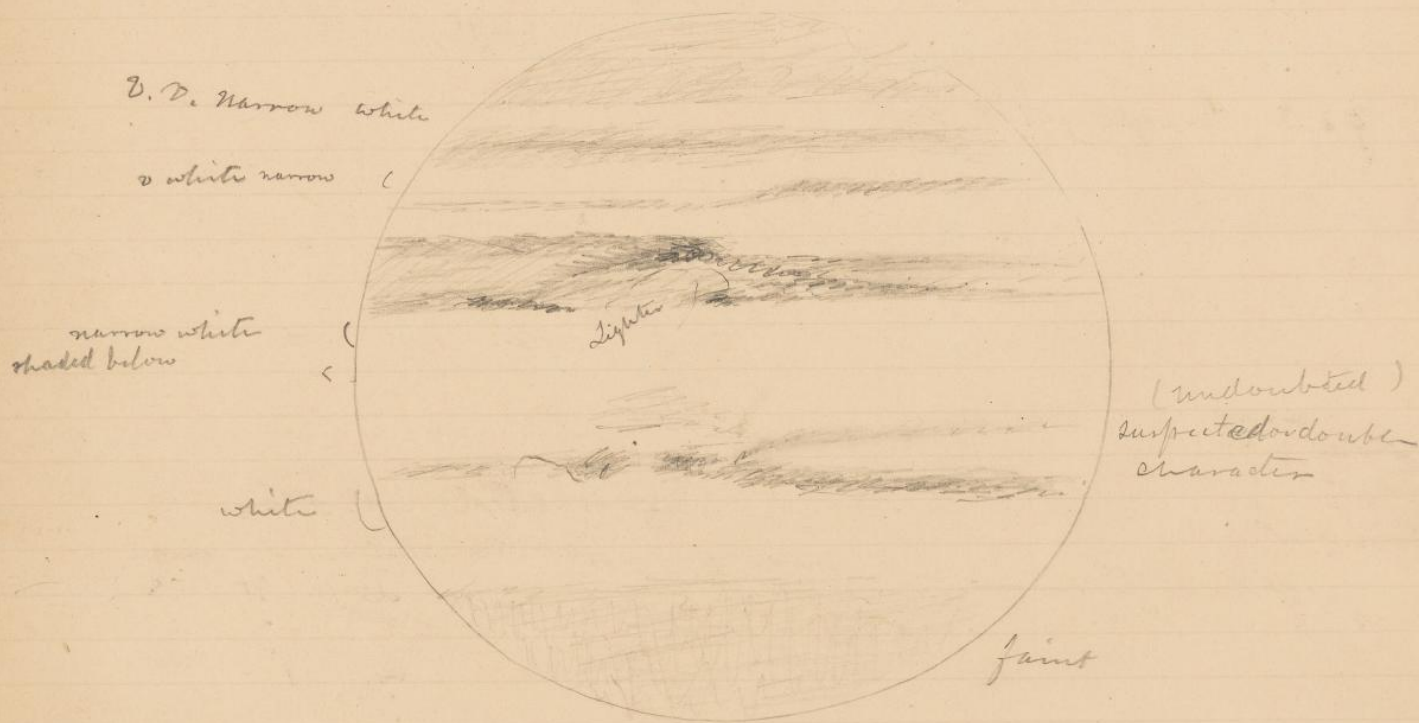
white

Belt shading ? or large
spot area

The brilliant patches or
 spots at g & h give a
 most beautiful effect when
 best seen. They extend where
 brightest over an area of 1" or more not round
 but more like the irregular bright patches on Moon

1860 April 13 2

236 15^h 24^m 50.10^s 36



Definition pretty good
quite clear

1 3 2 4
• • ⊕ • •

Photometry

1860 April 13th Perfectly Clear very fine night

In Cellar West Wing Lamp S adjusted to
good maximum with diaphragm Z

236. 9^h 55^m

Venus

paces
19.5 + 0.6
19.0

10 5

Jupiter

38. paces + 0.6^{ft}
40
41

Found 100 ft = 38 paces

Jupiter

1860 April 14

Definitions will now admit of seeing
 transit of Satellite I nor of making a draw-
 ing of belts

236 10^h 44^m

Bright



Jupiter

1860 April 15 Sunday

236 10^h 30^m

But very faint dusky bands scarcely visible.

A v.v. narrow vivid white band
 reddish brown
 space between belts too
 narrow

luminous

Whiter

This side of region
 Jupiter is remarkably
 white I should judge



The very white streaks are only about 1" wide

I notice that frequently one edge of a darker map will be bordered by a more luminous region as at X. brightest next the dark map. It is not an illusion by any means nor an effect of contrast.

It suggests a comparison of neighborhoods of Sun's spots & faculae

April 15

236 10^h 55^m

11^h 15^m

faint dusky

brilliant white C

whitish
boulder



} white band

} white band
narrow

} white

} whitish edging

white

Jupiter

1860 April 17
Bad definition

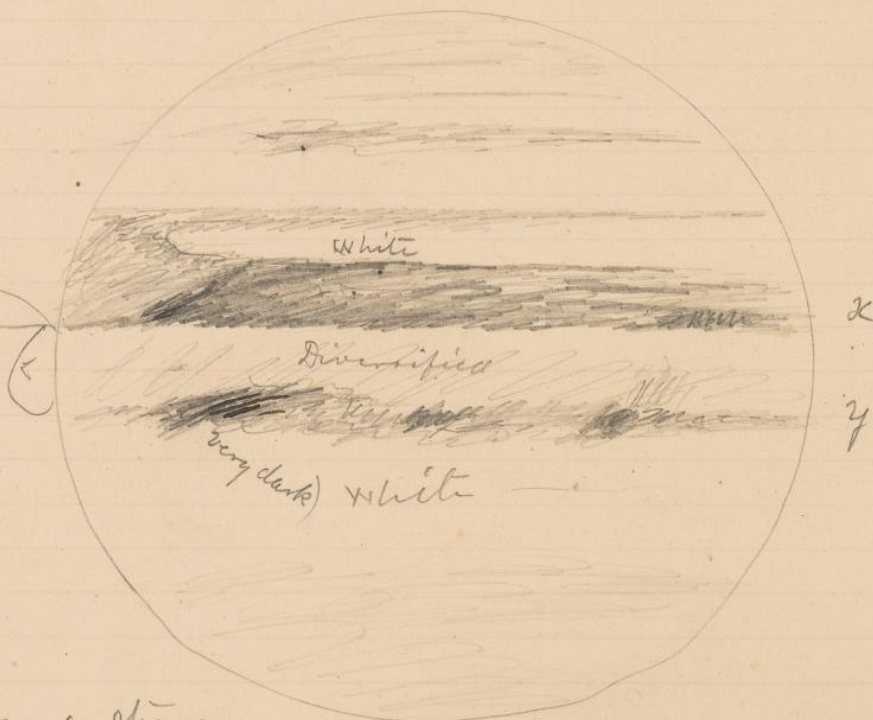
236 = 9.25 to

The Equatorial Zone is
 less bright & more diversified
 with irregular. curdlings
 & mottlings than the region north of $y =$. The Northern
 edge of x is lightened up at its northern edge by a
 decided white boarder brightest next the belt but
 too irregular to be called a white band

At first sight only two belts were visible con-
 spicuously and at 9^h. 10^m they had the aspect
 represented by  A They were abruptly
 terminated on the free side & had
 a similar truncated aspect.

236 = 9.25 to 9.33

should be higher up
 This bordered by
 a white edge
 too narrow

Compare Feb 20th 1860

The belt y is now a strong
 feature on planet almost as much so as x

Jupiter

1860 April 17

236

9^h 45^m

2.3 4 1
2

2 & 2.3 nearly equal
1 plainly brightest & 4 as
evidently smallest.

Photometry

April 18th 1860

To determine relative amounts of light
 reflected from ^{average} white & dark belts of Jupiter set up a
 disc of pure white paper with belts of grey brown paper
 pasted upon it found a tolerable resemblance
 when the contrast was as in

specimens in margin judging from recollection of Planet

Found they were equal in brilliancy
 when their distance from lamp was as

$$\frac{3.60}{4.35} \quad \text{hence their brightness as } \left(\frac{3.60}{4.35} \right)^2 = \frac{1}{1.44}$$

This is probably an approximate representation
 of average illumination of the belts compared with the
 average illumination of the rest of the planet I think
 it quite possible that a few of the white streaks may be
 twice as bright as the general illumination of planet

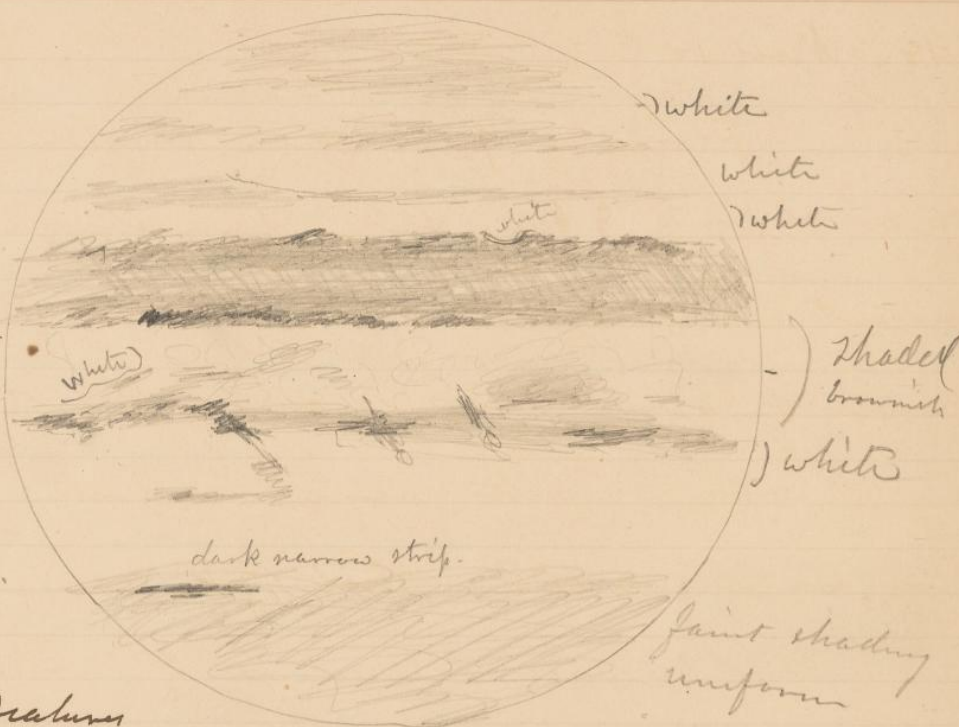
Vide two pages further on

860 April 18

236 8 38
8 50

Duplex

v.v. narrow white edge -
The belts on this side
lft conspicuous than usual.



Admirable definition

It is impossible to
delineate all the features

The Equatorial Zone is by no means white excepting
perhaps an uncertain lighting up at very edge of upper
belt -

If all the belts were col-
lected leaving only the region of average whiteness,
unchanged I judge they would cover
 $\frac{1}{4}$ of surface of planet. Hence if as
they are 1.51 darker than average of
rest of surface in consequence of their presence the Planet is made
darker in the proportion $\frac{1}{4} (3 \times 1.00 + 1 \times 1.51) = 1.13$ than it
would be without them

Shade of
belt compared
with white



The noticeable white belts
are usually quite narrow and contrast as strongly with general sur-
face as the dark belts do hence

$$\frac{\text{Whitest belts}}{\text{General surface excluding dark belts}} = \frac{1}{1.51} \quad 1.51$$

or if we include

General surface excluding dark belts
also dark belts then we have

$$\frac{\text{Albedo of narrow very white belts}}{\text{General Albedo of whole surface}} = 1.13 \times 1.51 = 1.70$$

General Albedo of whole surface

Albedo of Whitest brilliant spots probably exceed

2.0 (vide April 5 & 4)

Photometry Jupiter. Belts

1860 April 18 236 9^h to $9^h 25^m$

Placed a pure white chalk ball painted with "Flake white" $3 \frac{6}{10}$ inches in diameter at a distance to subtend nearly apparent diameter of Jupiter as seen with power of 144 [about 12 or 15 feet distant.] Then marked on its surface with crayon a dusky zone of form & position resembling that of the principal Southern belt & rubbed it out & touched it with chalk until its relative intensity compared with that of general white surface as Belt of Jupiter to its general white surface - i.e. excluding the well defined & strong dark belts

Lamp to Chalk Globe
" paper P

4.80

3.95

3.85

3.90

Paper P exactly resembles shade of belt (the principal S belt) as contrasted with white surface of globe - hence

$$\frac{\text{Principal Belt of } 4}{\text{Average of surface without belts}} = 1 : \left(\frac{3.90}{4.80} \right)^2 = \frac{169}{256} = 1 : 1.51 = \frac{1}{1.51}$$

$$\frac{1}{1.51} = 0.66$$

$$\frac{1}{1.51} = 0.66$$

$$\frac{1}{1.51} = 0.66$$

Darker parts of belts may not infrequently have ^{denominator of} this ratio
 $2 \times 1.51 = 3.0$

$3 \times 1.51 = 4.5$ must be rare very dark spots

Photometry Jupiter - Venus

1860 April #18

Perfectly Clear

Compared Venus (half phase) and
Jupiter with

Lamp S. Diaphragm Z.

Lamp in Cellar West Wing

Venus
236 9^h 45^m
9 55

Bulb. B₂ to Lamp

st st
39.4 + 0.6
39.9

Jupiter
236 9^h 50^m

..

st st
99.0 + 0.6

Photometry

1860 April 18th

Papers of different shades acquiring equal brightness
at relative distances noted - From Lamp S

W

$$\frac{W}{B} = \left(\frac{10.65}{3.95} \right)^2 = 7.27$$

$$\begin{array}{r} 10.65 \\ 3.95 \end{array} \quad \begin{array}{r} 1.0273 \\ 0.5966 \\ \hline 0.4307 \\ 0.8614 \\ \hline = 7.27 \end{array}$$

B

$$\begin{array}{r} 10.65 \\ 3.95 \end{array}$$

$$\frac{W}{B'} = \left(\frac{10.65}{6.10} \right)^2 = 3.05$$

$$\text{lighter strip} = P \quad \frac{B'}{B} = \frac{1.51}{3.05} = \frac{1}{2}$$

$$\begin{array}{r} 10.65 \\ 6.10 \end{array} \quad \begin{array}{r} 1.0273 \\ 0.7853 \\ \hline 0.2420 \\ 0.4840 \\ \hline = 3.05 \end{array}$$

B'

W

Photometry

10-65

730

$$10.65 = 1.0273$$

7.27 = 08615

$$= 0.1658$$

10 65

725

2
0.3316

$$= 2.14$$

$$\frac{W}{13''} \cancel{\frac{W}{13''}} = \left(\frac{10.65}{7.27} \right)^2 = 2.14$$

Photometry

Cutting out little discs of the foregoing specimen of tinted paper of about apparent diameter equal to $1'' \times 144 = 2.2$ to represent satellites of J under power of 144 it seemed that when projected on the normal ^{dead white} white back ground B alone would be called by contrast "very dark" or "almost black" or possibly "black". B' would be considered as "dark" but not a deliberate "black". While B'' could only appear as "dusky" or perhaps "dark".

When therefore a satellite is called "black" & compared in intensity to the shadow it must be from 3 to 8 times less bright than back ground.

Cut out of each paper B, B' & B'' a disc $\frac{2}{10}$ inch in diam and fastened them on the white screen with which they had been compared & found to have the reflect the relative quantities of light

$$\frac{W}{B} = 7.27$$

$$\frac{W}{B'} = 7.05$$

$$\frac{W}{B''} = 2.14$$

Taking diam. of satellite of Jupiter at $1''.5$ with a power of 141 its ap. diameter seen in telescope will be $1''.5 \times 141 = 211'' = 2.3243$

$$\text{in } 1'' \quad 4.6856$$

$$7.0099$$

$$0.200 \quad 9.3010$$

$$195.5 \quad 2.2911$$

$$16''.3$$

Examining the discs at a distance of 16 feet found that B might unreasonably be called "black" but not if viewed with attention ~~while B' & B'' were~~ it would rather be called "dark" or "very dark". The latter perhaps most commonly B' would be called "dark". B'' "dusky" scarcely "dark" excepting in a hasty description. But merely "dusky" or "darkish".

Now if we take the remarkable phenomenon seen Jan 28 1848 we have the following particulars

Photometry Jupiter

1st The shadow of 1st Satellite on belt & consequently both on on belt & being nearest satellite the shadow should appear most black even if Jupiter's white belts shine by native light.

2nd In contrast with it 3rd Satellite cast projection on bright zone only $\frac{1}{2} \left(\frac{10}{45} + \frac{10}{60} \right) = \frac{1}{5}$ diam Jupiter = from shadow of 1st Sat. and less than that distance from Jupiter's prec. limb.

3rd No difference of intensity was noticed & all were called "very black"

I placed as on next page ^{but one.} a disc of "0.20 diam. to represent 3rd satellite & at same proportionate distance as seen in telescope that is at on scale in which diam 3rd Sat 1".5 is 0.20 the dist of it from shadow of 1st Sat should be $\frac{1}{5}$ diam 4 = $\frac{1}{5} 39" = 7"$ ^{1.5} placed a disc of black paper painted dense lamp black. on ground shaded to $\frac{1}{5}$ to represent shading of belt on lower side of which ^{1.5} the shadow was projected

When screen was held at proper distance so as to make the apparent angular dimensions of objects as seen with power 141 in telescope it was evident at once that there was a difference of intensity the black disc projected on dusky belt was plainly of a more intense hue than the dark disc B projected on the white ground W. This was the independent judgment of 10 different persons.

There could be no possibility of comparing equal discs of B' or B" as equally dark.

I conclude from above that the 3rd Satellite seen on bright zone at about $\frac{1}{7}$ diam 4 distant from limb was only $\frac{B}{W} = \frac{1}{7.27}$ as bright as

Photometry Jupiter

~~Jupiter~~ the ~~1st~~ white band. This band is not noticed as having been particularly bright. Satellite may have been darker but scarcely brighter without a decided contrast not to be overlooked

From the Diagrams Jan 28 we have

4 diam

~~4 Centre~~ to 3rd Satellite by 3 diagrams was

$$\frac{1}{5} \left(2 \frac{10}{84} + \frac{10}{63} + 2 \frac{10}{62} \right) 42.8 = \cancel{8.8} 6.2$$

$$15.2 = 1.1818$$

$$21.4 = 1.3304$$

$$9.8514$$

$$\sin \phi = \frac{21.4 - 6.2}{21.4} = \frac{15.2}{21.4} =$$

$$\phi = 45^\circ$$

The dif. of long. of Sun & Earth seen from 4 = 5°

Hence angle of incidence of sunlight on disc of Jupiter in region of 3rd Satellite at time of diagrams = $45^\circ - 4^\circ = 41^\circ$

at point on which Sat is projected

According to Lambert, the intensity of 4th illumination comp. with intensity at its centre will be = $\cos 41^\circ = \cancel{0.766} 0.754$

while average intensity comp with centre = 0.667

$$\text{Hence } \frac{\text{Albedo Satellite}}{\text{Albedo Jupiter-white belt}} \times \frac{1}{7.27} \frac{0.754}{0.667} = \frac{1}{6.3}$$

In the absence of any remark to the contrary it is not likely that this zone on which 4 was projected was much brighter than ordinary surface of planet excluding the darker belts.



Photometry

1860 April 23

For Comparison of G & B_2 with S & diaphragmsI Comp with S diaphragm (m)
$$\begin{array}{r} 11 \\ 1.92 \\ 1.96 \end{array}$$
Equal images G & S }
$$\begin{array}{l} \text{Globe to Bulb } B^2 \\ \text{" " Lamp I} \end{array}$$

$$\begin{array}{r} 9.20 \\ 9.85 \end{array}$$
 S to I

54.79

Comparisons this ev'g were made by viewing the images of the objects compared both reflected from one of the auxilliary bulbs - B_2 , B_3 & 1371 being used for this purpose

The objects compared were

1st G illuminated by direct light of I or of $I + W.C.B$
compared with S reduced by diaphragms.

2nd Image of $I + W.C.B$ reflected from B_2 compared with
 S

Photometry

Lamps readjusted

I to WCB 54.70

Images equal on 1371

34.60 1371 to WCB
34.20

I Comp with S Diaphragm Y

4.40

3.98

After above
 (I & WCB placed together 54.80 ft from S.)
 Elobe to B₂ image $q = S$ (Y)
 Elobe to I + WCB towards S

7.45

(1)

8.25

Elobe to Bulk B₃ $q = S$ (Y)
 " I + WCB towards S

7.68

(2)

8.35

Elobe to B₂ $q = S$ (m)
 " I + WCB

9.00

(3)

9.75

Elobe to B₂ $q = S$ (m)
 " I + WCB

9.30

(4)

8.89

B₂

I + WCB to S' 54.90

Photometry

S to I 54.8 W
S (m) Comp with I

W
2.66
2.91
2.72

Cypher to B₂ ... G = S (com)
" I + WCB

9.30 (5)
8.90

Cypher to B₂ ... G = S (W)
" I + WCB

8.10 (6)
7.80

I comp with S (W)

4.81
4.21

I comp with WCB

35.40 1371.6 WCB
33.50

I & WCB were compared first then I & WCB placed close together & used as one lamp I + WCB. I having also been compared with S

$$\left(\frac{34.4}{20.5}\right)^2 = 2.82$$

Receiving Bulbs reversed between each comparison

The Bulb receiving the images was held about 1 foot 0.7 of a foot perp. to line from G to I + WCB

$$I + WCB = 3.8 I$$

Measurements are all to centers of bulbs & to the face of diaphragm =

Photometry

B_2 image of $I + WCB$ (B_2 to B_3) μ $S(Y)$
 B_2 to $I + WCB$ 7.70
 11.40

" 6.65 "
 10.40

$\int$ " 7.00 "
 10.70

The above were comparisons between
 image of $S(Y)$ in B_3 with image of
 $I + WCB$ reflected from B_2

$I + WCB$ comp with $S'(Y)$ 2.95
 3.09
3.00

$I + WCB$ comp with $S(m)$ 1.90
 1.70
1.75

B_2 image $I + WCB$ (B_2 to B_3) $S(m)$ 9.26
 $I + WCB$ to B_2 12.96

$I + WCB$
 It seems that S has become fainter here on looking at S
 its image S' did not seem altered. But I think both $I + WCB$ had

The results on this page not reliable

$$\frac{I}{web} = \frac{1}{2.8} \quad \text{earlier experiments}$$

$$I + web = 3.8 I$$

$$\therefore \frac{3.8 I}{Sy} = \left(\frac{3.0}{51}\right)^2 \quad \text{latest Exp-}$$

$$\therefore \frac{I}{Sy} = \left(\frac{4.3}{50}\right)^2 \quad \text{earlier Exp-}$$

$$\therefore \frac{I+web}{Sy} = \frac{9}{51^2}$$

$$\therefore \frac{I}{Sy} = \frac{1}{3.8} \left(\frac{18}{50}\right)^2$$

The ratio $\frac{Sy}{I+web}$ increased in the ratio $\frac{1}{2}$ in the later experiments on free page probably

Measured diameter of section of part of G
exposed to light

greatest diam.	=	1.650
least	=	1.578
mean	=	1.614

G Had just been repainted =

$$H = \frac{\text{Light rec'd by eye at } p \text{ from globe of Chalk } G. \text{ distant } \Delta \text{ from } p \text{ and } \Delta' \text{ from illuminator } I}{\text{Light rec'd by eye at } p \text{ from companion lamp } S \text{ distant } \Delta \text{ from } p}$$

$$H = \frac{1}{494} \frac{\Delta^2}{\Delta'^2 \Delta''^2} \frac{I}{S}$$

From mean of all above experiments
G. of Chalk painted brilliant white
Diameter $0.8^{\text{th}} 0.0672$

Occultation of Venus

1860 April 24th L.P.B. Great Refractor—1st Contact on dark side of Moon $SC = 10$ 54^h 57.2 - 4.0
cor of SC 25.21st Contact Camb. m. 8 41 9.50
2 11 42.89
3 11 43.11
4 11 21.611st Contact was noted at about 4^h 5^m

too late by mark without signal

Last contact $SC = 10$ 55 31.9
35.2
10 54 56.79
2 11 42.89
3 11 43.11
4 11 21.61

Imm. Camb. m. 2. 8 41 48.09

No peculiarity was noticed in the aspect of the planet until the C encroached upon the last half of illuminated part of planet. I noticed then that the remaining sector had less intensity of light - less light, that is, in proportion to its area, than the portion already covered - & the very apex before disappearing was quite dim. It disappeared however instantly at the last.

There was no luminous condens visible to Venus or at least none conspicuous as Moon's edge was.

Occultation of Venus.

860. Apr. 24.

Mc 7 44 00.0
 Annals 7 42 8.9

obs. by R. J. Paine, with Five feet Equatorial.

chron. 333 8 44 40 - 26 - 10.4 8 44 29.6 total Imm.
 8 42

comp. 8 41 47.16 Lamb. m. 2.
 8 41 43.0

333 9 31 24 - 18 - 7.2 9 31 16.8 Beginning of Em.
 9 32 10 - 60 - 24.0 2 42.44

Mc 9 39 0 comp. 9 28 34.36 Lamb. m. 2.
 333 9 38 59.4 9 28 29.0

Mc fan 2 43.04
 333 fan 2 42.44

South Boston -
 April 24

Chronometer set to Boston time

Immersion, complete disappearance, at 8. 42. 6"

Immersion, first appearance on the bright limb - 9. 28. 59

Full appearance of Planet - 9. 30. 6

Rebriant of observation, a common spy-glass -

J. H. Church

April 25-60
 J.C. = 9.37 =
 3457 = 9.36.56.7
 1,45.3
 9,38,42.0
 937,
 + 1.42.0

J. H. Church
 Obs of Venus

Occultation of Venus

1860 Apr. 24

obs. by R. F. Bond with "Christoph" Telescope

chron. No. 4787

M. J. Clock	8	49	00	clock	9	42	00
4787	8	46	41	chron.	9	39	41
						2	19
						2	43.04
				4787 fast			24 04

Total disappearance of Venus, 4787 =	8	47	11.0
			24.04
Lamb. m. 2	8	47	46.96

Beginning of Reappearance, 4787 =	9	28	59.5
			24.04
Lamb. m. 2.	9	28	35.46

Occultation of Venus.

1860. Apr. 24

obs. by H. P. Tuttle with State Equatorial. (pos. 42)

chron. 424.

$$\Sigma C = 9 \quad 54 \quad 00$$

$$424 \quad 9 \quad 53 \quad 46.3$$

$$13.7$$

$$\Sigma C \text{ fast} \quad 36.2$$

$$\text{Least contact. Imm. } 424 = 10^h \quad 55^m + 48 = 17.2 \quad 10^h \quad 55^m \quad 17.2$$

$$21.7$$

$$10 \quad 54 \quad 55.5$$

$$2 \quad 11 \quad 42.89$$

$$8 \quad 43 \quad 12.61$$

$$1 \quad 25.72$$

Imm. Camb. m. 2.

$$8 \quad 41 \quad 46.89$$

Emission

$$11 \quad 42 \quad +35^{\text{h}} \quad \text{h}$$

$$11^h \quad 42^m \quad 14.0$$

$$22.1$$

$$11 \quad 41 \quad 51.9$$

$$2 \quad 11 \quad 42.89$$

$$9 \quad 30 \quad 9.01$$

$$1 \quad 33.41$$

Em. Camb. m. 2.

$$9 \quad 28 \quad 35.60$$

Atmosphere very unsteady. Could see no projection of the planet on the moon's disc.

At the first contact the light of the planet totally hid the dusky edge of the moon.

The time of the emission is good.

Photometry

1860 April 25

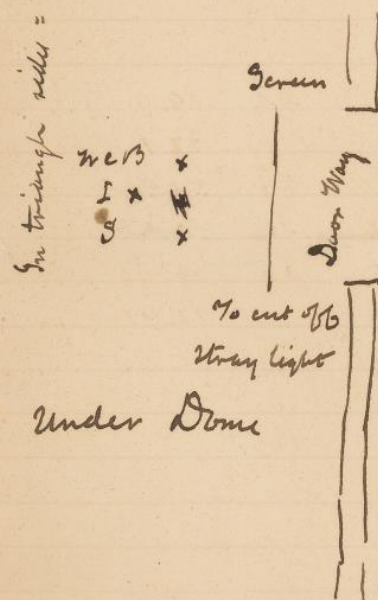
For Absorption of B_2

4 French Moderation Lamps used

W.C.B. large size
 R.F.B. medium
 I smaller
 S smaller.

Diaphragm X on R.F.B.

All adjusted to give maximum constant flame
 and compared separately with X 14th
 afterwards the three together - W.C.B. I and S
 compared with X



West Transit Room

Door way

X

An auxiliary Bulb
 Thermometer bulb.
 and also B_1 Diam 0.60

 B_4

Diam 0.304 (March 14)
 of Mercurial surface

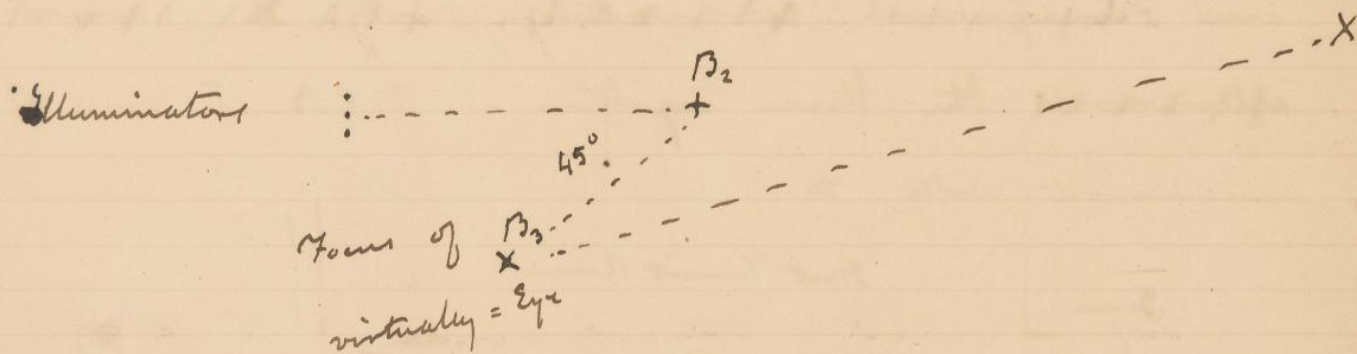
used in comparisons of X with other lamps.

No difference could be discerned between results by the two
 In order to make the conditions similar to those of comparison of Sun image
 on B_2 March 26 & 28 The angle at B_2 between the

Photometry

860 April 25th (Continued)

Illuminating lamps $I + S + WCB$ and the line B_2 to
~~Eye~~ (which was virtually the place of eye)
 was nearly the same as that of Sun seen from
 B_2 at Wyeth's house and the line from B_2 to Object
 glass of telescope viz 45°



The measured distances are in all cases to be
 reduced to the foci of the bulbs.

Photometry

April 25 (Cont.)

Differential

E + S' + W.C.B. comp with R7B (X)

Distances of B_2 to B_3 to night are least distances of surfaces
 Reckoning t from B_2 comp with X'

$t = 0^m$
 2.90 } on B_4
 3.20 }
 3.22 } on B_1
 3.04 }

45° Bulb B_3 to B_2 nearest surface
 B_2 to B_3 " "

$t = 9^m$
 6.78
 6.86 (1)

Bulb B_2 to Lamp nearest surface

8.40

 B_3 to X

$$54.40 - 8.40 + 6.72 \cos 45^\circ = 50.75 \quad \approx B_3 X$$

-3.65

50.75

45° B_2 to Lamp nearest surface

7.89

$$X \text{ to } B_3 = 54.40 - 7.89 + 8.48 \cos 45^\circ = 52.51 \quad = B_3 X$$

+1.89
 52.51
~~54.40~~
~~56.29~~

 B_2 to B_3

8.48

 $t = 16^m$

(2)

$$B_3 X = 54.40 - 7.56 + 8.28 \cos 45^\circ = 52.70$$

45° B_2 to B_3 Lamp?

7.56 $t = 26^m$
 (3)

 B_2 to B_3

8.28

R7B (X) comp again
 with I + S' + W.C.B.

$t = 25^m$
 2.92 on B_1 ?
 2.96
 3.00 on B_4 ?
 2.96

Photometry

450

 B_2 to B_3

5 32

 $t = 42$

(4)

 B_2 to Lamps

12 07

$$B_3 X = 54.40 - 12.07 + 5.32 \cos 45^\circ = 46.09$$

$$\begin{array}{r} -8.31 \\ +3.76 \\ \hline 46.09 \end{array}$$

$$B_3 X = 54.40 - 11.91 + 4.60 \cos 90^\circ = 42.49$$

Angle 900

 B_2 to B_3

4.60

 $t = 48$

(5)

 B_2 to Lamps

11.91

(1) to (5) Dist from X to 3 lamps 54.4

(6) to (13) " 54.1

I + S + WEB Comp with RFB(X)

2.80

2.55

2.86

 $t = 55$

Diaphragm X taken off & replaced by

(Z)

$$B_3 X = 54.10 - 14.72 + 14.10 \cos 5^\circ = 53.43$$

50

 B_2 to B_3
Lamp to B_2

(Z)

14.10

14.72

 $t = 67$

(6)

300

 B_2 to B_3 B_2 to Lamps

$$B_3 X = 54.10 - 14.82 + 7.60 \cos 30^\circ = 45.86$$

$$\begin{array}{r} -8.24 \\ +6.58 \\ \hline 45.86 \end{array}$$

45.86

7.60

14.82

 $t = 72$

(7)

9 knots
Z not (m) was
lost (6) & (5)
is very
near

Photometry

20

B_3 to B_2
 Lamp to B_2
 B_3 to (m)

Z
 (m)

11 $t=78$
 13.98
 14.60 (8)
 53.40

X Comp with I+S+Y+V 2.65 $t=85^{m}$

20

B_3 B_2
 Lamp B_2
 B_3 X

(X)

9 18 $t=92$
 9 89 (9)
 53.40

20

B_3 B_2
 Lamp B_2
 B_3 (X)

X

9 05 $t=94$
 9 74 (10)
 53.45

X Compared with 3 Lamps

Lamps
 III

50 ft ±

2 1/2 ft X
 Bulb

105 $t=105$
 2.40
 2.60
 2.72
 2.70

500

B_3 to B_2
 B_2 to Lamps
 B_3 to X

$t=112$
 6.00
 10 05 (11)
 46 30

Photometry

94⁰

B_3 to B_2
 B_2 to Lamp
 B_3 to X

$t=119^m$
 4 58
 12 50 (12)
 40.95

X comp. with 3 Lamps

$t=125^m$
 2.32
 2.46

Lamps to X 54.10 for (6) to (12) ind.

Photometry

Disc to Object glass Comet rack 35.75
 " " Lamps 49.00
 Bulb B₂ to Object glass 39.30

Above is for Disc 9 ft by 3 Lamps
 Compared with light of same lamps reflected
 from Bulb B₂
 Both viewed with Comet-rack

Comparison of light of 2 lamps Wc B & S reflected
 from image in B₂ with light of 4 to Tel 37.8
 same lamps reflected from B₂ to " 39.3
 Chalk Disc Globe of Lamps to B₂ 52.6

Globe Bulb

X
X

X
X
1 1/2 in

Telescope

Photometry

N.B. That in equalizing images from B_2 with X. both received upon B_3 . The distances recorded are in all cases the ~~lesser~~ least distances of surfaces of bulbs.

The point between the three lamps I. S. & W. B., used as illuminations, taken for measurement of distances was the centre of gravity of the triangle

I. S. at n
W. B. at n

Obs of Comp of B_2 for absorption occupied about $2\frac{1}{2}$ hours or say $2^h 20^m$ for the 14 intervals 10^m to an interval between sets of comparisons on an average

Ven

Venus

April 27 1860 3 P.M.

Phase very nearly a
half moon.

The deficiency of light
from g towards edge is
noticeable

Last evening at 8 P.M.

There was a protuberance
at α not now visible

Not good definition



Photometry

1460 April 27

Comparisons of image of two lamps reflected
from B_2 and Disc D perp. to visual ray -
all in line with each other

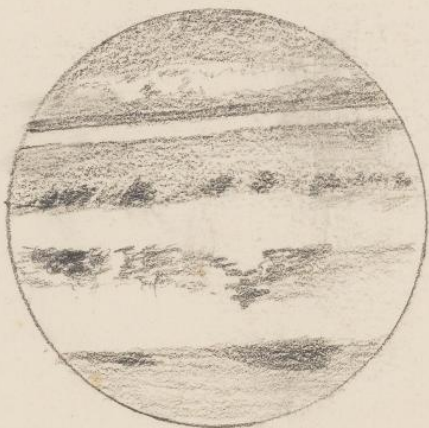
Lamps to D	26.0 ⁶⁵	24.7	42.5 ^{out of Moon shine}
" B_2	36.8	38.0	53.9
Eye to B_2	81.5	97.8	121.4

After lamps were removed found an image from
Moon light perhaps $\frac{1}{4}$ as bright as that from lamps
also a perceptible image from diffused light

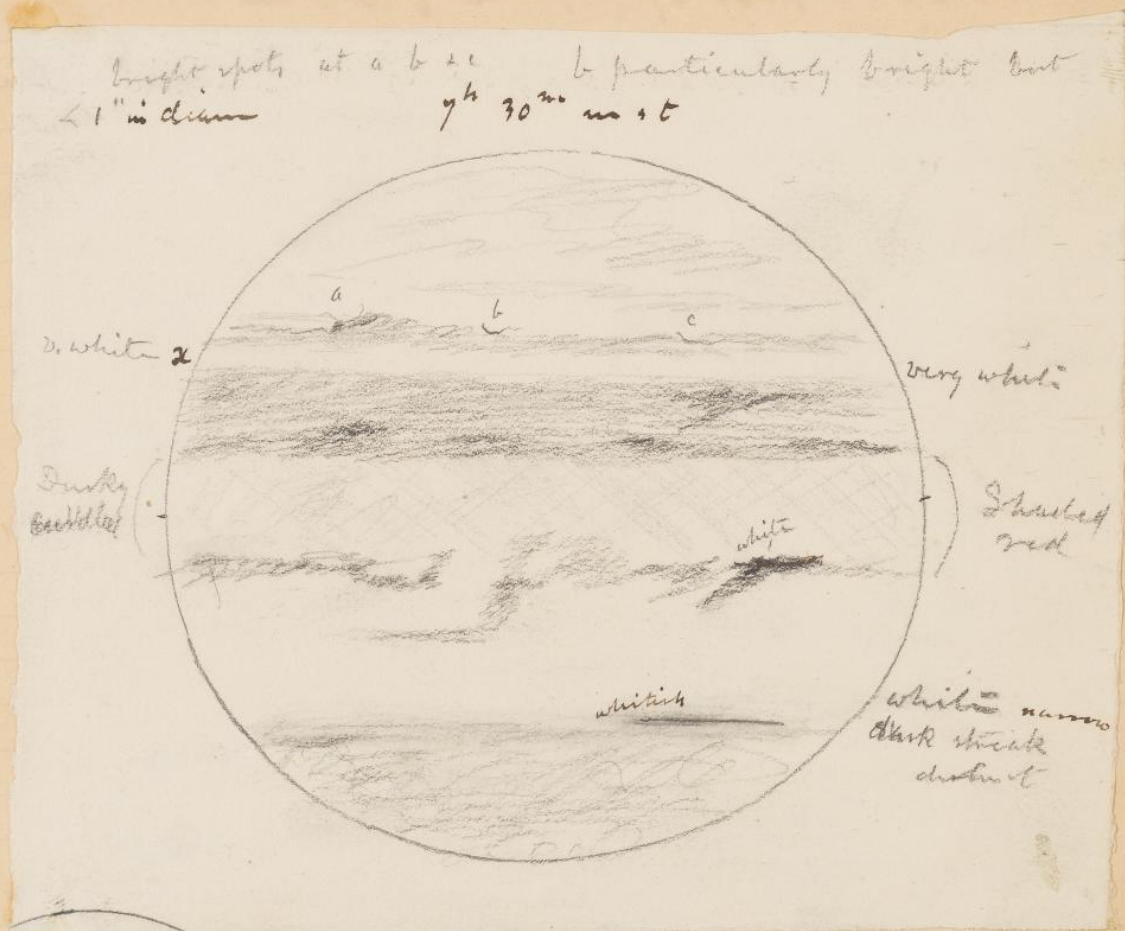
April 27/28 Found that a dead white
disc $1\frac{7}{10}$ in in diam was far fainter than
bull bte well exposed to sun light at equal
distances

I find Chalk gas in solid masses
ground down at surface & painted with "Flake" white
water color is the brightest ^{dead white} surface I can get

1860 April 27 7^h to 8.50 m s t H R 2



Jupiter

1860 April 27th

The bright spots are most decided when vision is most tranquil

Most of the darker streaks & outer borders of belts are edged with a sudden brightening this I have before noticed - These excepted x is the whitest part of the planet.

Photography

1860 April 28 7^h 30 to

Took photographs of Venus with thin-
cirrus in sky = With 15th ap- 5 beats = $\frac{10}{3}$ ³ given
strong negative

With 5th ap- 3 beats gave a decided
image of $\frac{3}{4}$ breadth of phase ☾.
But time not long enough for full phase ☾ half moon
not enough for the brightest part.

Plate marked 000
Venus

Exp 20 beats at 7^h 50^m dist
3 } 5th ap. Found that the 20 beats exposure, which was the shortest
5 } would give a negative of all of illuminated half of
10 } disc strong enough for a positive copy re-
40 } sulting from Moon for 20 to 25 beats of
1 beat exposure & full aperture

Plate V. 5th aperture
Moon 50 beats a decided image but not
strong enough negative for copying

Pla

I conclude from above Plate 000

$$\frac{\text{Intensity of Venus}}{\text{Intensity of Moon}} = \left(\frac{15}{5}\right)^2 \frac{22}{20} \times \text{cor. for extinction.}$$

Not satisfactory on account of cirrus cloud.

Photography

8h 30^m

Half Moon -

With full ap. takes best in 20 beats

15 in ap.

Q 15ⁱⁿ

25 very strong
 With 15ⁱⁿ aperture 20 beats = $\frac{40^3}{3}$ ga was the best
 time

5 in. ap

In plate

80 beats
 15
 10
 15
 20
 30
 50
 100

No image found on
 plate - probably by
 some accident the
 telescope had been moved.

There was too much cirrus in the sky
 to admit of decisive comparisons = of Venus
 & Moon.

Photometry

1860 April ²⁹/₃₀

placed a dead white disc $1\frac{65}{100}$ in -
 in diameter side by side with the silvered bulb B_2
 distant 75 feet both illuminated by direct sunlight -
 dispersed light excepting from sky near Sun being
 excluded -
 found the image of bulb much the brightest
 I doubt that it would be fainter than a disc of 2ⁱⁿ
 or even larger -

Placed Bulb B_1 1.760 in diam at distance
 of 75.0 ft & disc D 1.16 at distance 73.5 ft & found
 lights ~~about~~ equal - side by side I thought the disc
 the brightest. I all experiments the disc was presented
 to perp. incidence of Sun's rays & at angle of 25° with line of vision

By first experiment an opaque dead white disc of equal
 diameter with B_2 would reflect more light in
 the proportions

$$\left(\frac{3.4}{2.0}\right)^2 \sec 25^\circ = 2.89 \sec 25^\circ = 3.2$$

By second

$$\left(\frac{1.76}{1.16}\right)^2 \left(\frac{75.0}{73.5}\right)^2 \sec 25^\circ = 2.31 \sec 25^\circ = 2.5$$

Photometry

1860 May 2

Compared with lamp light reflected from
a brick of rather dark color (thought to be
of tint of Tufts College wall) with
white paper

Paper from lamp	5.80
Brick ..	2.65

Paper	6.00
Brick	2.65

The contrast of color is so great that the
comparison cannot be made with much
certainty.

$$\frac{\text{Brick albedo}}{\text{Paper ..}} = \left(\frac{2.65}{5.90} \right)^2 = 0.2017 = \frac{1}{4.96}$$

2.65	0.4232
5.90	<u>0.7708</u>
	9.6524
	<u>2</u>
	9.3048
	0.6952

The paper was dead white not
distinguishable from flake white or
barley if at all.

