ficial helping to raise the altitude of the planet and thus conduce to better definition. But the chief value of the site lies in the relatively steady character of the air for which quality it was originally selected. Though not so important spectroscopically as visually it is nevertheless a factor to be taken into account.

As to the advantages of the time chosen for the research in its bearing on the result they are set forth by Mr. Slipher in his article as is also the manner an ingenious one in which he reduced systematic error to as nearly nul as possible.

Mr. Slipher was left entirely unbiassed in his investigation. In order furthermore to render himself unprejudiced in his measurements, in every case where he could have occasion to recognize or to think he recognized a plate, a paper covering up the plate number and bearing a ficticious number written without his knowledge by an assistant was put over the plate mark and was not removed until, not only the plate was measured, but practically the whole investigation closed.

His result follow. It is noteworthy that the value got with the slit parallel to the terminator is very nearly the value of the probable error in the investigation for the motion with the slit perpendicular to the terminator. This is of course what it should be as the probable error means that where no force is at work the result got would probably differ from zero by just this amount.

From the efficiency of the instrument and the unbiassed manner in which the measurements were made we may, I think, conclude from the size of the probable error that the evidence of the spectroscope is against rotation of short duration and that so far as its measure of precision permits the investigation confirms a rotation period of 225 days.

Lowell Observatory, 1903 March 28. *Percival Lowell.*

A Spectrographic Investigation of the Rotation Velocity of Venus.

By *V. M. Slipher.*

If v is the velocity of a point on the equator of Venus, due to axial rotation; then the relation between the rotation and spectrographic velocity is given by the equation,

$$v_s = 2v(1+\cos i),$$

where i is the angle Earth-Venus-Sun, and v_s is the spectrographic velocity corresponding to the opposite displacement of the planetary lines at the edges of the spectrum the slit of the spectrograph being set on the planet's equator. For Venus at superior conjunction $i = 0°$ and $v_s = 4v$, at elongation $i = 90°$, $v_s = 2v$, and at inferior conjunction $i = 180°$, $v_s = 0$. Thus to gain most from the condition that Venus shines by reflected sunlight the observations must be made when i is small. The present passage of Venus through superior conjunction gave an opportunity to investigate the rotation velocity under favorable conditions. An investigation of this kind was made by A. Belopolsky [1]), at Pulkowa, in 1900, but when the planet was near elongation. Although I began observations the first of last November, the nearness of the planet to the Sun and unfavorable weather allowed me to secure only a few satisfactory plates before the middle of February. Plates secured since that time were made in a manner which so facilitated the measurements, that I have preferred not to include measures from the early plates, although those measured gave results in entire accord with those from the later ones given below.

In the above equation the factor

$$2(1+\cos i) = K$$

is known when i is given. The values of i, K [2]) and the semidiameter of Venus for the dates of the observations are given in the following table:

1903	i	K	Semidiam.
Febr. 23	29°6	3.8	5ʺ47
Mar. 2	31.3	3.7	5.56
7	33.1	3.7	5.63
12	35.0	3.6	5.71
19	37.6	3.6	5.83

This apparent diameter gave the spectrum a breadth on the plates of a little more than 0.4 mm.

In this work the new three-prism spectrograph was employed, attached to the 24-inch refractor. A comparison of the optical power of this and other large spectrographs is given, by Director Lowell in his paper. For the region of the spectrum measured the linear dispersion is about 11.5 tenth metres to the millimeter. It is arranged with two devices for guiding, the one by light reflected from the first prism, the other, by light from the slit-plate. I have found guiding by the latter method more accurate, especially for planetary work, since one can see what part of the disk is on the slit. The attachment of the spectrograph to the adapter is such as to readily permit rotation through any desired angle about the optical axis of the telescope. This made easy the obtaining of plates with the slit in different positions.

Since measures from my first plates gave no certain evidence of rotation I was convinced that the displacement must be very small even with the considerable dispersion employed. These early results, undecisive as they were, lead me to take every possible precaution against instrumental errors and any personal systematic errors in the measurements. To effect the elimination of such errors as far as possible, I made the plates with the spectrograph in the following positions:

[1]) See Astronomische Nachrichten, No. 3641.
[2]) This is the same as Belopolsky's *k*.

1) with slit perpendicular to terminator, camera above collimator
2) » » » » » » below »
3) » » parallel » » »

The effect of changing the camera from above in 1) to below in 2) is, of course, to reverse the direction of the the inclination of the planetary lines; while the planetary lines in 3) should be without inclination, since it is here assumed that the axis of rotation is about perpendicular to the planet's orbit. On March 19, I secured two pairs of plates, with camera above and below, and with the slit set at an angle of 45° to the terminator.

In order to further increase the accuracy of the measurements blank spaces of about 1/2 mm were left on the negatives between the planetary spectrum and the two parts of the comparison. To do this the slit length was fixed at 2.3 mm and before the exposure to the iron spark — which was generally made after the exposure to the planet — a metall tongue was drawn across the slit until it occulted the central 1 1/2 mm, or about three times the length occupied by the image of the planet. This left about 1/3 mm open at the ends for the two parts of the comparison spectrum. Leaving the slit long during the exposure to Venus was helpful in judging of the accuracy of the guiding since errors would reveal themselves by causing a broadening of the spectrum.

These spectrograms were made on plates of very fine grain, with a slit width of 0.018 mm and an exposure of about 8 minutes. They were obtained during the hour immediately following sunset. The quiescence of the atmosphere at this time of day and the elevation of 1 1/3 miles of the observatory made good to a very large degree the low altitude of the planet. The seeing was especially fine during the week from March 6, to 12, when most of the plates were secured. The temperature of the spectrograph was easily kept constant during the evening by the device for that purpose. An idea of the exellence of the plates may be had from the great number of fine monochromatic lines I was able to select for measurement.

Measurement of Plates.

The plates were measured under a micrometer microscope of the usual type, equipped with a protractor arc and vernier reading to single minutes, with an eyepiece magnifying about 18 diameters. The plates were placed under the microscope most frequently with violet end to right. I always kept my self ignorant of the position of the slit and camera for the plate, so that I should not be biassed by knowing in which direction to expect inclination. When the attention was centered on the planetary lines the blank spaces of about 1/2 mm between them and the comparison lines — above and below — kept the latter quite out of view. Thus the settings on the planetary lines — which, of course, were always measured first — were made with less difficulty and with freedom from any influence of the comparison lines. This increase in the distance between the two parts of the comparison spectrum also increased the accuracy of the measures on the comparison lines. In order to avoid measuring lines which might appear good and still be affected by close neighboring lines I kept a Rowland Atlas of the solar spectrum before me on the measuring table.

The reading of the protractor for an undisplaced (comparison) line is indicated by φ_0 and that for the displaced (planetary) line by φ, where φ increases with inclination toward the right. Thus for direct rotation

$$\varphi_0 - \varphi = \Delta\varphi$$

is positive for camera above and negative for camera below.

The measures of the plates follow.

Febr. 23, Plate 765. Slit parallel to terminator.

λ	φ	λ	φ₀
4185.1	1° 51′	4185.1	1° 50′
87.2	1 55	91.5	1 46
99.3	1 54	4204.2	1 47
4204.2	1 59	22.4	1 47
06.7	2 23	47.7	1 44
10.5	2 15	82.6	1 55
15.6	2 1	99.4	1 44
22.4	2 4	4315.2	1 42
33.7	2 9	37.2	1 46
39.0	2 9	53.0	1 49
45.4	1 39	76.2	1 45
47.0	1 59	4427.5	1 52
47.7	1 42	Mean φ_0 =	1° 47′.3
50.3	1 47	$\varphi_0-\varphi$ =	−0 4.8
75.0	1 29		
93.3	2 1		
4318.8	1 20		
44.7	1 48		
59.8	1 24		
4401.7	1 33		
Mean φ =	1° 52′.1		

Febr. 23, Plate 766.
Slit perpendicular to terminator, camera below. Good plate

λ	φ	λ	φ₀
4199.3	2° 50	4210.5	2° 46′
4204.2	3 12	19.5	2 48
06.7	3 16	22.4	2 50
08.7	2 40	27.5	2 52
10.5	2 54	33.7	2 53
11.2	2 44	36.0	2 47
12.7	2 44	82.6	2 53
15.6	3 17	82.6	2 57
17.7	3 18	94.3	2 48
19.5	3 21	99.4	2 52
22.4	2 50	4315.2	2 46
27.6	2 38	37.2	2 54
31.2	2 52	Mean φ_0 =	2° 50′.5
39.0	3 17	$\varphi_0-\varphi$ =	−0 0.1
40.0	2 27		
45.4	2 54		
47.0	2 48		

λ	φ
4250.3	2° 25'
51.0	3 5
54.5	2 30
93.3	2 57
94.3	2 37
98.2	2 31
4318.8	2 17
28.1	2 42

Mean φ = 2° 50'.6

Febr. 25, Plate 775.

Slit perpendicular to terminator, camera above.

λ	φ
4250.3	1° 16'
54.5	1 19
85.6	1 5
87.0	1 6
93.3	1 6
94.3	1 10
4337.2	1 6
38.1	1 9
44.4	1 18
59.8	0 46
70.0	0 44
76.2	1 9
99.8	1 4
4407.8	0 54
17.8	1 11
25.5	0 54
30.8	1 5
42.4	0 44
44.0	0 58
47.8	0 59
56.0	0 59

Mean φ = 1° 3'.0

λ	φ_0
4247.7	1° 6'
82.6	1 9
94.3	1 1
99.4	1 4
4315.2	1 1
37.2	1 10
53.0	1 6
70.0	1 9
76.2	1 10
4427.5	1 6
35.0	1 8
55.0	1 9

Mean φ_0 = 1° 6'.6

$\varphi_0 - \varphi$ = +0 3.6

Febr. 26, Plate 780. Slit perpendicular to terminator, camera above. Very good plate.

λ	φ
4206.7	1° 22'
10.5	0 51
19.5	1 5
22.4	1 6
33.7	1 11
39.0	1 15
40.0	0 57
45.4	1 12
47.7	1 12
50.3	0 41
51.0	1 15
54.5	1 49
75.0	1 18
82.5	1 11
85.6	0 59
87.1	1 8
93.3	0 55
4318.8	1 3
25.2	1 1

λ	φ_0
4210.5	1° 5'
19.5	1 7
22.4	1 11
33.7	1 9
47.7	1 14
82.6	1 6
94.3	1 5
99.4	1 5
4315.2	1 11
37.2	1 8
53.0	1 9
76.2	1 6

Mean φ_0 = 1° 8'.0

$\varphi_0 - \varphi$ = +0 0.1

λ	φ
4353.0	0° 50'
59.8	1 22
70.0	1 2
77.4	1 17

Mean φ = 1° 7'.9

Febr. 26, Plate 781.

Slit parallel to terminator. Good plate.

λ	φ
4222.4	1° 32'
33.7	0 57
38.2	1 10
46.2	1 7
47.0	1 29
50.3	1 27
54.5	1 27
93.3	1 19
94.3	1 15
4318.8	1 19
59.8	1 20
67.7	0 47
70.0	0 57
90.2	1 9
4407.8	0 53
17.8	1 6
25.5	1 0
35.8	1 12
42.5	0 57
44.0	1 1
47.8	1 4

Mean φ = 1° 9'.9

λ	φ_0
4222.4	1° 13'
33.7	1 11
47.7	1 10
82.6	1 7
94.3	1 15
99.4	1 6
4315.2	1 9
37.2	1 14
76.2	1 11
4427.5	1 15
42.4	1 14

Mean φ_0 = 1° 11'.4

$\varphi_0 - \varphi$ = +0 1.5

Febr. 27, Plate 783.

Slit parallel to terminator. Superb plate.

λ	φ
4204.2	1° 15'
11.2	1 9
22.4	1 19
38.2	1 6
47.0	1 5
47.7	1 12
50.3	1 11
54.5	1 20
75.0	1 20
85.6	1 14
93.3	1 13
94.3	1 0
4318.8	1 3
53.0	1 15
59.8	1 9
75.1	1 14
76.2	1 14
91.2	1 2
4407.8	1 6
25.5	1 7
42.4	1 15

Mean φ = 1° 10'.9

λ	φ_0
4202.3	1° 9'
10.5	1 9
33.7	1 10
47.5	1 9
82.6	1 10
94.3	1 10
99.4	1 9
4315.2	1 11
37.2	1 10
76.2	1 12
4427.4	1 10

Mean φ_0 = 1° 9'.9

$\varphi_0 - \varphi$ = −0 1.0

Mar. 2, Plate 789. Slit perpendic. to terminator, camera above.

λ	φ
4204.2	2° 22′
10.5	2 5
15.6	1 57
22.4	2 0
33.7	2 1
39.0	1 56
50.3	2 0
51.0	2 11
54.4	2 8
78.4	2 25
85.6	2 28
93.3	2 29
94.3	2 30
4315.2	2 25
18.8	2 36
53.0	2 27
59.8	2 32
70.0	2 14
76.2	2 22
99.8	2 20
4407.8	2 36
22.7	2 22
25.5	2 20

Mean $\varphi = 2° 17'.7$

λ	φ_0
4210.5	2° 19′
22.4	2 26
33.7	2 21
47.7	2 23
82.6	2 21
94.3	2 23
99.4	2 23
4315.2	2 23
37.2	2 21
53.0	2 21
76.2	2 24

Mean $\varphi_0 = 2° 22'.3$

$\varphi_0 - \varphi = -0 \quad 4.6$

Plate was under microscope with film down, which changes sign of $\varphi_0 - \varphi$.

March 2, Plate 790.

Slit perpendicular to terminator, camera below. Excellent plate.

λ	φ
4182.5	1° 46′
87.2	2 5
4204.2	1 39
05.7	1 50
06.7	1 53
10.5	1 45
15.6	1 49
17.7	1 13
19.5	1 45
25.6	1 43
27.5	1 52
30.0	1 22
33.7	1 24
39.0	1 30
40.0	1 18
45.4	1 9
46.2	1 42
47.0	1 38
47.7	1 35
50.3	1 59
51.0	1 25
54.5	1 52
85.6	1 40
93.3	1 6
94.3	1 37
98.2	1 34
4307.0	2 12
18.8	1 31
59.8	1 20

Mean $\varphi = 1° 37'.7$

λ	φ_0
4187.2	1° 37′
91.7	1 33
4204.2	1 38
10.5	1 34
19.5	1 38
22.4	1 36
33.7	1 33
47.7	1 30
82.6	1 43
94.3	1 45
99.4	1 39
4315.2	1 37
37.2	1 40
76.2	1 42

Mean $\varphi_0 = 1° 37'.5$

$\varphi_0 - \varphi = -0 \quad 0.2$

March 2, Plate 791.

Slit parallel to terminator. Good plate.

λ	φ
4204.2	0° 52′
10.5	1 4
11.1	1 10
15.6	1 32
19.5	0 58
22.4	0 51
31.2	1 31
33.7	1 56
39.0	1 40
45.4	1 22
47.0	1 1
50.3	0 57
51.0	0 50
54.5	1 28
65.4	0 56
85.6	1 2
87.1	1 13
93.3	1 12
94.3	1 14
4301.3	1 6
18.8	1 11
53.0	1 5
59.8	1 31
70.0	1 36
80.9	1 23
99.8	1 6

Mean $\varphi = 1° 13'.3$

λ	φ_0
4204.2	1° 12′
10.5	1 13
19.5	1 12
22.4	1 9
33.7	1 19
47.7	1 18
82.6	1 19
94.3	1 18
99.4	1 16
4315.2	1 18
37.2	1 21
53.0	1 18
76.2	1 18

Mean $\varphi_0 = 1° 16'.2$

$\varphi_0 - \varphi = +0 \quad 2.9$

March 6, Plate 792.

Slit perpendicular to terminator, camera above. Excellent plate.

λ	φ
4182.2	2° 8′
4200.1	1 34
04.2	2 4
10.5	1 56
15.6	1 49
22.4	1 44
33.7	1 25
39.0	1 48
40.0	1 40
45.4	1 49
47.0	1 40
47.7	1 43
54.5	1 42
75.0	1 43
85.6	1 56
93.3	1 21
94.3	1 31
4306.8	1 31
60.0	1 51
70.0	1 39

Mean $\varphi = 1° 43'.7$

λ	φ_0
4182	1° 39′
88	1 39
99.3	1 38
4227.5	1 39
33.7	1 50
36.0	1 35
51.0	1 44
82.6	1 41
94.3	1 42
99.4	1 38
4315.2	1 38
37.2	1 39
76.2	1 37

Mean $\varphi_0 = 1° 39'.9$

$\varphi_0 - \varphi = -0 \quad 3.8$

March 6, Plate 793.

Slit parallel to terminator. Only a fair plate; comparison not so good as planetary spectrum.

λ	φ	λ	φ_0
4210.5	2° 6′	4219.5	1° 47′
11.2	1 56	27.5	1 49
15.6	2 4	33.7	1 49
17.7	1 55	36.0	1 45
19.5	1 17	50.3	1 47
22.4	2 12	51.0	1 47
33.7	2 3	82.6	1 45
39.0	2 17	94.3	1 47
38.2	2 14	99.4	1 47
45.4	1 35	4315.2	1 48
47.0	1 45	76.2	1 48
47.7	1 34	Mean φ_0 =	1° 47.′2
50.3	1 16	$\varphi_0 - \varphi$ =	+0 2.7
51.0	2 7		
54.5	2 25		
75.0	1 8		
85.6	0 54		
93.3	1 20		
4313.8	1 34		
18.8	1 34		
70.0	1 31		
77.4	1 31		
Mean φ =	1° 44.′5		

March 6, Plate 794.

Slit perpendicular to terminator; camera below. Excellent plate.

λ	φ	λ	φ_0
4200.1	1° 45′	4204.2	1° 25′
04.2	1 12	10.5	1 24
06.7	1 33	19.5	1 22
10.5	1 24	22.4	1 23
11.2	1 15	27.5	1 24
12.7	1 32	33.7	1 25
17.7	1 29	36.0	1 23
19.5	1 10	51.0	1 29
22.4	1 1	82.6	1 25
33.7	1 13	94.3	1 26
38.2	1 30	99.4	1 25
39.0	1 40	4315.2	1 27
45.4	1 59	Mean φ_0 =	1° 24.′8
47.0	1 19	$\varphi_0 - \varphi$ =	+0 1.3
47.7	1 37		
50.3	1 33		
51.0	1 14		
54.5	1 17		
55.2	1 15		
85.6	1 21		
86.6	1 3		
90.0	1 12		
93.3	1 28		
94.3	1 32		
4318.8	1 14		
Mean φ =	1° 23.′5		

March 9, Plate 803.

Slit perpendicular to terminator; camera below. Excellent plate.

λ	φ	λ	φ_0
4199.3	1° 18′	4204.2	1° 15′
4200.1	1 33	22.4	1 15
04.2	1 16	47.7	1 19
06.7	1 23	68.0	1 14
10.5	1 3	82.6	1 12
15.6	1 39	85.6	1 17
21.6	1 21	4306.0	1 22
22.4	1 17	15.2	1 14
33.7	1 13	37.2	1 16
39.0	1 39	53.0	1 20
40.0	1 8	70.0	1 19
45.4	1 21	76.2	1 14
46.3	1 3	Mean φ_0 =	1° 16.′4
47.0	1 4	$\varphi_0 - \varphi$ =	+0 0.6
47.7	1 16		
50.3	1 18		
51.0	1 4		
54.5	1 8		
85.6	1 6		
87.1	0 53		
93.3	1 51		
94.3	1 6		
4318.8	1 25		
53.0	1 10		
59.8	1 0		
Mean φ =	1° 15.′8		

March 9, Plate 804.

Slit perpendicular to terminator; camera below.

λ	φ	λ	φ_0
4176.7	2° 27′	4185.1	2° 5′
77.7	2 14	4204.2	2 7
81.0	2 23	10.5	2 5
85.1	2 21	19.5	2 11
87.2	2 9	22.4	2 9
99.3	2 17	33.7	2 5
4200.1	1 51	39.0	2 8
04.2	1 52	47.7	2 12
06.7	2 27	82.6	2 5
10.5	2 13	94.3	2 7
12.7	1 54	99.4	2 7
13.7	2 26	4315.2	2 3
15.6	2 8	Mean φ_0 =	2° 7.′0
17.7	2 0	$\varphi_0 - \varphi$ =	+0 0.9
18.8	1 55		
19.5	2 4		
21.6	1 49		
22.4	1 50		
24.3	1 58		
33.7	2 1		
37.4	1 56		
39.0	2 1		
45.4	2 24		
51.0	2 13		

λ	φ
4254.5	2° 5′
93.3	2 1
94.3	1 44
4318.8	2 7

Mean φ = 2° 6′.1

March 10, Plate 809. Slit parallel to terminator; camera to right. An excellent plate.

λ	φ
4179.0	2° 4′
85.1	1 32
87.3	1 43
88.8	1 10
92.7	1 47
99.3	1 36
4204.2	1 40
06.7	1 47
10.5	1 43
12.8	1 26
17.8	1 54
18.8	1 30
20.5	1 33
22.4	1 48
24.3	1 56
31.0	1 28
33.7	2 5
38.2	1 49
47.0	1 50
47.7	1 39
50.3	1 51
68.8	1 45
82.6	1 36
83.2	1 31
85.6	2 4
93.3	1 36
94.3	1 4
4318.8	1 29

Mean φ = 1° 40′.6

λ	φ_0
4187.2	1° 41′
99.3	1 41
4206.7	1 40
19.5	1 41
22.4	1 40
27.5	1 42
33.7	1 37
36.0	1 44
50.3	1 36
82.6	1 39
94.3	1 41
99.4	1 41
4315.2	1 39
37.2	1 43

Mean φ_0 = 1° 40′.4

$\varphi_0 - \varphi$ = −0 0.2

March 11, Plate 811.

Slit perpendicular to terminator; camera above. A good plate.

λ	φ
4182.5	0° 57′
85.1	1 6
87.2	0 49
99.3	0 53
4204.2	0 36
06.7	0 48
10.5	1 12
11.1	0 53
19.5	0 49
22.4	1 5
25.5	1 9
33.9	0 55
39.0	0 42
45.4	1 0
47.0	0 43
47.7	0 47

λ	φ_0
4182.0	0° 50′
87.2	0 49
4210.5	0 48
19.5	0 55
22.4	0 51
27.5	0 54
33.7	0 54
36.0	0 52
47.7	0 51
82.6	0 56
94.3	0 55
99.4	0 55
4315.2	0 53

Mean φ_0 = 0° 52′.5

$\varphi_0 - \varphi$ = −0 0.5

λ	φ
4250.3	0° 46′
51.0	1 10
85.6	0 51
93.3	0 35
94.3	0 57
4318.8	0 44

Mean φ = 0° 53′.0

March 11, Plate 815.

Slit perpendicular to terminator; camera below.

λ	φ
4199.3	2° 16′
4200.1	2 4
06.7	1 55
15.6	2 22
19.5	2 7
22.4	1 39
25.5	2 18
33.7	1 48
39.0	2 8
46.3	2 21
47.7	1 48
50.3	2 24
51.0	1 50
54.5	2 6
71.3	2 21
75.0	2 36
85.6	1 54
93.3	1 38
94.3	2 8
4315.2	2 19
18.8	2 3
25.2	1 43
37.2	1 39
53.0	1 40
59.8	1 36

Mean φ = 2° 1′.7

λ	φ_0
4210.5	2° 1′
19.5	1 53
33.7	2 8
36.0	2 7
47.7	2 7
51.0	1 53
82.6	2 1
94.3	2 3
99.4	2 1
4315.2	2 3
37.2	2 0
53.0	2 10

Mean φ_0 = 2° 2′.3

$\varphi_0 - \varphi$ = +0 0.6

March 12, Plate 818.

Slit parallel to terminator; camera to right.

λ	φ
4199.3	2° 21′
4200.1	2 12
04.2	2 0
06.7	1 57
10.5	2 18
12.7	2 12
15.6	2 8
19.5	1 17
22.4	1 48
23.7	1 30
33.7	1 46
39.0	1 27
40.0	1 19
46.3	1 36
47.0	1 27
47.7	1 43
50.3	1 38

λ	φ_0
4199.3	1° 48′
4219.5	1 44
27.5	1 47
33.7	1 45
36.0	1 47
50.3	1 48
51.0	1 39
60.7	1 44
82.6	1 48
94.3	1 43
99.4	1 41
4315.2	1 46

Mean φ_0 = 1° 45′.0

$\varphi_0 - \varphi$ = +0 2.5

λ	φ
4251.0	1° 47′
54.5	1 30
75.0	1 56
77.7	1 17
94.3	1 10
95.4	1 29
4313.8	1 9
18.8	1 46

Mean $\varphi = 1° 42'.5$

March 12, Plate 819.

Slit perpendicular to terminator; camera below. Fine plate.

λ	φ
4182.5	1° 57′
85.0	1 29
87.3	1 23
99.3	1 33
4200.1	1 25
04.2	1 22
06.7	2 5
10.5	1 24
11.2	1 18
12.8	1 37
15.6	1 15
22.4	1 41
24.3	1 13
27.5	2 8
33.7	1 15
38.2	1 1
39.0	1 41
45.4	1 13
47.0	1 13
47.7	1 16
51.0	1 15
54.5	1 20
93.3	1 34
94.3	1 2
4313.8	1 18
18.8	1 1

Mean $\varphi = 1° 25'.3$

λ	φ_0
4202.2	1° 24′
10.5	1 29
19.5	1 28
27.5	1 25
33.7	1 26
36.0	1 21
51.0	1 23
60.7	1 26
82.6	1 21
94.3	1 47
99.4	1 27
4315.2	1 28

Mean $\varphi_0 = 1° 25'.4$

$\varphi_0 - \varphi = +0 \quad 0.1$

March 12, Plate 821.

Slit perpendicular to terminator; camera above.

λ	φ
4175.7	1° 28′
77.7	1 18
81.0	2 21
85.1	1 40
87.3	1 49
98.8	1 37
99.3	1 42
4204.2	2 2
06.7	1 41
08.7	1 37
10.5	1 37
15.6	2 6
17.7	1 47
19.5	1 49
22.4	1 19
4225.7	1° 51′
31.2	1 30
33.7	1 50
39.0	1 41
40.0	1 46
46.3	1 49
47.0	1 35
50.3	1 19
51.0	1 41
54.5	1 26
82.6	1 57
93.3	2 13
94.3	2 20
4318.8	1 55

Mean $\varphi = 1° 45'.0$

λ	φ_0
4191.6	1° 49′
4204.5	1 47
10.5	1 45
19.5	1 46
22.4	1 47
33.7	1 50
39.0	1 53
47.7	1 47
82.6	1 47
94.3	1 51
99.4	1 48
4315.2	1 53

Mean $\varphi_0 = 1° 48'.6$

$\varphi_0 - \varphi = +0 \quad 3.6$

March 19, Plate 822.

Slit at an angle of 45° to terminator; camera above. Excellent plate.

λ	φ
4199.3	1° 22′
4204.2	1 34
05.7	1 41
06.7	1 42
10.5	1 27
12.1	1 37
15.6	1 34
19.5	1 27
20.5	1 34
22.4	1 50
31.3	1 27
38.3	1 36
39.0	1 34
45.4	1 56
47.0	1 26
47.7	1 36
50.3	1 56
51.0	1 36
75.0	1 35
85.6	1 28
94.3	1 36
98.3	1 32
4301.3	1 28
15.2	1 29
18.8	1 40

Mean $\varphi = 1° 35'.3$

λ	φ_0
4210.5	1° 34′
19.5	1 32
22.4	1 35
27.5	1 31
33.7	1 31
36.7	1 33
47.7	1 32
82.6	1 32
94.3	1 31
99.4	1 33
4315.2	1 32

Mean $\varphi_0 = 1° 32'.4$

$\varphi_0 - \varphi = -0 \quad 2.9$

March 19, Plate 823.

Slit at an angle of 45° to terminator; camera above. Excellent plate.

λ	φ
4199.3	1° 54′
4200.2	1 46
04.2	2 1
05.7	1 59
10.5	1 50
15.6	1 35
19.5	1 34

λ	φ_0
4210.5	1° 38′
19.5	1 39
22.4	1 39
33.7	1 39
36.0	1 38
51.0	1 42
82.6	1 41

λ	φ
4222.4	2° 2'
23.7	1 18
24.4	1 37
24.7	1 49
31.3	1 42
33.7	1 37
38.3	1 43
39.0	1 26
45.4	1 23
46.3	1 39
47.0	1 44
47.7	1 43
50.3	1 40
51.0	1 17
54.5	2 4
85.6	1 16
94.3	1 18
4315.2	1 5
25.3	1 40

Mean φ = 1° 38'.5

λ	φ_0
4294.3	1° 36'
99.4	1 39
4315.2	1 41

Mean φ_0 = 1° 39'.2

$\varphi_0 - \varphi$ = +0 0.7

March 19, Plate 824.

Slit at an angle of 45° to terminator; camera below.

λ	φ
4179.6	2° 33'
81.0	1 32
85.1	1 56
87.3	1 59
96.4	2 5
98.8	1 57
99.3	1 48
4200.2	1 51
04.2	1 59
06.7	2 23
10.5	1 46
15.6	2 23
19.5	2 1
22.4	1 47
25.0	1 51
31.2	1 32
39.0	1 45
40.0	1 30
45.4	1 43
47.0	1 40
4247.7	1° 43'
51.0	1 46
54.5	2 9
92.3	2 6
93.3	2 0
94.3	1 45
98.3	1 30
4318.8	2 28
25.3	1 33

Mean φ = 1° 53'.8

λ	φ_0
4185.1	1° 52'
91.6	1 56
4204.2	1 50
10.5	1 54
19.5	1 55
22.4	1 54
33.7	1 55
47.7	1 54
82.6	1 53
94.3	1 52
99.4	1 53
4395.2	1 58

Mean φ_0 = 1° 53'.8

$\varphi_0 - \varphi$ = 0 0.0

March 19, Plate 825.

Slit at an angle of 45° to terminator; camera below.

λ	φ
4176.7	1° 16'
77.7	1 31
79.6	1 36
81.0	1 29
85.1	1 39
87.3	1 45
99.3	1 1
4204.2	1 35
06.7	1 18
10.5	1 12
11.2	1 24
15.5	1 32
19.5	1 23
22.4	1 28
23.7	1 2
33.4	1 25
33.7	1 6
39.0	1 10
45.0	1 25
47.0	1 13
47.7	1 30
50.3	1 9
51.0	1 23
54.5	1 43
75.0	1 22
93.3	1 10
94.3	1 23
4315.2	1 15

Mean φ = 1° 22'.3

λ	φ_0
4181.0	1° 25'
91.6	1 23
4204.2	1 29
10.5	1 24
19.5	1 23
22.4	1 28
33.7	1 28
47.7	1 29
82.6	1 26
94.3	1 22
99.4	1 22
4315.2	1 25

Mean φ_0 = 1° 25'.3

$\varphi_0 - \varphi$ = +0 3.0

The results of the measures are here tabulated for convenience of reference:

Tabular View of Measurements and Reductions.

φ_0 = Reading of protractor for comparison lines
φ = » » » » planetary »
$\varphi_0 - \varphi = \Delta\varphi$

v_s = spectroscopic Velocity in kilometers per sec.
v = true » » » » »

1903	Number of Plate	Mean φ_0	Mean φ	$\varphi_0 - \varphi$	Position of slit to terminator	Position of camera	v_s Direct (+) Retrogr. (−)	$\frac{v_s}{K} = v$
Febr. 23	765	1° 47'.3	1° 52'.1	−4'.8	parallel	—	(−)0.45	(−)0.12
23	766	2 50.5	2 50.6	−0.1	perpend.	below	+ 0.01	+ 0.00
25	775	1 6.6	1 3.0	+3.6	»	above	+ 0.34	+ 0.09
26	780	1 8.0	1 7.9	+0.1	»	»	+ 0.01	+ 0.00

1903	Number of Plate	Mean φ_0	Mean φ	$\varphi_0 - \varphi$	Position of slit to terminator	of camera	v_s Direct (+) Retrogr. (−)	$\frac{v_s}{K} = v$
Febr. 26	781	1° 11'.4	1° 9'.9	+1'.5	parallel	to right	(+)0.14	(+)0.04
27	783	1 9.9	1 10.9	−1.0	»	»	(−)0.09	(−)0.02
Mar. 2	789	2 22.3	2 17.7	−4.6*	perpend.	above	−0.43	−0.12
2	790	1 37.5	1 37.7	−0.2	»	below	+0.02	+0.01
2	791	1 16.2	1 13.3	+2.9	parallel	to right	(+)0.27	(+)0.07
6	792	1 39.9	1 43.7	−3.8	perpend.	above	−0.36	−0.10
6	793	1 47.2	1 44.5	+2.7	parallel	to right	(+)0.26	(+)0.07
6	794	1 24.8	1 23.5	+1.3	perpend.	below	−0.12	−0.03
9	803	1 16.4	1 15.8	+0.6	»	»	−0.06	−0.02
9	804	2 7.0	2 6.1	+0.9	»	»	−0.09	−0.02
10	809	1 40.4	1 40.6	−0.2	parallel	to right	(−)0.02	(−)0.01
11	811	0 52.5	0 53.0	−0.5	perpend.	above	−0.05	−0.01
11	815	2 2.3	2 1.7	+0.6	»	below	−0.06	−0.02
12	818	1 45.0	1 42.5	+2.5	parallel	to right	(+)0.24	(+)0.06
12	819	1 25.4	1 25.3	+0.1	perpend.	below	−0.01	−0.00
12	821	1 48.6	1 45.0	+3.6	»	above	+0.34	+0.09
19	822	1 32.4	1 35.3	−2.9	angle 45°	»	(−)0.27	(−)0.07
19	823	1 39.2	1 38.5	+0.7	»	»	(+)0.07	(+)0.02
19	824	1 53.8	1 53.8	0.0	»	below	(±)0.00	(±)0.00
19	825	1 25.3	1 22.3	+3.0	»	»	(+)0.28	(+)0.08

* See notes on measurements.

Slit perpendicular to terminator, camera above, $\Delta\varphi_m = -0°0'.27 \pm 0'.96$

» » » » » below, » $= +0\ 0.46 \pm 0.14$

» parallel » » » to the right, » $= +0\ 0.51 \pm 0.71$.

To make clear the value of $\Delta\varphi$ in terms of velocity in the line of sight and of the planet's limb I have added columns 8 and 9. A glance at the table will show that the errors of observation were small and that there is no evidence of a short rotation period for the planet. A rotation period of twenty-four hours would incline the planetary lines one-third of a degree, a quantity quite large in comparison with the errors of observation. I am at present unable to state definitely how small a rotation velocity might be detected with this instrument. In the case of Venus where there is great intensity of light, permitting the use of plates of fine grain, it should be small. This is a point which I hope soon to investigate.

Lowell Observatory, 1903 March 28. *V. M. Slipher.*

Photometrische Beobachtung der Mondfinsternis 1903 April 11.

Von Dr. *H. Clemens.*

Um die relativen Helligkeiten der einzelnen Phasen der Finsternis zu messen, benutzte ich ein Webersches Milchglasplattenphotometer, das mir in liebenswürdigster Weise von der Firma Schmidt u. Hänsch in Berlin zur Verfügung gestellt worden war. Die Konstruktion darf als bekannt vorausgesetzt werden. Die Vergleichung der beiden vom Monde resp. von der Vergleichsflamme, einer Benzinflamme von 20 mm Höhe, beleuchteten Scheiben erfolgte mittelst eines Lummer-Brodhunschen Würfels, die Einstellung geschieht durch Änderung des Abstandes der einen Milchglasplatte von der Benzinflamme. Die Höhe der letzteren stand unter fortlaufender Kontrolle und für jedes Zehntelmillimeter ihrer sich in sehr engen Grenzen haltenden Abweichung von 20 mm wurde nach Vorschrift von Professor Weber die gemessene Helligkeit um 1 % korrigiert.

Um die Lichtabnahme des Mondes möglichst weit verfolgen zu können, hatte ich die von ihm erleuchtete Milchglasplatte, die dem Apparate beigegeben war, durch eine bedeutend lichtdurchlässigere Scheibe aus gewöhnlichem matten Glase ersetzt. Der sehr auffällige Farbenunterschied zwischen dem Monde und der Vergleichsflamme wurde durch Einschieben eines blauen Glases vor letztere derartig herabgemindert, daß die Schärfe der Einstellung durch ihn nicht mehr beeinträchtigt ward. Bei den Messungen 1 bis 34 und 58 bis 79 war das Mondlicht durch ein Rauchglas gedämpft, dessen Absorptionskoeffizient zu 3.75 bestimmt ist.

Während der größten Phase der Finsternis war die Helligkeit zu gering, um noch gemessen zu werden. Die Luft war sehr rein und durchsichtig, so daß trotz der beträchtlichen Zenitdistanz des Mondes eine ungünstige Beeinflussung durch atmosphärische Verhältnisse, mit Ausnahme der noch näher zu betrachtenden letzten Messungen, ausgeschlossen sein dürfte.

Jede der im folgenden aufgeführten Messungen besteht