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II. *A Memoir on the Latitude of the University at Cambridge : With Observations of the Variation and Dip of the Magnetic Needle.* By SAMUEL WILLIAMS, F. A. A. *Hollis Professor of Mathematics and Natural Philosophy in the University.*

I. **T**HE latitude of Cambridge has generally been supposed to be $42^{\circ} 25'$ north. I cannot find how early, by what observer, or with what instruments it was determined. The earliest observations at Cambridge of which I can find any account, were those of eclipses made by Mr. *Thomas Brattle*, mentioned in *the Philosophical Transactions* for 1704, No. 292. p. 1630. The first of these was of a solar eclipse, June 12, 1694. And he there informs us, that in his calculations, the latitude of *Boston* was allowed to be $42^{\circ} 25'$. This has been universally received as the latitude ever since that time, and probably for many years before. As the ancient instruments belonging to the College were but small, I was desirous to examine this matter with all the accuracy I could. With this view I made the following observations. They were taken in the Philosophy-Chamber in Harvard-Hall, with an astronomical quadrant of two feet and an half radius, made by *Siffons*.

I. The

1. The latitude of the University at Cambridge, computed from observations of the meridian altitude of the sun's upper limb.

Time.	Observation of the meridian altitude of the sun's upper limb.	Refraction.	☉'s Semidiameter.	Parallax.	☉'s Declination South.	Latitude of the University.
1782.						
Oct. 9	41° 24' 30"	1' 15"	16' 5", 0	6"	60 29' 35"	42° 23' 21"
10	41 1 39	1 16	16 5, 3	6	6 52 23	42 23 25,3
11	40 39 3	1 17	16 5, 5	6	7 15 5	42 23 20,5
By a mean of these observations the latitude is						42° 23' 22",3

2. The latitude of the University computed from observations of the meridian altitude of stars near the Equator.

Observations of the meridian altitude of

Time.	♃ In the wing of the Eagle.	♄ In the shoulder of Antinous.	♅ In the hand of Antinous.	♆ In the shoulder of Aquarius.	♇ In the shoulder of Aquarius.	♈ In the Arm of Aquarius.
1782.						
Oct. 9	50° 19' 9"	48° 5' 35"	0 " "	0 / "	0 " "	0 / "
12	50 19 51	48 5 57	46 10 34			
23		48 5 48	46 10 50			
Nov. 1			46 10 33			
3				41 7 8	46 15 45	45 9 35
4				41 6 53	46 15 33	45 9 20
5				41 6 53	46 15 34	45 9 18
Mean,	50 19 30	48 5 46,6	46 10 39	41 6 58	46 15 37,3	45 9 24,3

CALCULATIONS.

♃ in the wing of the Eagle.

Mean of merid. altitudes taken Oct. 9, 12, 1782, 50° 19' 30"

Refraction by De la Caille's tables, — 55

True meridian altitude, 50 18 35

Declin. N. Jan. 1, 1782, by *Connoi. des Temps*, 1782, 2 41 55

Increase

Increase of declination in 9, 5 months,	+	5", 5
Aberration,	+	8, 6
Nutation,	—	8, 6
Apparent declination N. Oct. 11, 1782,		2° 42' 0, 1
Complement of the latitude,		47 36 34, 9
<i>Latitude,</i>		42 23 25, 1

π in the shoulder of *Antinous*,

Mean of merid. altitudes taken Oct. 9, 12, 28, 1782,	48	5	47
Refraction,	—	1	0
True meridian altitude,	48	4	47
Declin. N. Jan. 1, 1782, by <i>Connoi. des Temps</i> , 1782,	0	28	4
Increase of declination in 9, 5 months,	+	6, 7	
Aberration,	+	7, 5	
Nutation,	—	8, 3	
Apparent declination N. Oct. 16, 1782,		0 28	9, 9
Complement of the latitude,		47 36	37, 1
<i>Latitude,</i>		42 23	22, 9

θ in the hand of *Antinous*.

Mean of meridian altitudes taken Oct. 12, 23,	}	46	10	39
and November 1, 1782,				
Refraction,	—	1	4	
True meridian altitude,	46	9	35	
Declin. S. Jan. 1, 1782, by <i>Connoi. des Temps</i> , 1782,	1	26	57	
Decrease of declination in 9, 5 months,	—	7, 8		
Aberration,	—	6, 3		
Nutation,	+	8, 0		
Apparent declination S. Oct. 22, 1782,		1 26	50, 9	
Complement of the latitude,		47 36	25, 9	
<i>Latitude,</i>		42 23	34, 1	

β in

β in the shoulder of *Aquarius*.

Mean of merid. altitudes taken Nov. 3, 4, 5, 1782,	41° 6' 58" "
Refraction,	— 1 16
True meridian altitude,	41 5 42
Declin. S. Jan. 1, 1782, by <i>Connoi. des Temps</i> , 1782,	6 30 59
Decrease of declination in 10 months,	— 12, 5
Abberation,	— 3, 5
Nutation,	+ 6, 3
Apparent declination S. Nov. 4, 1782,	6 30 49, 3
Complement of the latitude,	47 36 31, 3
<i>Latitude</i> ,	42 23 28, 7

α in the shoulder of *Aquarius*.

Mean of merid. altitudes taken Nov. 3, 4, 5, 1782,	46 15 37
Refraction,	— 1 4
True meridian altitude,	46 14 33
Declin. S. Jan. 1, 1782, by <i>Connoi. des Temps</i> , 1782,	1 22 5
Decrease of declination in 10 months,	— 14, 3
Aberration,	— 5, 4
Nutation,	+ 5, 2
Apparent declination S. Nov. 4, 1782,	1 21 50, 5
Complement of the latitude,	47 36 23, 5
<i>Latitude</i> ,	42 23 36, 5

γ in the arm of *Aquarius*.

Mean of merid. altitudes taken Nov. 3, 4, 5, 1782,	45 9 24
Refraction,	— 1 6
True meridian altitude,	45 8 18
Declin. S. Jan. 1, 1782, by <i>Connoi. des Temps</i> , 1782,	2 28 33
Decrease of declination in 10 months,	— 14, 8

I

Aberration,

Aberration,	—	5''
Nutation,	+	4, 6
Apparent declination S. Nov. 4, 1782,		2° 28' 17, 8
Complement of the latitude,		47 36 35, 8
<i>Latitude,</i>		42 23 24, 2

The latitude by the meridian altitude of

δ in the <i>Eagle</i> ,	42 23 25, 1
π in <i>Antinous</i> ,	22, 9
θ in <i>Antinous</i> ,	34, 1
β in <i>Aquarius</i> ,	28, 7
α in <i>Aquarius</i> ,	36, 5
γ in <i>Aquarius</i> ,	24, 2

By a mean of these observations the latitude is 42 23 28, 6

3. The latitude of the University computed from observations of the meridian altitude of the pole-star.

Observations of the meridian altitude of the pole-star, below the pole.

1783. May 27	40° 33' 22''
28	40 33 25
29	40 33 35
June 5	40 33 22
<u>Mean altitude,</u>	<u>40 33 26</u>

CALCULATION.

Mean of merid. altitudes taken May 27, 28, 29, } 40 33 26
and June 1, 1783. Below the pole.

Refraction by De la Caille's tables, — 1 17

True meridian altitude, 40 32 9

Declin. N. Jan. 1, 1782, by *Connoi. des Temps*, 1782, 88 8 28

Increase

Increase of declination in one year,	+	19",6
Increase of declination in 5 months,	+	8, 2
Aberration,	—	17, 0
Nutation,	+	2, 5
Apparent declination N. June 1, 1783,		88° 8' 41, 3
Distance from the pole,		1 51 18, 7
Latitude,		42 23 27, 7

From these calculations the latitude computed

1. From observations of the sun, is 42 23 22, 3
2. From observations of six stars near the Equator, 42 23 28, 6
3. From observations of the pole-star, 42 23 27, 7

In making the above observations I found it much easier to note the bisection of a star by the wire of the telescope, than to determine exactly the point of contact between the limb of the sun and the wire. On this account I esteem the observations of the meridian altitude of the stars more accurate than those of the sun: And therefore fix upon the mean of all the *sidereal observations* as the true

Latitude of Harvard-Hall at Cambridge, 42° 23' 28", 46

A R E M A R K.

The preceding observations will serve to determine the accuracy of the quadrant, as well as the latitude of the place. For this purpose I shall select the observations which were made on β in the shoulder of *Aquarius*, and those of the pole star.

Apparent declination of β S.		6° 30' 49,"3
Apparent declin. of the pole-star N.	88° 8' 41,"3	} 91 51 18, 7
Distance from the pole.	1 51 18, 7	
Below the pole at the time of observ.	1 51 18, 7	

True meridian altitude of β ,	41° 5' 42"
True meridian altitude of the pole-star,	40 32 9
Sum of the declinations and altitudes,	179 59 59

Hence it appears, that the sum of all the errors in the assumed declinations of these two stars, in the refraction, quadrant, and mean altitudes, do not amount to more than one second. It may therefore be presumed that the quadrant, observations, and elements of the calculations are very exact. The reason why the observations on β in *Aquarius* were chosen to examine the quadrant by, was because they are nearer the mean latitude than those of any other star, and therefore may be presumed to be the most correct.

II. Observations of the variation and dip of the magnetic needle, at the University in Cambridge.

Time.	Variation.	Dip.	Observer.
Year. Mon. D. H.	° ' W	° ' ,	
1708,	9 0 W		Mr. Brattle,
1742,	8 0 W		Dr. Winthorp.
1757,	7 20 W		Dr. Winthorp.
1761, Feb. 25,	7 14 W		Mr. Williams.
1763,	7 0 W		Dr. Winthorp.
1780, Dec. 25, 1, P. M.	7 2 W	69 51	Mr. Williams.
1782, June 21, 4, P. M.	6 46 W	69 41	Mr. Williams.
1783, Dec. 23, 3, P. M.	6 52 W	69 41	Mr. Williams.

In the year 1782, Professor Sewall observed the diurnal variation of the magnetic needle during several months. At the

the same time I observed the diurnal alterations in the dipping needle. These observations are too numerous to be inserted here. In general, there is a remarkable regularity in the observations taken by the variation needle. The variation generally increases from seven or eight o'clock, A. M. till about two or three, P. M. From this time it generally decreases until seven or eight the next morning. The inclination or dip is subject to rather greater diurnal alterations than the variation; but they do not seem to be so regular in their changes. The least inclination I have ever observed was $68^{\circ} 21'$; the greatest $70^{\circ} 56'$.

