

APPENDIX.

D I A G R A M S

REPRESENTING THE

DIURNAL CHANGE IN MAGNITUDE AND DIRECTION

OF THE

MAGNETIC FORCES IN THE HORIZONTAL PLANE,

AT THE ROYAL OBSERVATORY, GREENWICH,

FOR EACH MONTH OF THE SEVERAL YEARS,

1841 to 1876,

BY

SIR G. B. AIRY, K.C.B., LATE ASTRONOMER ROYAL.

GREENWICH OBSERVATIONS, 1884.

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RESULTS DEDUCED FROM THE MEASURES OF TERRESTRIAL MAGNETIC FORCE IN THE HORIZONTAL PLANE, AT THE ROYAL OBSERVATORY, GREENWICH, FROM 1841 TO 1876.

By SIR G. B. AIRY, K.C.B., late Astronomer Royal.

I THINK it desirable to premise a short statement on the origin of the Magnetic Department of the Royal Observatory, and on the successive steps in its constitution.

It appears to have been recognized many years ago that magnetic determinations would form a proper part of the business of the Royal Observatory. When I commenced residence at the Royal Observatory, at the end of 1835, I found in the garden a small wooden building, evidently intended for the examination of compasses, perhaps of the size of those used in the Royal Navy. But the locality was inconvenient, and the structure was totally unfit for any delicate magnetic purposes. For some preliminary experiments, a small observatory was borrowed from Captain Fitzroy, R.N. But no real progress was made in magnetism.

In the beginning of 1836, I brought before the Board of Visitors a scheme for the erection of a Magnetical Observatory. The Board approved the plan, and recommended it favourably to the Admiralty. The Government Department superintending the Park gave their consent to an extension of the grounds of the Observatory, and the additional ground was inclosed in 1837. The Magnetic Observatory was built, from my plans, in the spring of 1838. Since that time, no essential alteration has been made in the building, except in 1864, when the ground below the three arms, East, West, and South, was excavated, in order to obtain positions for the three fundamental instruments, in which the severity of the temperature changes would be much diminished. Small accidental interruptions of observation occurred in 1847 January and 1861 July.

The observations before 1848 were made entirely by eye, employing magnets 2 feet in length. That for declination carried a collimator, permitting observation by the telescope of a theodolite; those for horizontal and vertical force were furnished each with a small plane reflector, to which telescopes being directed, the divisions of a fixed scale were thereby observed. The observations were made at every two hours, day and night; proper precautions were taken for assurance of the general accuracy of the times of observation; and I do not doubt that the results interpreted from these observations are each as good as those derived from the succeeding system. But the labour was great, and (as measured by the interruption of assistants' work) was expensive.

The idea of self-registration, by photography, of the movements of the instruments, (an idea little entertained before that time) then suggested itself; and, at the Cambridge Meeting of the British Association in 1845, it was proposed by me for

consideration of the Council of that body, that the Government should be requested to promote, by offer of a pecuniary reward, the construction of a photographic self-registering instrument. This proposal was adopted by the Council, letters were addressed by Sir John Herschel, President of the Association, to Her Majesty's Treasury, and by myself to the Admiralty; and, finally, the assistance of Dr. Charles Brooke was secured for forming an efficient apparatus and making the necessary chemical arrangements adapted to our wants. The registers made by use of Dr. Brooke's apparatus commenced with the year 1848.

I do not propose here to describe the photographic recording apparatus. Allusions to the construction will be found in the Introductions to the Greenwich Observations for successive years, and especially, and in great detail, in the Introduction to the Volume for 1847. The only alteration that was made in it for several years is the following. Dr. Brooke had conceived that advantage would be gained by causing the recording barrel to revolve in 12 hours. But this caused a doubling of the curves traced on the photographic paper which is wrapped upon the barrel; and the inconvenience presented by this doubling was soon found to be so great that I thought it necessary to alter the clock-work so as to produce a revolution of the barrel in 24 hours. The records of the Change of Western Declination from the North, and of the Change of Horizontal Force, are made on the same barrel; and by alterations, first suggested by myself and carried out in 1880 by the present Astronomer Royal (then Chief Assistant), the two curves are now so traced that the simultaneous records of the two instruments, at all times, are in close juxtaposition.

While the observations were made by eye, at every two hours, the diurnal mean of the two-hourly readings was adopted as base for the day, and the excess of each two-hourly reading above the mean was adopted as "magnetic inequality" of that ordinate for that hour; producing 12 measures of "inequality" for that day. When the photographic system was introduced, a pencil curve was drawn so as to cut off the petty irregularities of the photographic trace, and the elevation of the points of that pencil curve above a photographic base was measured for every hour, producing 24 measures of "inequality."

In the instances of excessive and rapid disturbances of the magnets during magnetic storms, no measures of ordinates on that day were taken for the present purposes.

Thus the daily measures at each two hours or hour were obtained.

The next step was, to collect, for each month, all daily measures on corresponding hours through each month, and to take their mean. These are the measures for the hours which are actually treated in the present memoir. By combining (for each month) the inequality of Magnetic Horizontal Force at every two hours or at every hour, as abscissa, with the inequality of Magnetic Declination (on the same scale of measure) at the same two hours or hour, as ordinate,—points were defined in every

Monthly Curve representing completely the mean diurnal change of magnetism in the horizontal plane for each month. On the recommendation of the Board of Visitors of the Royal Observatory, reduced photographic copies of these curves were prepared under the superintendence of the Astronomer Royal for publication with the volume of Greenwich Observations for 1884. This work, as will be apparent, does not include any consideration of vertical force results.

The form of the curves, and the position of the points on them corresponding to hours of solar time, leave no doubt that the diurnal inequality is due mainly—and, as far as I can judge, entirely—to the radiant heat of the sun ; and, it would seem, not to its heat on the earth generally, but to its heat on points of the earth not very distant from the magnets. In the hot months of the year, the curve, though far from circular, surrounds the central point, in a form which, as viewed from that central point, never crosses itself ; and is, generally speaking, usually symmetrical with regard to E. and W. But in the cold months, the space included in the curve is much smaller, in many cases, probably not one-fifth of what it is in the summer months ; and the curve often crosses itself in the most bizarre fashion, with irregular loops at these crossings. In the summer months there is a certain degree of symmetry ; but here is, constantly, a preponderance on the west side, which leads me to imagine that the magnetic effect of the sun's heat upon the sea is considerably greater than the effect on the land.

To obtain some numerical basis for a Report which, though undoubtedly imperfect, may convey some ideas on this wonderful subject, I have adopted the following course. I have confined myself to the months of June and July as probably the two hottest, and the months of December and January as probably the two coldest. In each of the curves applying to these months, I have laid down a system of rectangular coordinates corresponding to the Greenwich astronomical meridian, and the line at right angles to the meridian (the geographical E. and W.). The extreme North ordinate and the extreme South ordinate were measured, and their sum taken, and interpreted by a scale of measure formed in accordance with the theory of the instruments, and this interpretation forms the "Range of Meridian Force in terms of the Mean Horizontal Force." In the same manner, the "Range of Transversal Force" is measured. As the time of each two-hourly or hourly result is marked on the curve, there is no difficulty in fixing approximately on the Solar Times corresponding to the extreme N. and S. values, and the extreme E. and W. values, mentioned above. These are all the elements of the magnetic record which are included in the subjoined table.

G. B. AIRY,
1885, June 22.

MEAN DAILY RANGE OF HORIZONTAL FORCE in the DIRECTION OF ASTRONOMICAL MERIDIAN.									
Year.	Month.	Range of Meridian Force.	In Göttingen Mean Solar Time.		Month.	Range of Meridian Force.	In Göttingen Mean Solar Time.		
			Approximate Hour of				Approximate Hour of		
			Minimum Meridian Force.	Maximum Meridian Force.			Minimum Meridian Force.	Maximum Meridian Force.	
			h m	h m			h m	h m	
1841	June	'0032	23.50	8. 0	December	'0012	2. 0	18. 0	1841
	July	'0033	23.50	8. 0		'0009	23.50	20. 0	
1842	June	'0022	0. 0	12. 0	January	'0010	0. 0	18. 0	1842
	July	'0028	0. 0	9. 0		'0014	0. 0	18. 0	
1843	June	'0027	23.20	8.30	December	'0011	2. 0	12. 0	1843
	July	'0028	23.50	8. 0		'0013	0. 0	7.30	
1844	June	'0029	23.20	8. 0	January	'0010	0. 0	6. 0	1844
	July	'0030	23.40	8. 0		'0015	0. 0	9. 0	
1845	June	'0025	22.40	8. 0	December	'0011	0.20	19. 0	1845
	July	'0022	23.30	8. 0		'0016	0. 0	8.10	
1846	June	'0030	22.40	7.50	January	Observations interrupted.			1846
	July	'0033	23.10	7.50		'0015	0.40	20. 0	
1847	June	'0026	23.40	8. 0	December	'0023	0.10	18.30	1847
	July	'0032	23.30	8. 0		'0018	0.30	19. 0	
1848	June	'0033	0.30	8. 0	January	'0019	0. 0	19. 0	1848
	July	'0045	0. 0	8. 0		'0013	0. 0	19. 0	
1849	June	'0035	1. 0	7.10	December	'0015	0.10	18. 0	1849
	July	'0036	0. 0	8. 0		'0019	23.40	19. 0	
1850	June	'0028	0. 0	19. 0	January	'0021	1. 0	19. 0	1850
	July	'0026	23.50	8. 0		'0015	4.50	18. 0	
1851	June	'0027	0. 0	8. 0	December	'0021	1.10	20. 0	1851
	July	'0026	0. 0	9. 0		'0017	2. 0	18.30	
1852	June	'0020	0.15	18.10	January				1852
	July	'0028	1. 0	17.40					
Göttingen Mean Solar Time is greater by 40 ^m . than Greenwich Mean Solar Time for the same instant.									

Göttingen Mean Solar Time is greater by 40". than Greenwich Mean Solar Time for the same instant.

MEAN DAILY RANGE OF HORIZONTAL FORCE in the DIRECTION TRANSVERSAL to the ASTRONOMICAL MERIDIAN.									
Month.	Range of Transversal Force.	In Göttingen Mean Solar Time.		Month.	Range of Transversal Force.	In Göttingen Mean Solar Time.		Year.	
		Approximate Hour of				Approximate Hour of			
		Maximum Easterly Force.	Maximum Westerly Force.			Maximum Easterly Force.	Maximum Westerly Force.		
		h m	h m			h m	h m		
June	'0036	20. 0	2. 0	December	'0016	10. 0	2. 0	1841	
July	'0027	20. 0	3. 0						
June	'0026	20. 10	3. 0	January	'0019	12. 0	1.50	1842	
July	'0029	20. 10	2. 10	December	'0016	10. 0	2. 0		
June	'0035	20. 30	2. 10	January	'0018	12. 0	2. 0	1843	
July	'0036	20. 20	2. 30	December	'0014	10. 0	2. 0		
June	'0033	20. 0	2. 15	January	'0016	14. 0	1.50	1844	
July	'0029	20. 0	2. 0	December	'0014	12. 0	2. 10		
June	'0032	20. 0	2. 20	January	'0020	14. 0	1.50	1845	
July	'0036	20. 0	2. 40	December	'0015	10. 0	2. 0		
June	'0038	20. 0	2. 10	January	'0018	10. 20	1.50	1846	
July	'0038	20. 20	3. 0	December	'0015	12. 0	2. 0		
June	'0034	19. 50	3. 30	January	Observations interrupted.			1847	
July	'0038	19. 30	2. 20	December	'0026	14. 0	2. 0		
June	'0037	20. 30	2. 10	January	'0028	10. 0	2. 20	1848	
July	'0041	20. 50	2. 20	December	'0019	13. 20	2. 0		
June	'0041	20. 0	3. 0	January	'0022	11. 0	2. 0	1849	
July	'0039	20. 20	2. 40	December	'0015	12. 0	1. 30		
June	'0034	20. 0	2. 0	January	'0022	10. 40	2. 30	1850	
July	'0034	20. 30	2. 0	December	'0012	9. 0	1. 0		
June	'0027	20. 20	2. 50	January	'0015	10. 0	2. 0	1851	
July	'0029	20. 40	2. 10	December	'0017	9. 40	1. 0		
June	'0028	21. 0	2. 0	January	'0015	11. 0	2. 0	1852	
July	'0022	21. 0	2. 10	December	'0015	9. 40	2. 10		
Göttingen Mean Solar Time is greater by 40", than Greenwich Mean Solar Time for the same instant.									

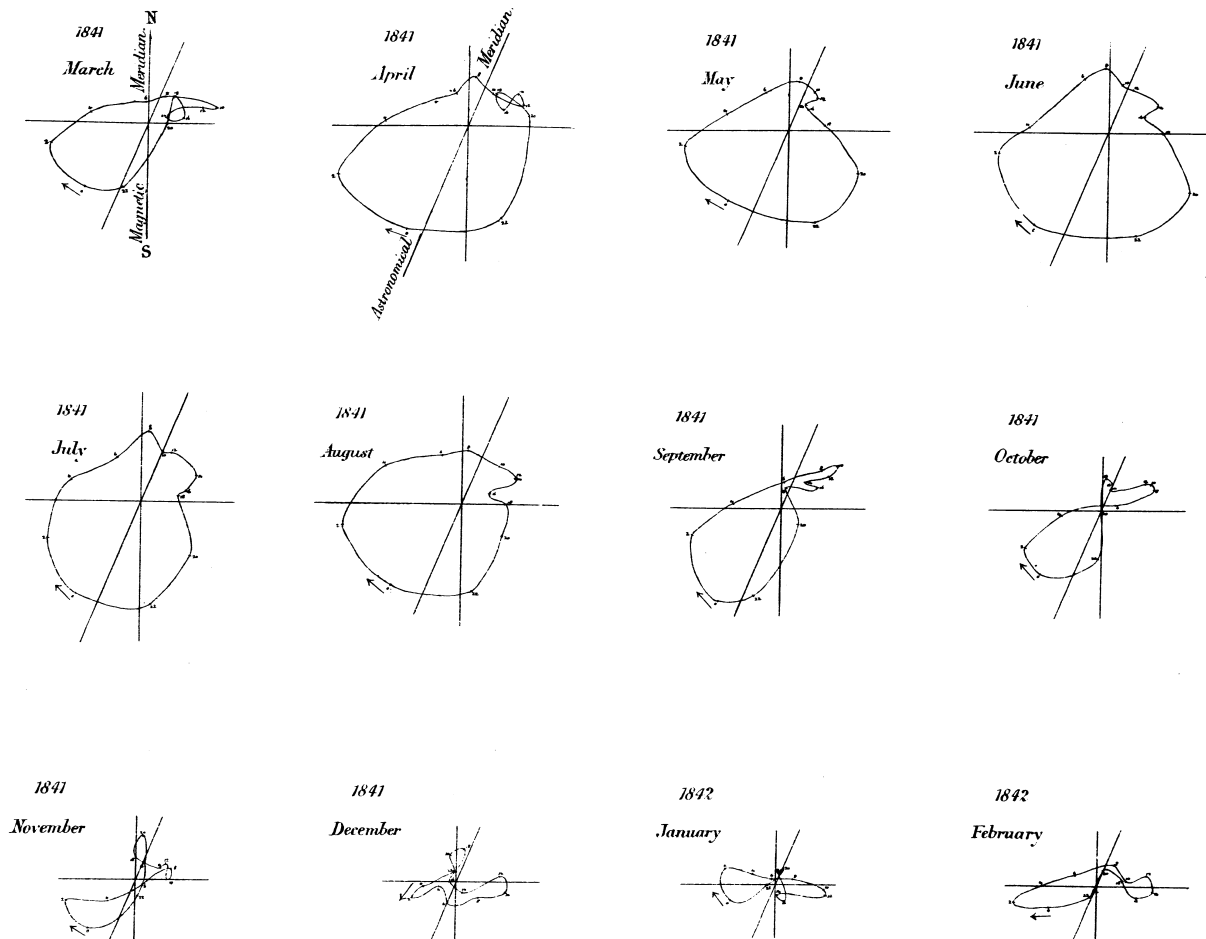
Göttingen Mean Solar Time is greater by 40". than Greenwich Mean Solar Time for the same instant.

MEAN DAILY RANGE OF HORIZONTAL FORCE in the DIRECTION OF ASTRONOMICAL MERIDIAN—concluded.									
Year.	Month.	Range of Meridian Force.	In Greenwich Mean Solar Time.		Month.	Range of Meridian Force.	In Greenwich Mean Solar Time.		
			Approximate Hour of Minimum Meridian Force.	Maximum Meridian Force.			Approximate Hour of Minimum Meridian Force.	Maximum Meridian Force.	
			h m	h m			h m	h m	
1865	June	*0035	23.30	11.0	January	No available result.			
	July	*0024	22.10	7.0	December	*0009	23.10	18.0	
1866	June	*0020	0.0	7.30	January	*0011	0.0	19.0	
	July	*0022	22.10	7.0	December	*0008	23.0	18.0	
1867	June	*0034	23.0	7.0	January	*0010	23.20	8.0	
	July	*0022	23.0	9.0	December	*0009	23.0	18.0	
1868	June	*0025	23.0	7.0	January	*0007	0.0	19.0	
	July	*0026	0.0	8.0	December	*0010	23.20	18.0	
1869	June	*0036	23.0	7.0	January	*0014	23.50	19.0	
	July	*0033	22.30	7.0	December	*0012	23.0	17.0	
1870	June	*0041	23.0	7.0	January	*0016	23.40	17.0	
	July	*0037	23.0	7.0	December	*0017	0.30	18.0	
1871	June	*0035	0.0	7.0	January	*0019	0.0	11.0	
	July	*0036	23.40	7.0	December	*0017	23.30	18.0	
1872	June	*0037	23.0	7.0	January	*0017	0.0	18.0	
	July	*0031	0.10	7.0	December	*0010	0.0	18.0	
1873	June	*0027	23.30	7.10	January	*0017	0.0	18.0	
	July	*0031	22.30	6.50	December	*0008	23.20	17.30	
1874	June	*0024	23.0	6.20	January	*0011	0.0	18.0	
	July	*0023	23.0	7.30	December	*0007	0.0	18.30	
1875	June	*0019	23.0	7.20	January	*0007	23.0	18.30	
	July	*0021	23.0	7.30	December	*0008	23.20	20.0	
1876	June	*0018	22.30	8.0	January	*0009	0.0	19.0	
	July	*0020	23.30	7.0	December	*0006	0.0	19.0	

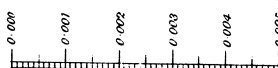
MEAN DAILY RANGE OF HORIZONTAL FORCE in the DIRECTION TRANSVERSAL to the ASTRONOMICAL MERIDIAN—concluded.									
Month.	Range of Transversal Force.	In Greenwich Mean Solar Time.		Month.	Range of Transversal Force.	In Greenwich Mean Solar Time.		Year.	
		Approximate Hour of Maximum Easterly Force.	Maximum Westerly Force.			Approximate Hour of Maximum Easterly Force.	Maximum Westerly Force.		
		h m	h m			h m	h m		
June	*0032	20. 0	2. 0	January	No available result.			1865	
July	*0028	18. 50	2. 0	December	*0015	10. 30	1. 0		
June	*0029	19. 30	2. 30	January	*0019	10. 40	1. 0	1866	
July	*0029	19. 30	2. 10	December	*0013	9. 0	1. 0		
June	*0027	20. 0	1. 40	January	*0013	10. 20	1. 0	1867	
July	*0026	20. 0	2. 0	December	*0012	9. 0	1. 0		
June	*0029	20. 0	2. 0	January	*0016	10. 0	1. 0	1868	
July	*0030	19. 30	2. 0	December	*0017	10. 0	1. 30		
June	*0042	19. 50	2. 10	January	*0018	12. 10	2. 0	1869	
July	*0038	19. 30	2. 30	December	*0015	10. 30	1. 0		
June	*0046	20. 10	2. 10	January	*0020	10. 20	1. 0	1870	
July	*0047	20. 0	2. 10	December	*0017	10. 40	2. 0		
June	*0046	20. 10	2. 20	January	*0021	11. 10	2. 0	1871	
July	*0043	20. 0	2. 30	December	*0019	12. 0	1. 30		
June	*0043	20. 0	2. 0	January	*0023	11. 10	2. 0	1872	
July	*0038	20. 0	2. 10	December	*0022	11. 0	1. 0		
June	*0032	20. 30	2. 50	January	*0026	10. 30	2. 0	1873	
July	*0036	20. 0	2. 20	December	*0017	11. 0	1. 0		
June	*0032	19. 50	2. 0	January	*0021	11. 0	1. 0	1874	
July	*0033	20. 20	2. 0	December	*0012	10. 30	1. 0		
June	*0027	19. 40	2. 0	January	*0014	10. 50	1. 0	1875	
July	*0024	20. 0	2. 10	December	*0012	10. 0	1. 0		
June	*0029	19. 30	2. 20	January	*0014	10. 0	1. 0	1876	
July	*0030	19. 20	2. 0	December	*0012	9. 30	1. 0		

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1841 March to 1842 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time



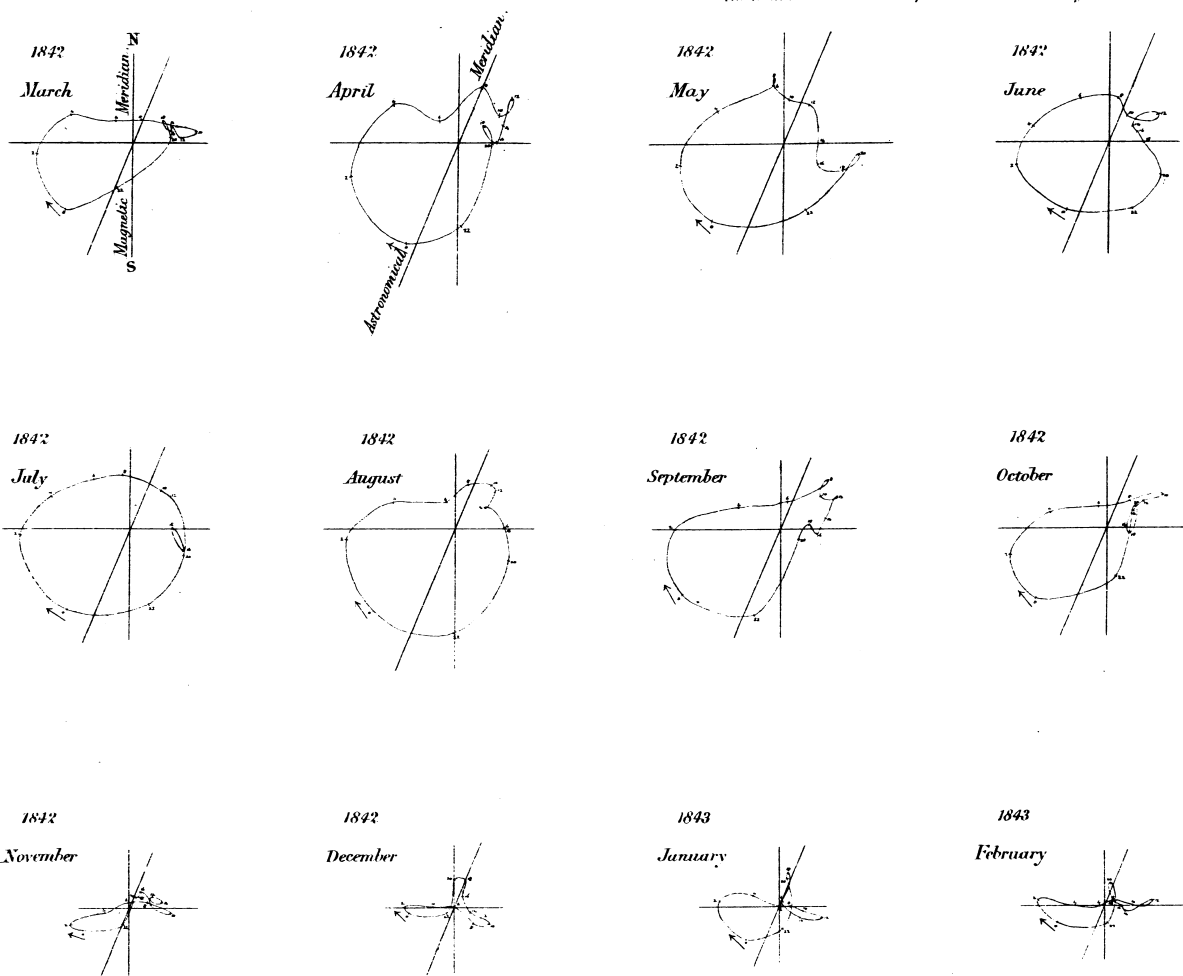
Scale in terms of Mean Horizontal Force.



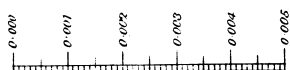
DANGERFIELD LITH. 22 BEDFORD ST. COVENT GARDEN. 8464

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1842 March to 1843 February.

The numbers on the curves represent hours of Göttingen Mean Solar Time.



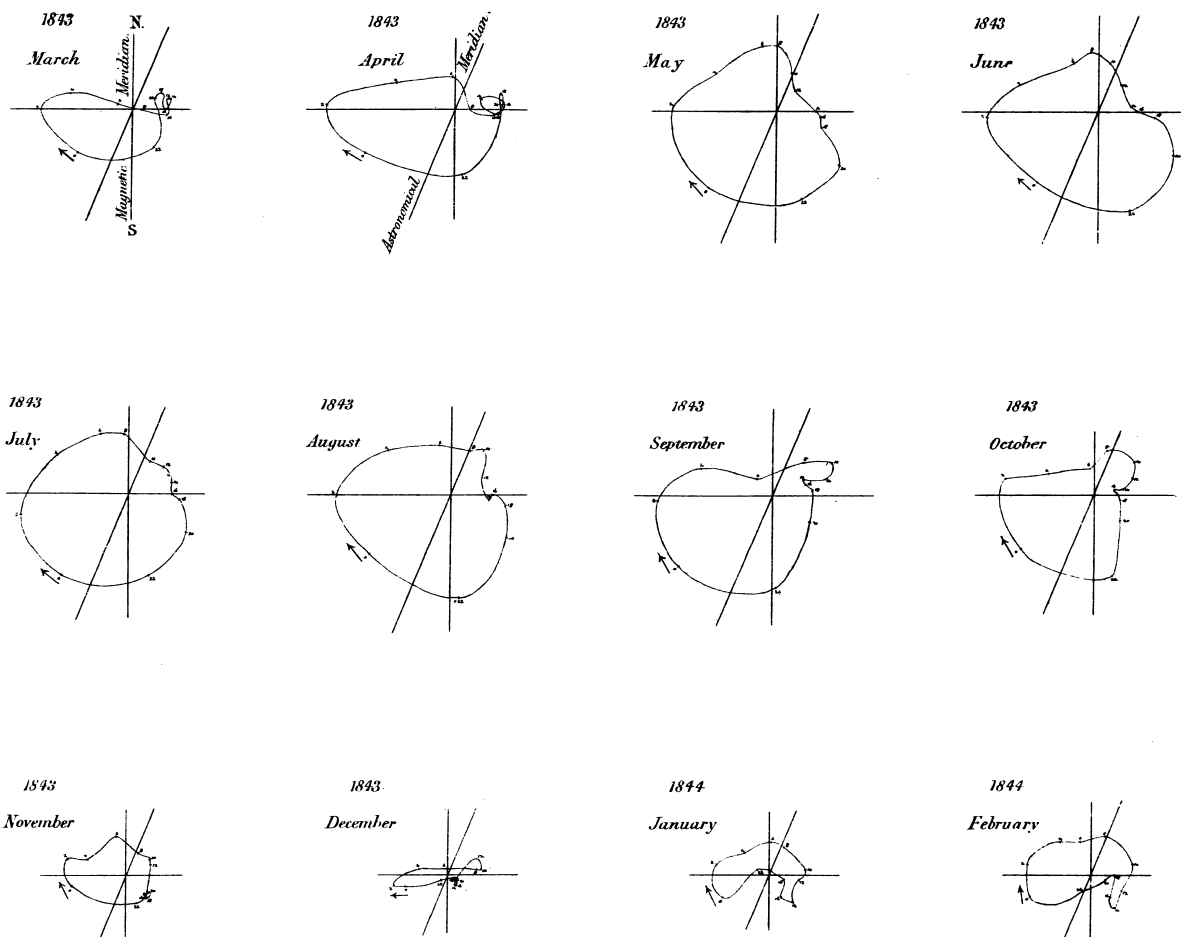
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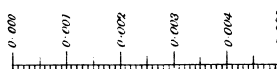
LINGERFIELD LITH. 22 BEDFORD ST COVENT GARDEN 8864

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1843 March to 1844 February.

The numerals on the curves represent hours of Gottingen Mean Solar Time.



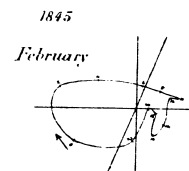
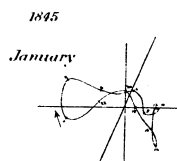
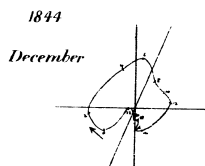
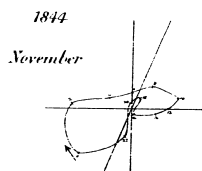
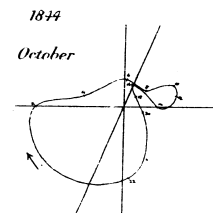
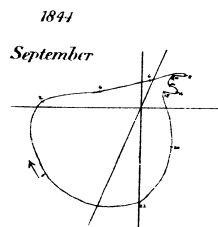
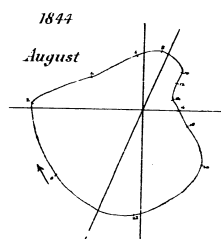
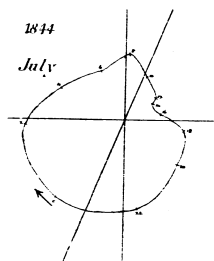
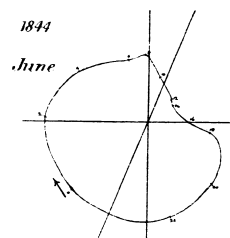
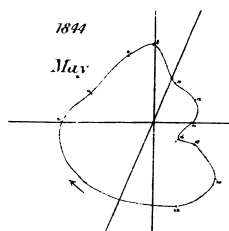
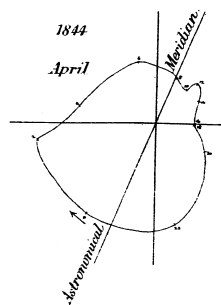
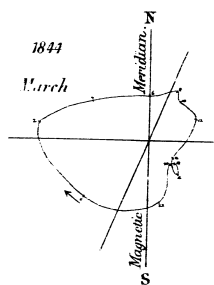
Scale in terms of Mean Horizontal Force.



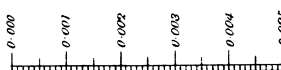
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN. 1844.

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1844 March to 1845 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



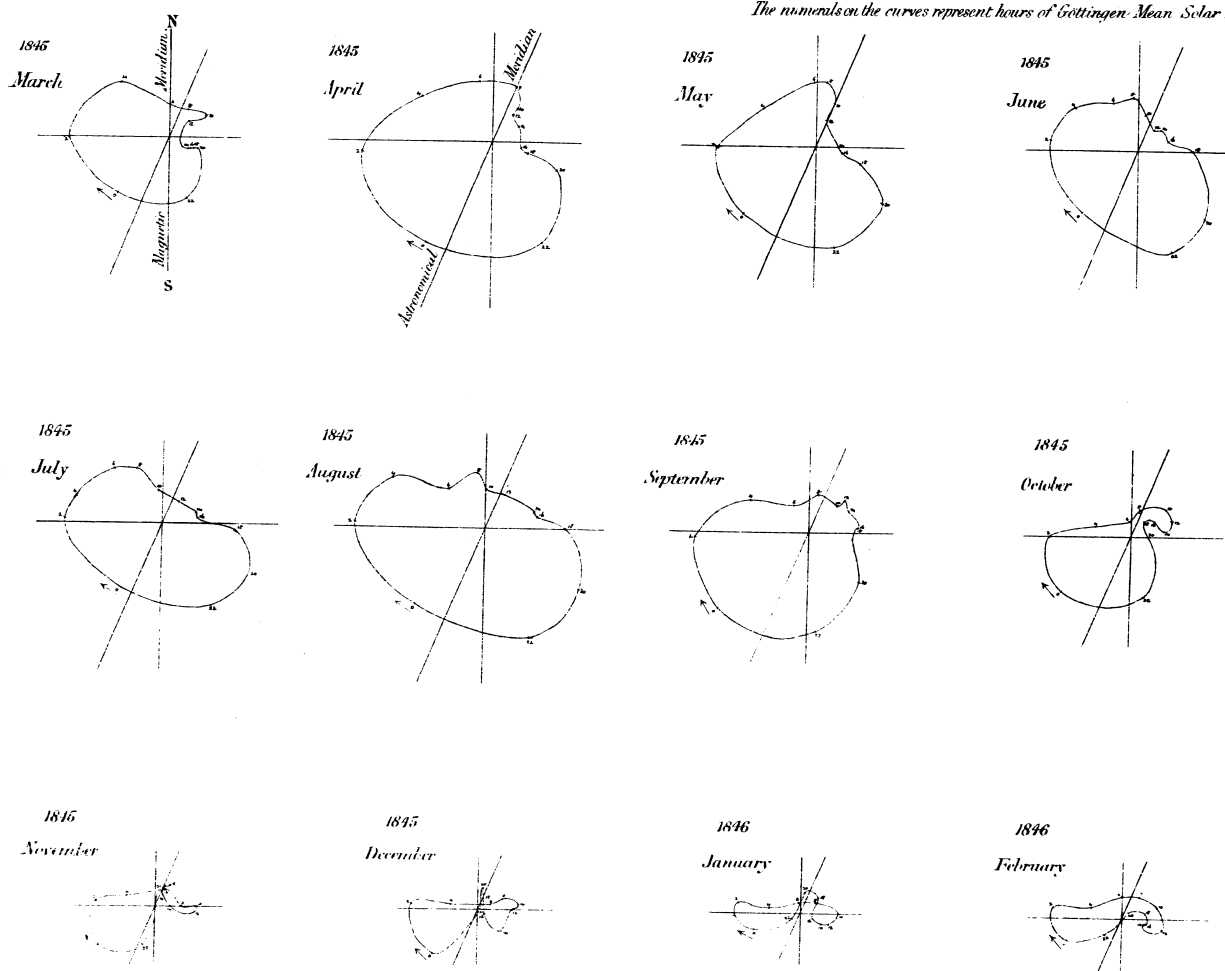
Scale in terms of Mean Horizontal Force.



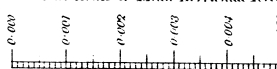
DANCERFIELD LITH 22 BEDFORD ST. LONDON W.C. 1881.

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1845 March to 1846 February.

The numerals on the curves represent hours of Gottingen Mean Solar Time.



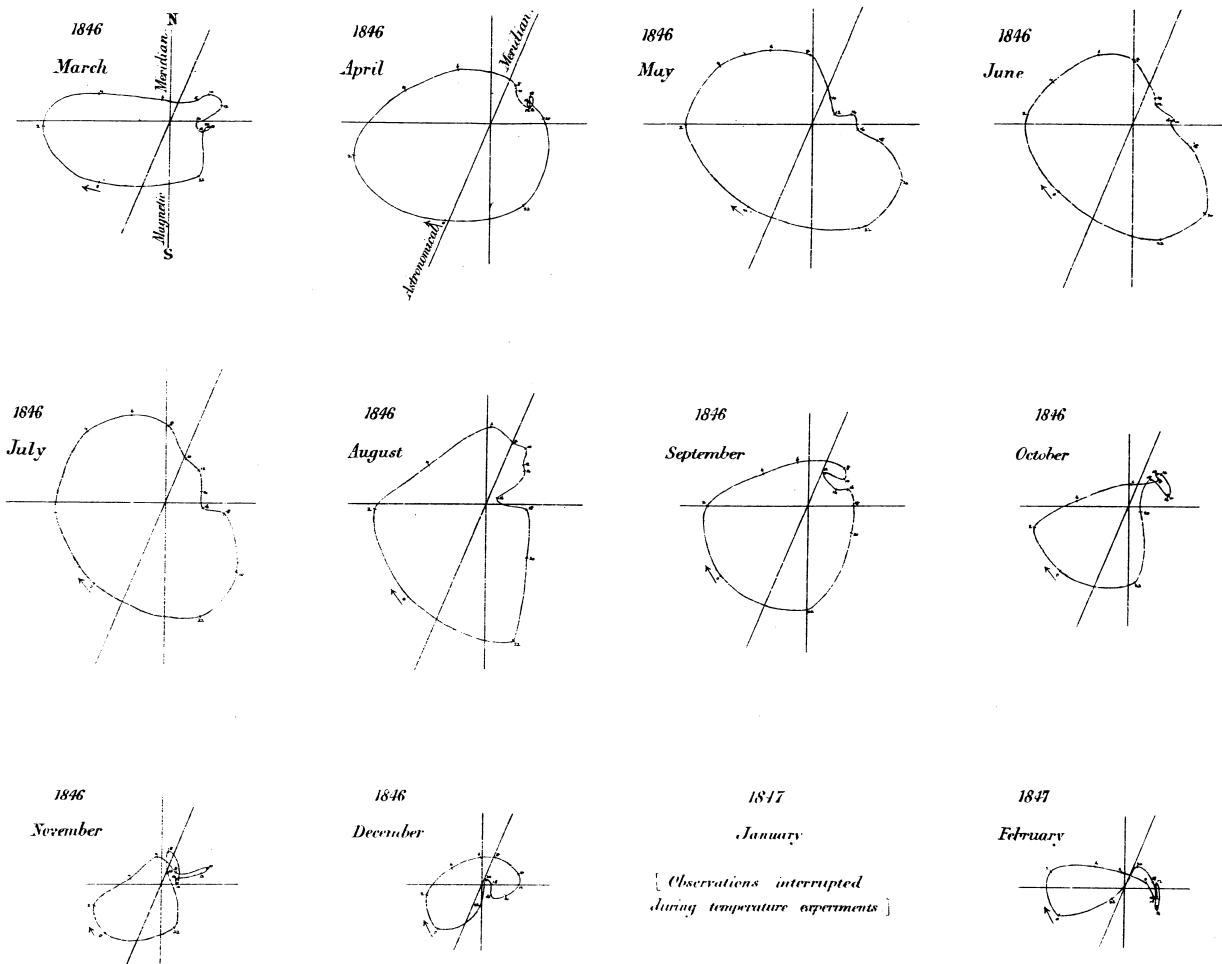
Scale in terms of Mean Horizontal Force.



DANGERFIELD LITH. 22, BEDFORD ST. COVENT GARDEN. 6867

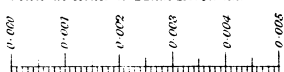
Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1846 March to 1847 February.

The numerals on the curves represent hours of Gottingen Mean Solar Time.



[Observations interrupted during temperature experiments]

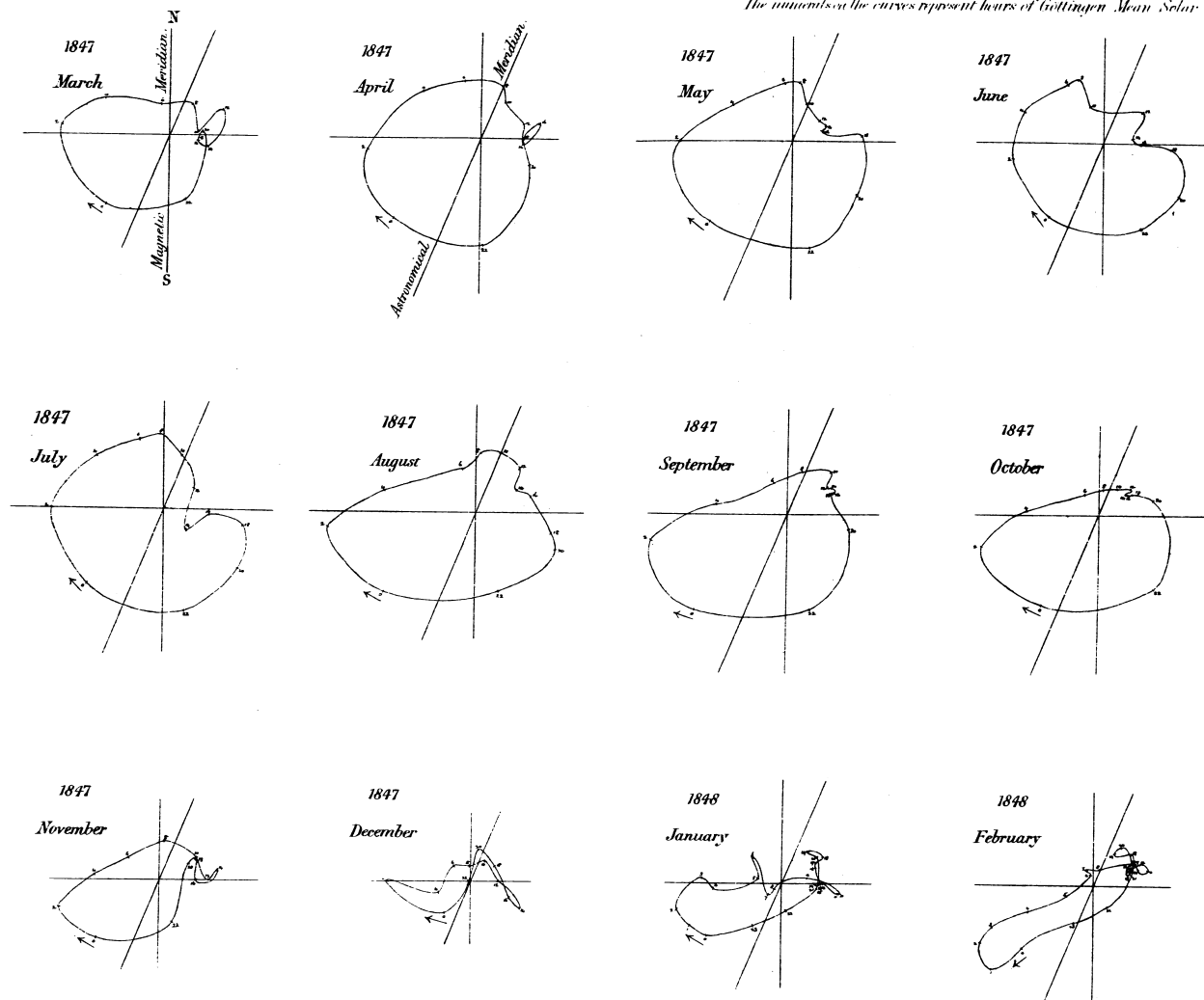
Scale in terms of Mean Horizontal Force.



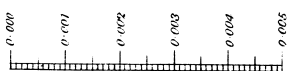
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 4667

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1847 March to 1848 February.

The numbers on the curves represent hours of Göttingen Mean Solar Time.



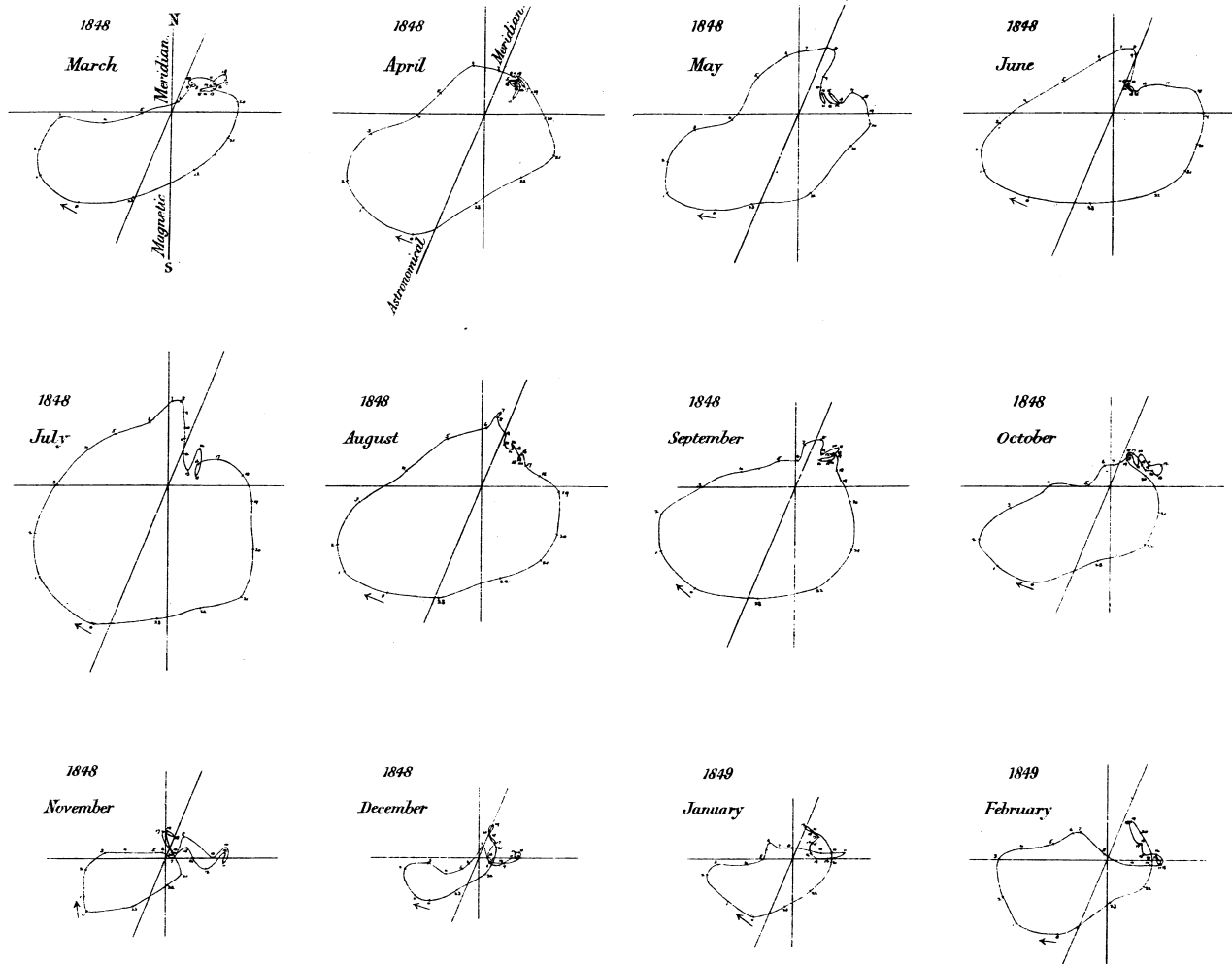
Scale in terms of Mean Horizontal Force.



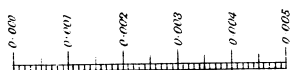
DUNDEFIELD LITH. 22, BEDFORD ST. COVENT GARDEN. 1863

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1848 March to 1849 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



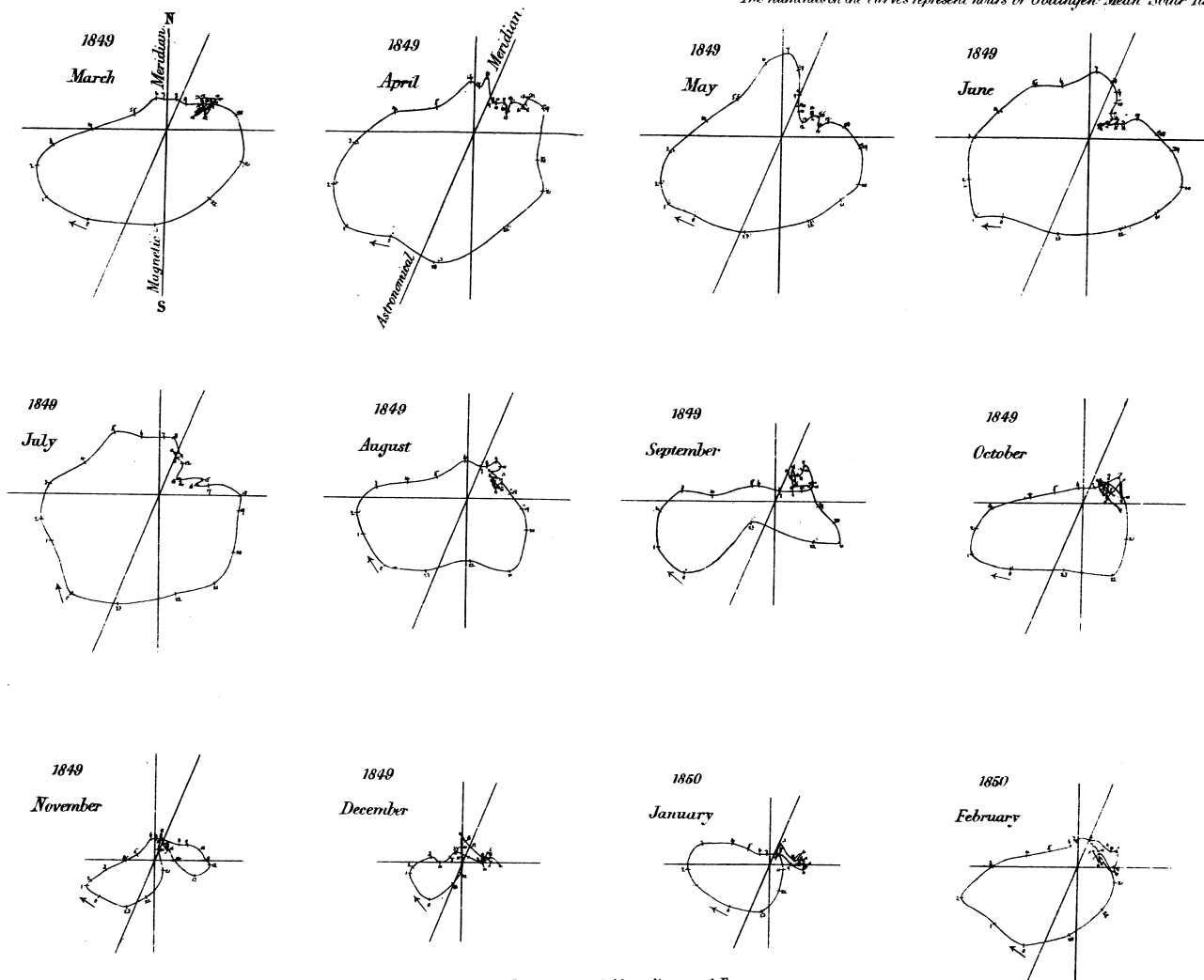
Scale in terms of Mean Horizontal Force



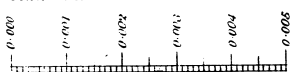
DANCERFIELD LITH 22, BEDFORD ST COVENT GARDEN 1849

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1849 March to 1850 February.

The numerals on the curves represent hours of Gottingen Mean Solar Time.



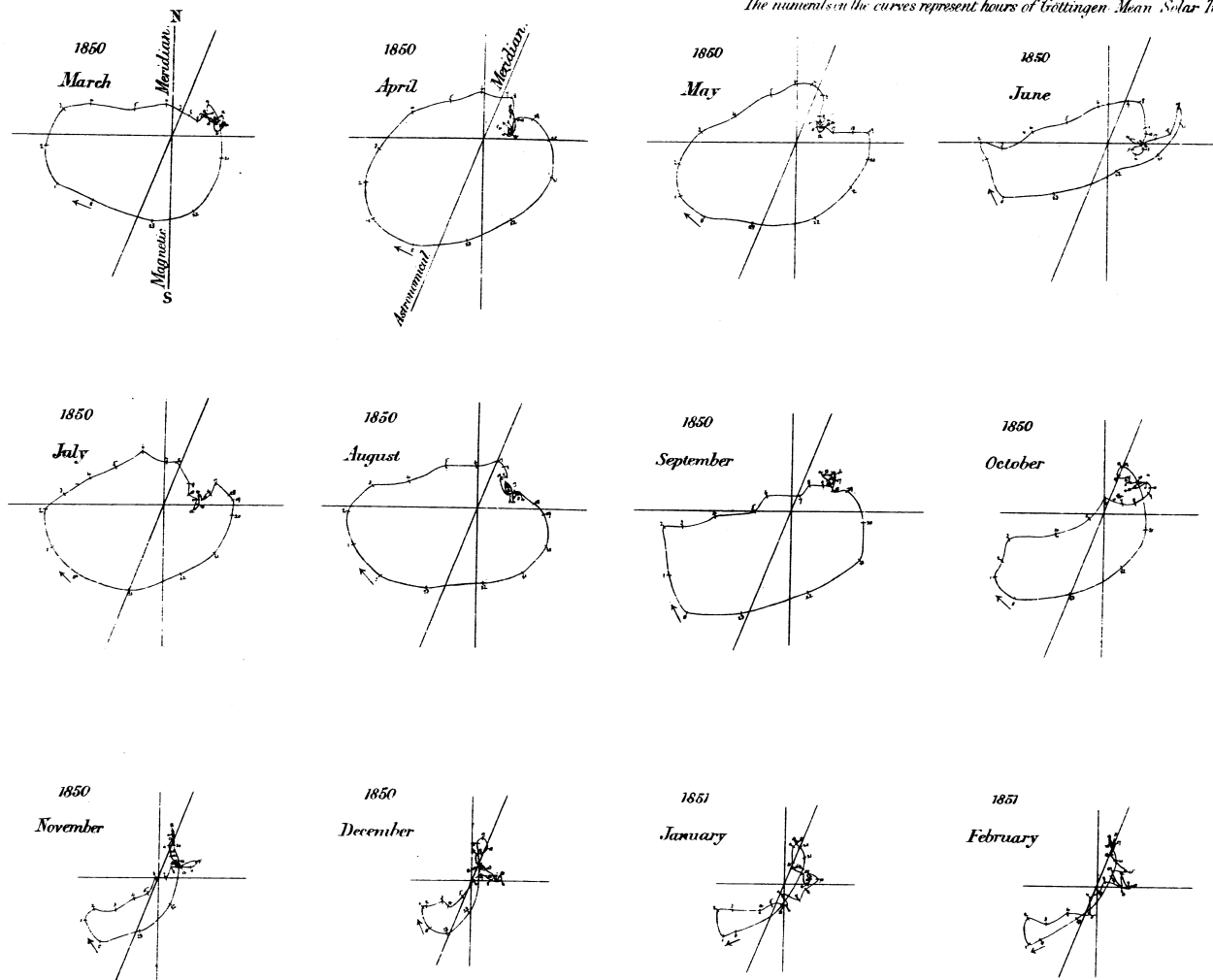
Scale in terms of Mean Horizontal Force.



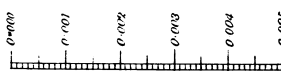
DAIGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 6667

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1850 March to 1851 February.

The numbers in the curves represent hours of Göttingen Mean Solar Time.



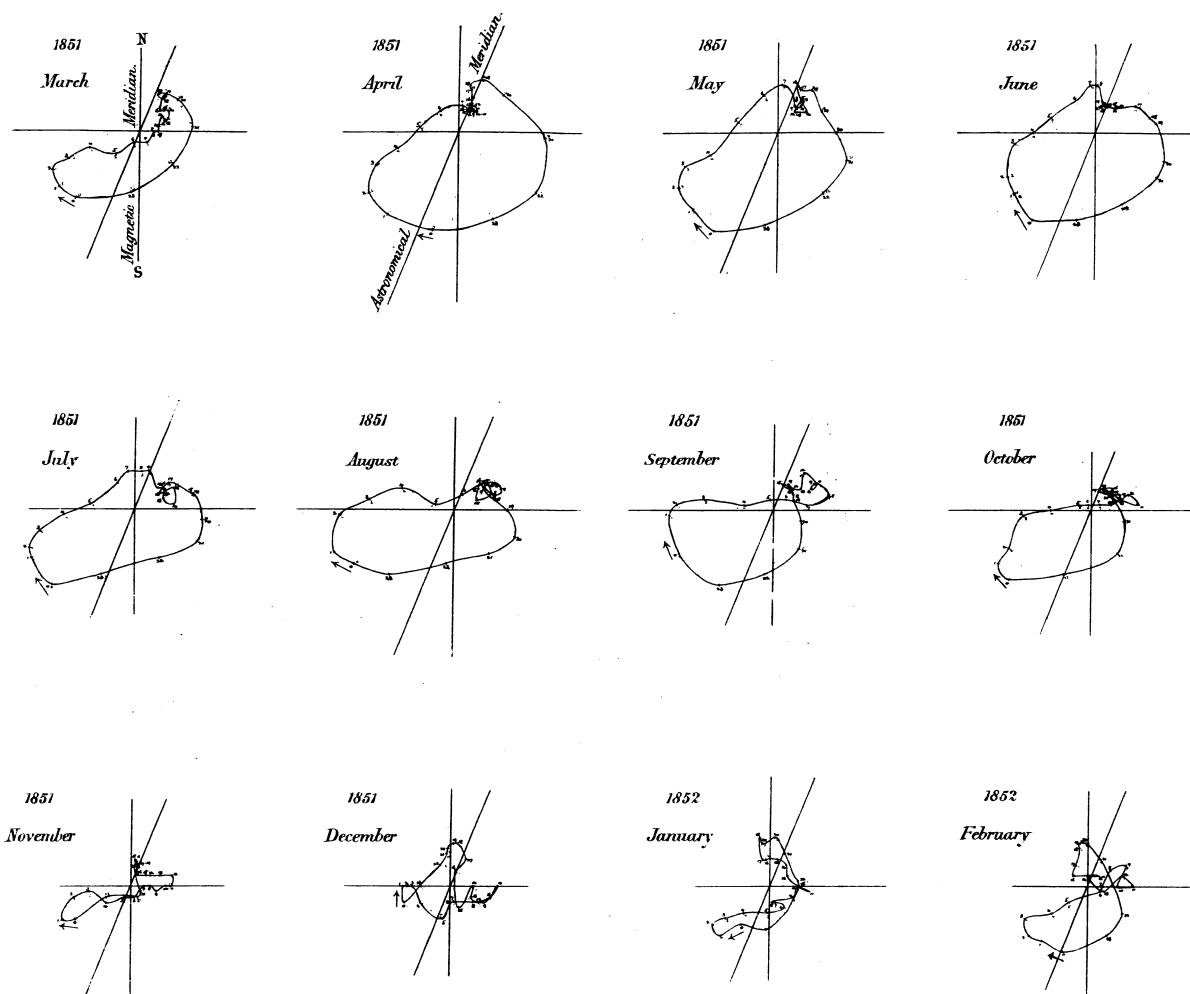
Scale in terms of Mean Horizontal Force.



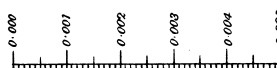
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 1857

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1851 March to 1852 February.

The numerals on the curves represent hours of Göttingen Mean Solar Time.



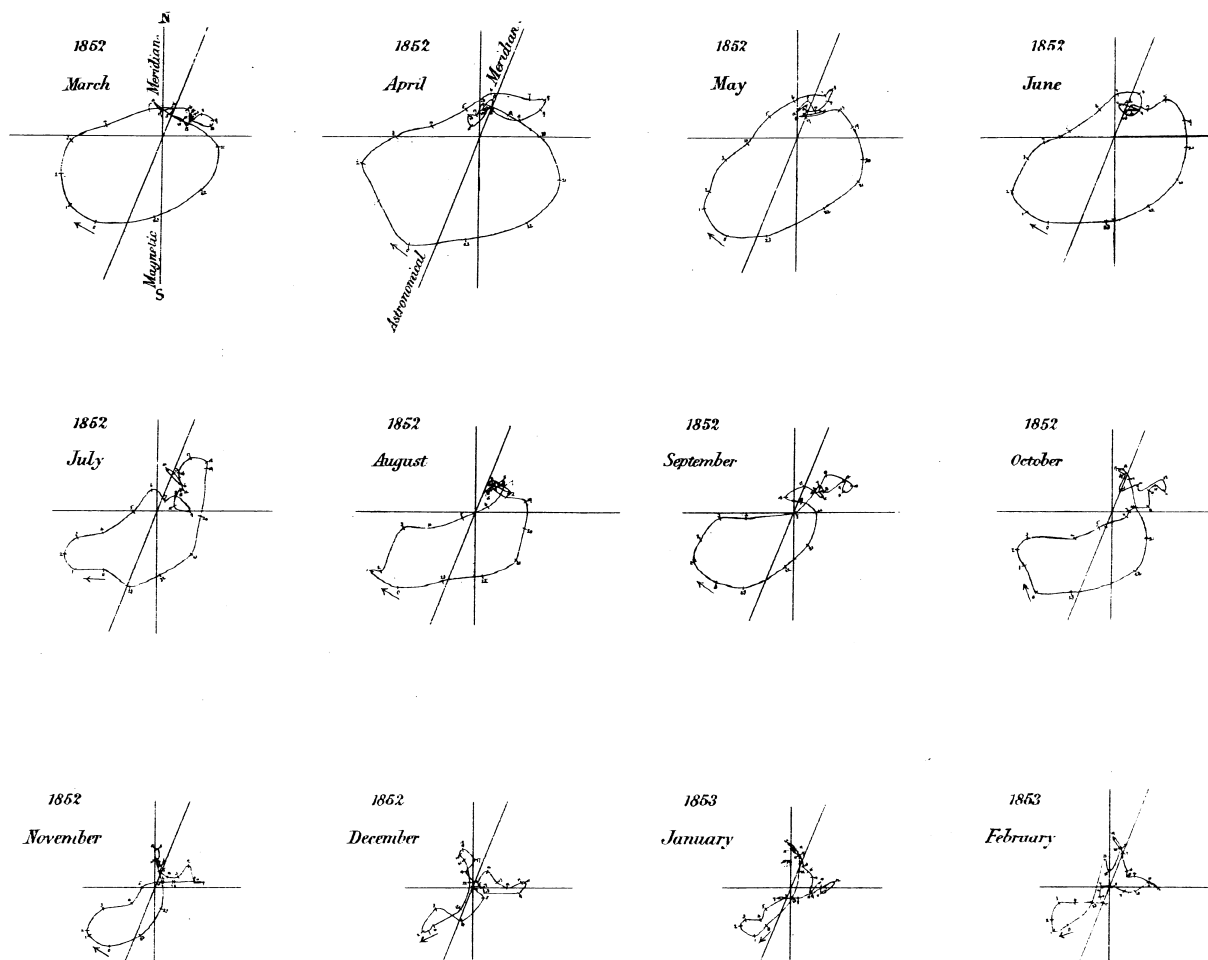
Scale in terms of Mean Horizontal Force.



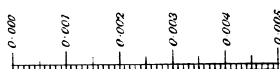
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 8000

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1852 March to 1853 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



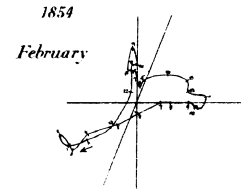
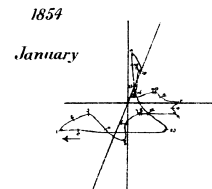
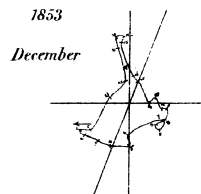
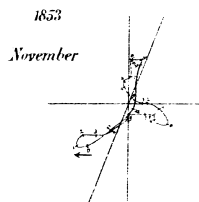
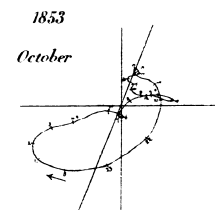
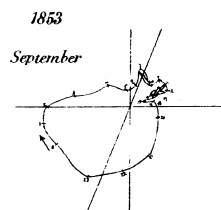
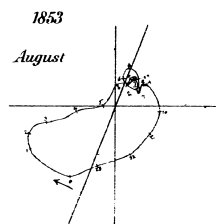
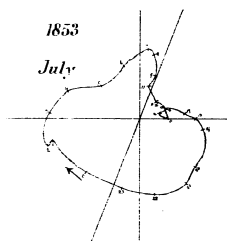
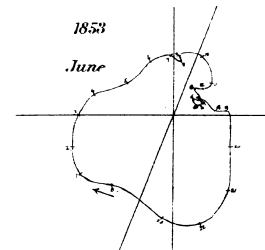
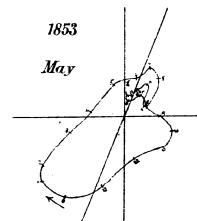
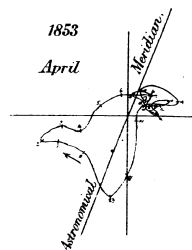
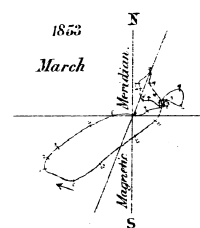
Scale in terms of Mean Horizontal Force



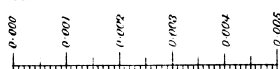
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 1853

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1853, March to 1854 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



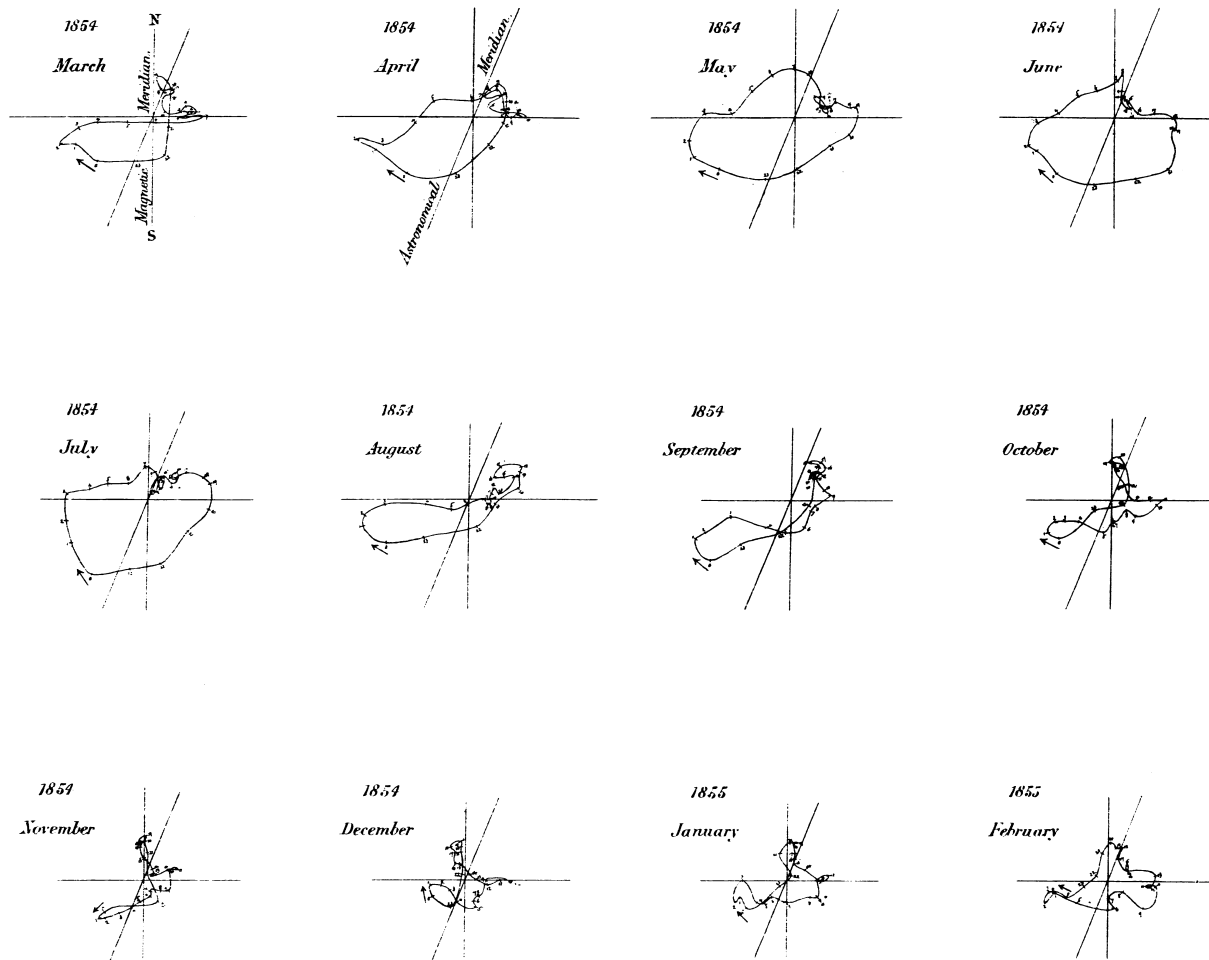
Scale in terms of Mean Horizontal Force.



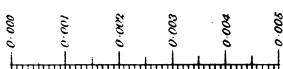
CHANCERY, LITH. 22, BEDFORD ST. COVENT GARDEN, W.C.

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1854 March to 1855 February.

The numerals on the curves represent hours of Göttingen Mean Solar Time.



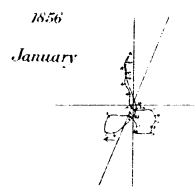
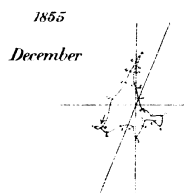
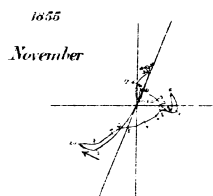
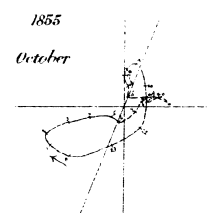
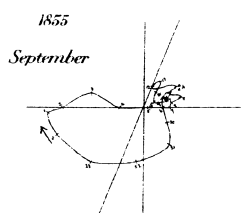
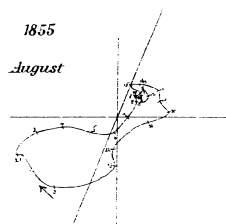
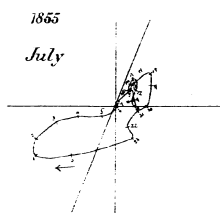
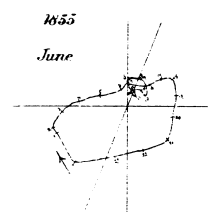
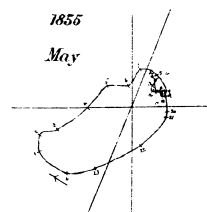
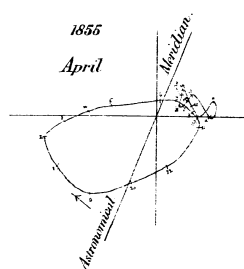
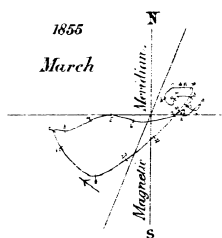
Scale in terms of Mean Horizontal Force.



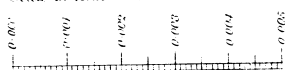
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 5000

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1855 March to 1856 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



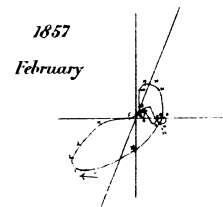
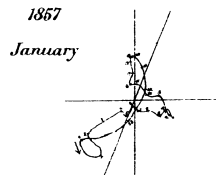
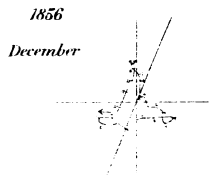
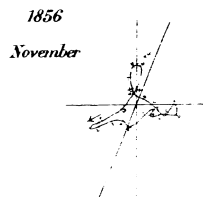
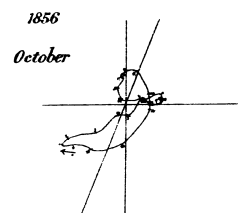
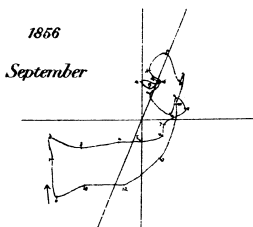
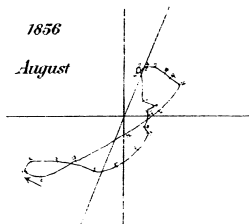
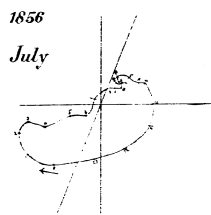
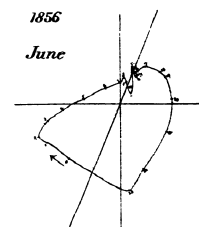
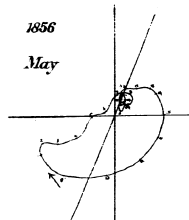
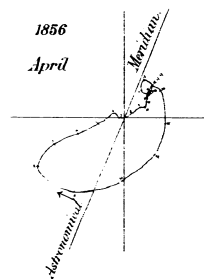
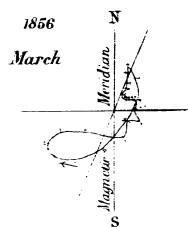
Scale in terms of Mean Horizontal Force



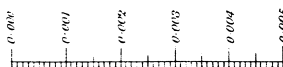
DANCERFIELD LITH 22 BEDFORD ST COVENT GARDEN 1865

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1856 March to 1857 February.

The numbers on the curves represent hours of Göttingen Mean Solar Time.



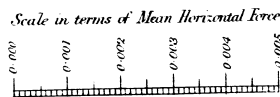
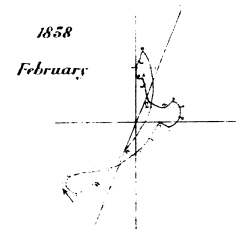
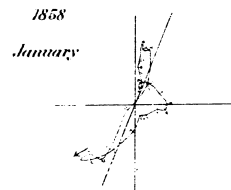
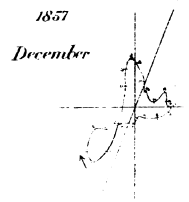
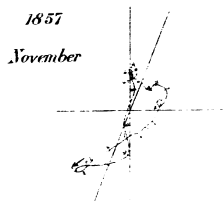
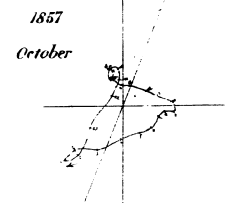
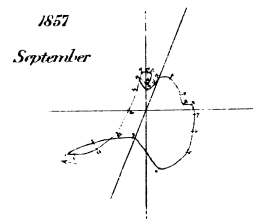
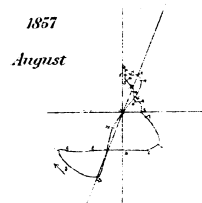
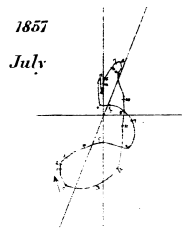
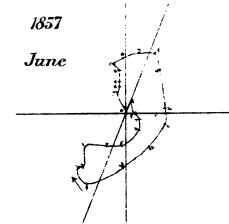
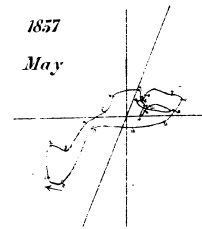
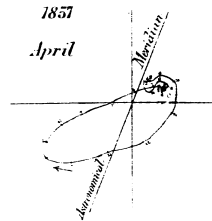
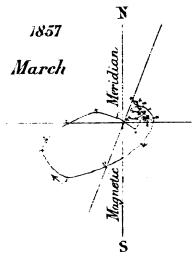
Scale in terms of Mean Horizontal Force.



CHANCERFIELD LITH. 22 BEDFORD ST COVENT GARDEN LONDON

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1857 March to 1858 February.

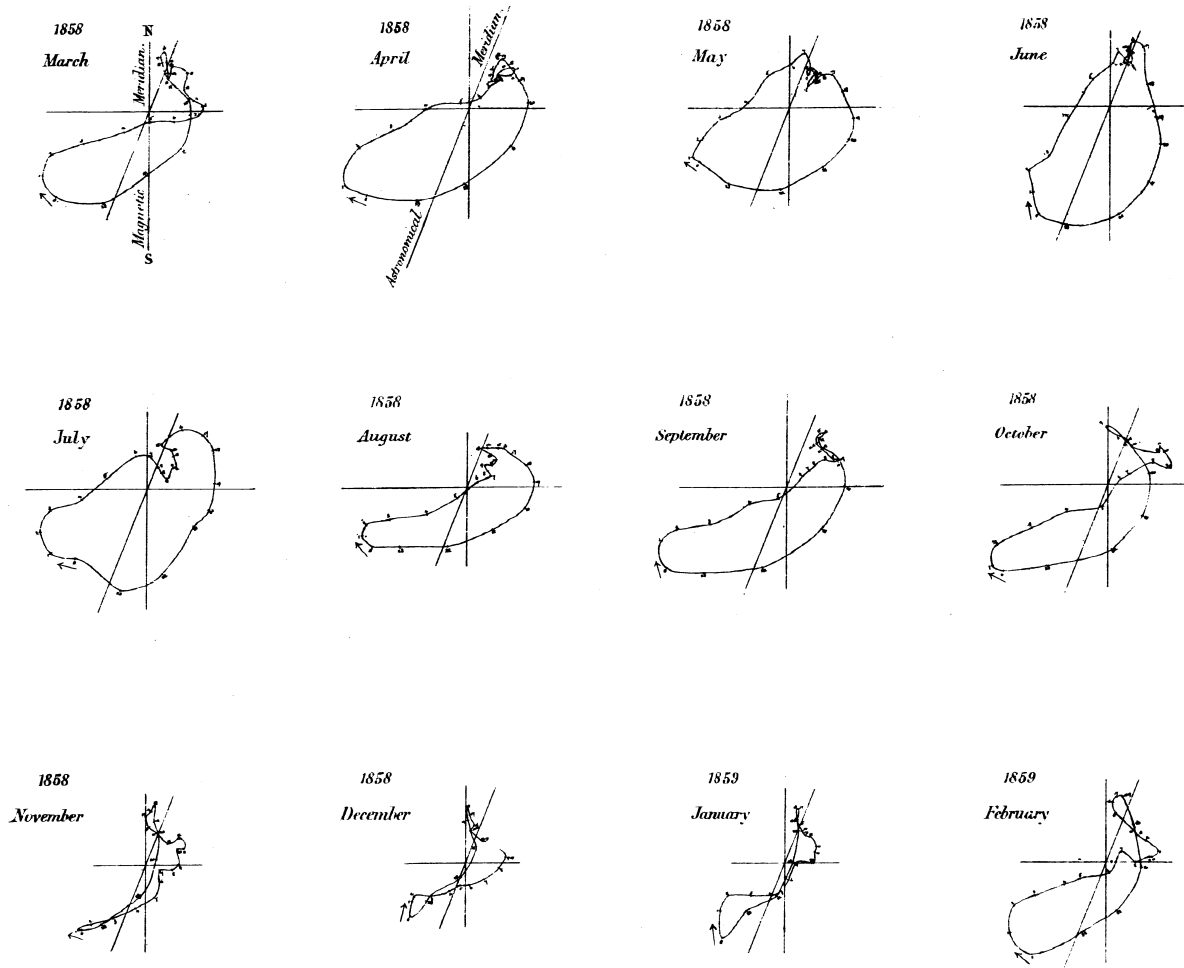
The numerals on the curves represent hours of Göttingen Mean Solar Time from 1857 March to 1857 December, and hours of Greenwich Mean Solar Time for 1858 January-February.



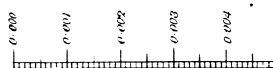
DANCERFIELD LITH 22 BEDFORD ST COVENT GARDEN. 6629

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1858 March to 1859 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.



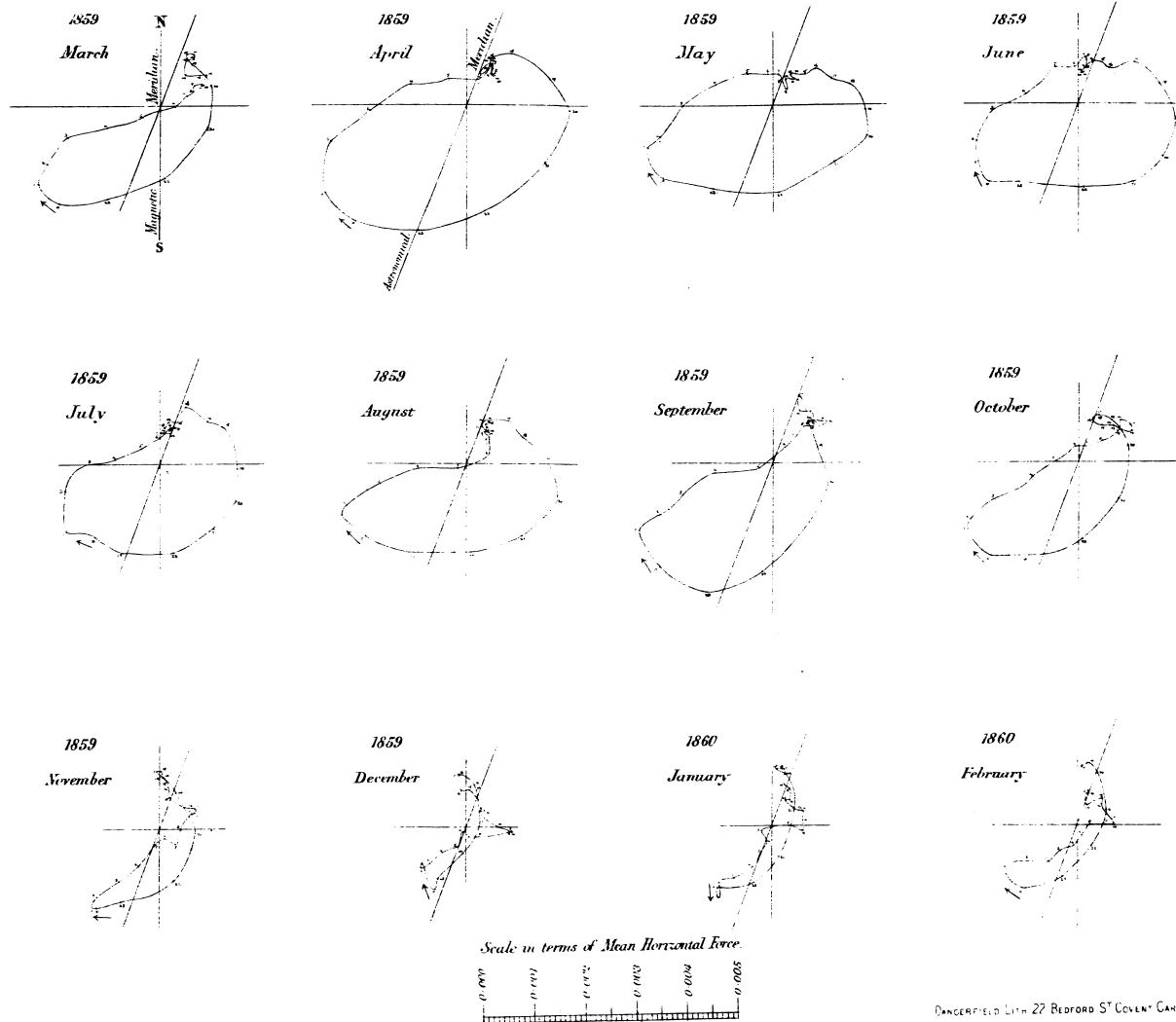
Scale in terms of Mean Horizontal Force



DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN. 8867

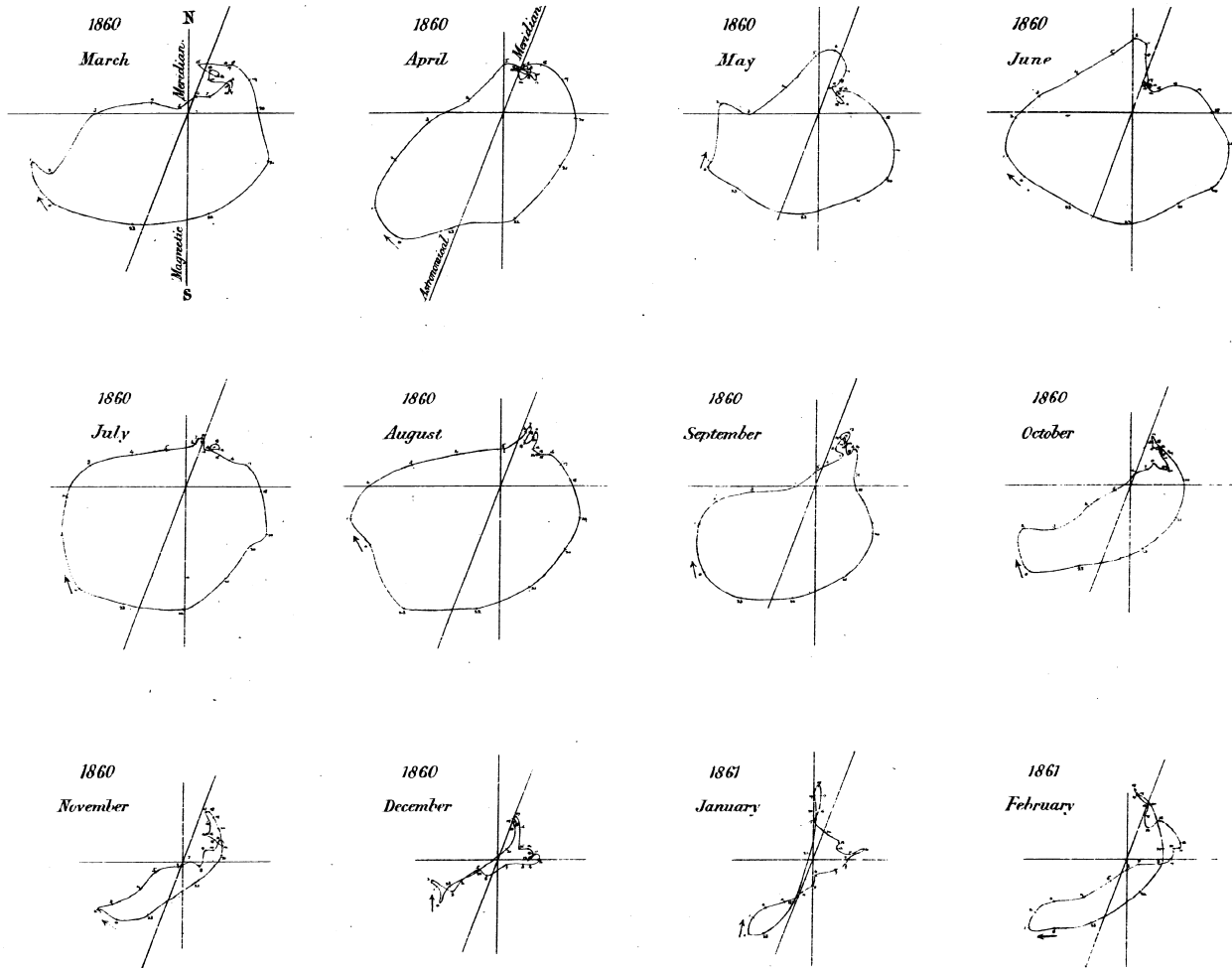
Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1859 March to 1860 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.

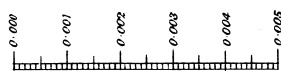


Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1860 March to 1861 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.



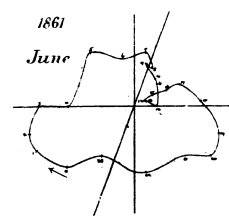
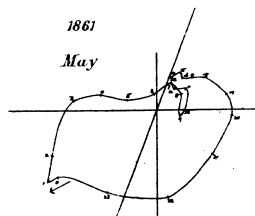
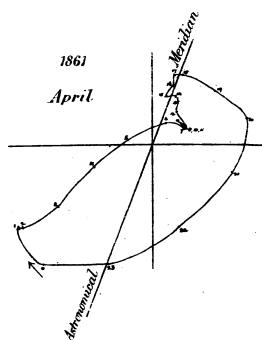
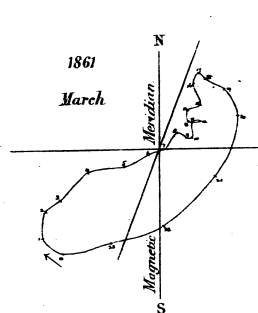
Scale in terms of Mean Horizontal Force.



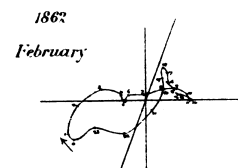
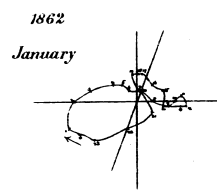
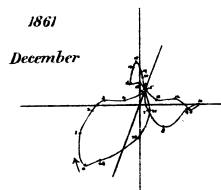
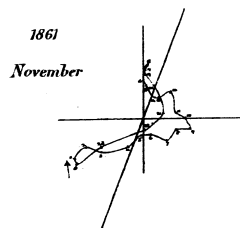
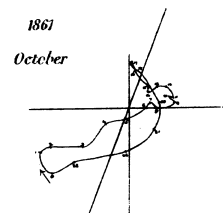
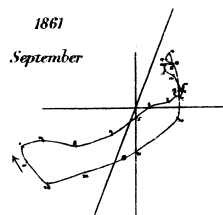
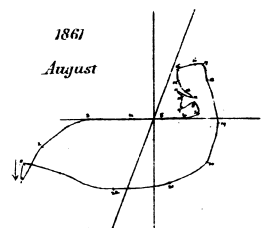
DARCEFIELD LITH 22 BEDFORD ST COVENT GARDEN. 8623

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1861 March to 1862 February

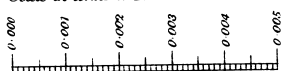
The numerals on the curves represent hours of Greenwich Mean Solar Time.



1861
July
[Observations interrupted.]



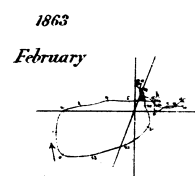
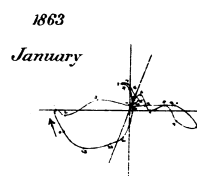
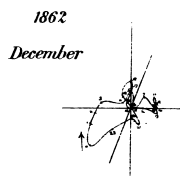
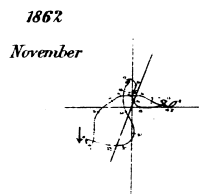
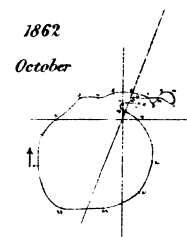
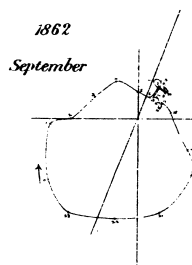
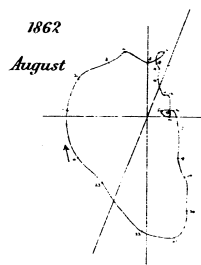
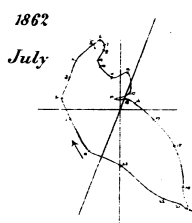
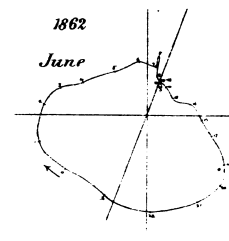
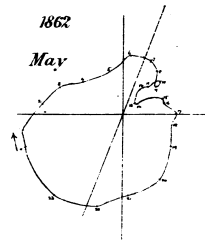
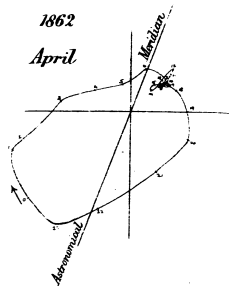
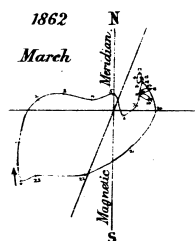
Scale in terms of Mean Horizontal Force.



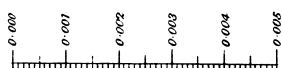
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 8667

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1862 March to 1863 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.



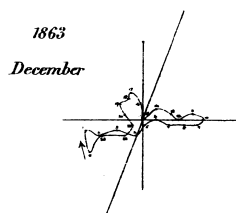
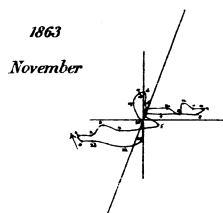
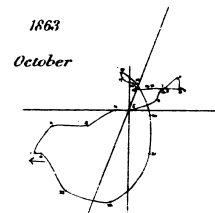
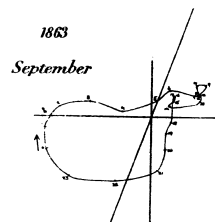
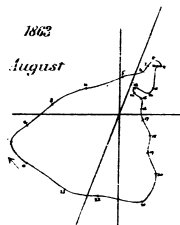
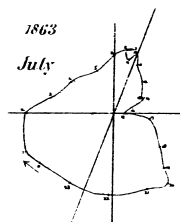
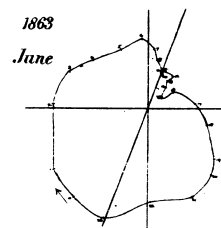
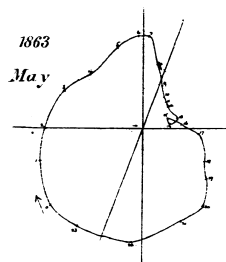
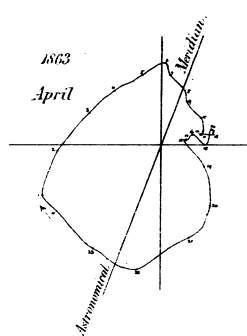
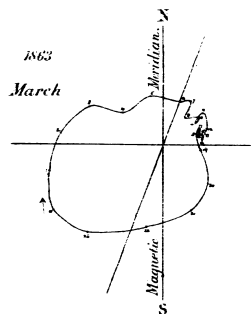
Scale in terms of Mean Horizontal Force.



DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 4623

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1863 March to 1864 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.

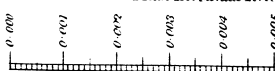


1864
January

[Observations interrupted during construction
of the Magnet Basement]

1864
February

Scale in terms of Main Horizontal Force.



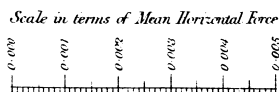
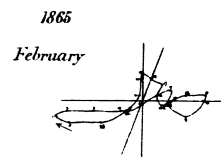
DANGERFIELD LITH. 22 BEDFORD ST. COVENT GARDEN. 1864.

Curve representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for the Month 1865 February.

The numerals on the curve represent hours of Greenwich Mean Solar Time.

1864 to 1865
March January.

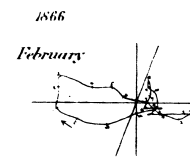
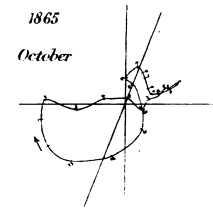
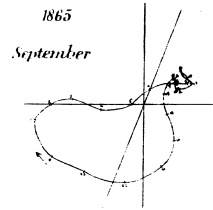
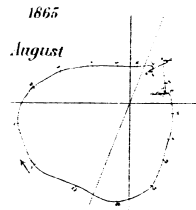
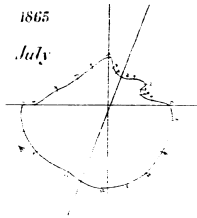
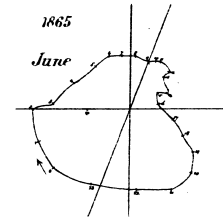
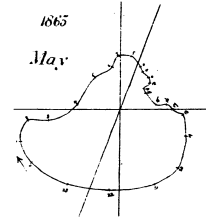
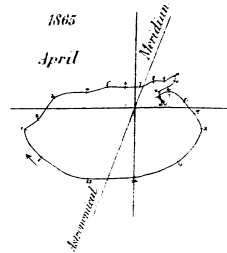
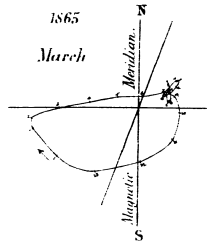
[Observations interrupted during construction
of the Magnet Basement]



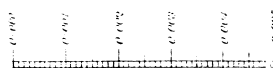
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 1865.

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1865 March to 1866 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



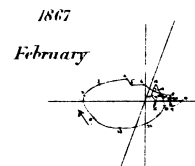
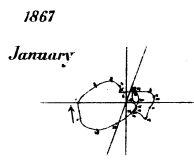
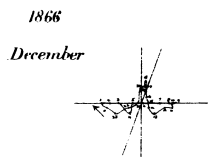
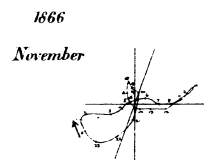
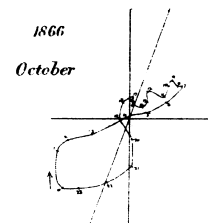
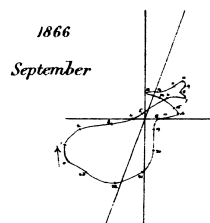
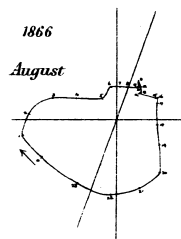
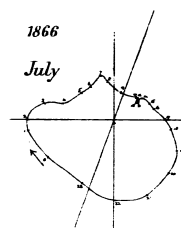
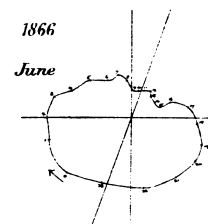
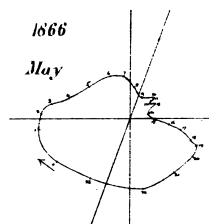
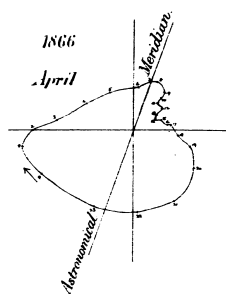
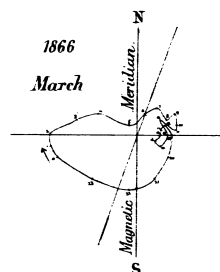
Scale in terms of Mean Horizontal Force.



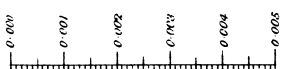
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN LONDON

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1866 March to 1867 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



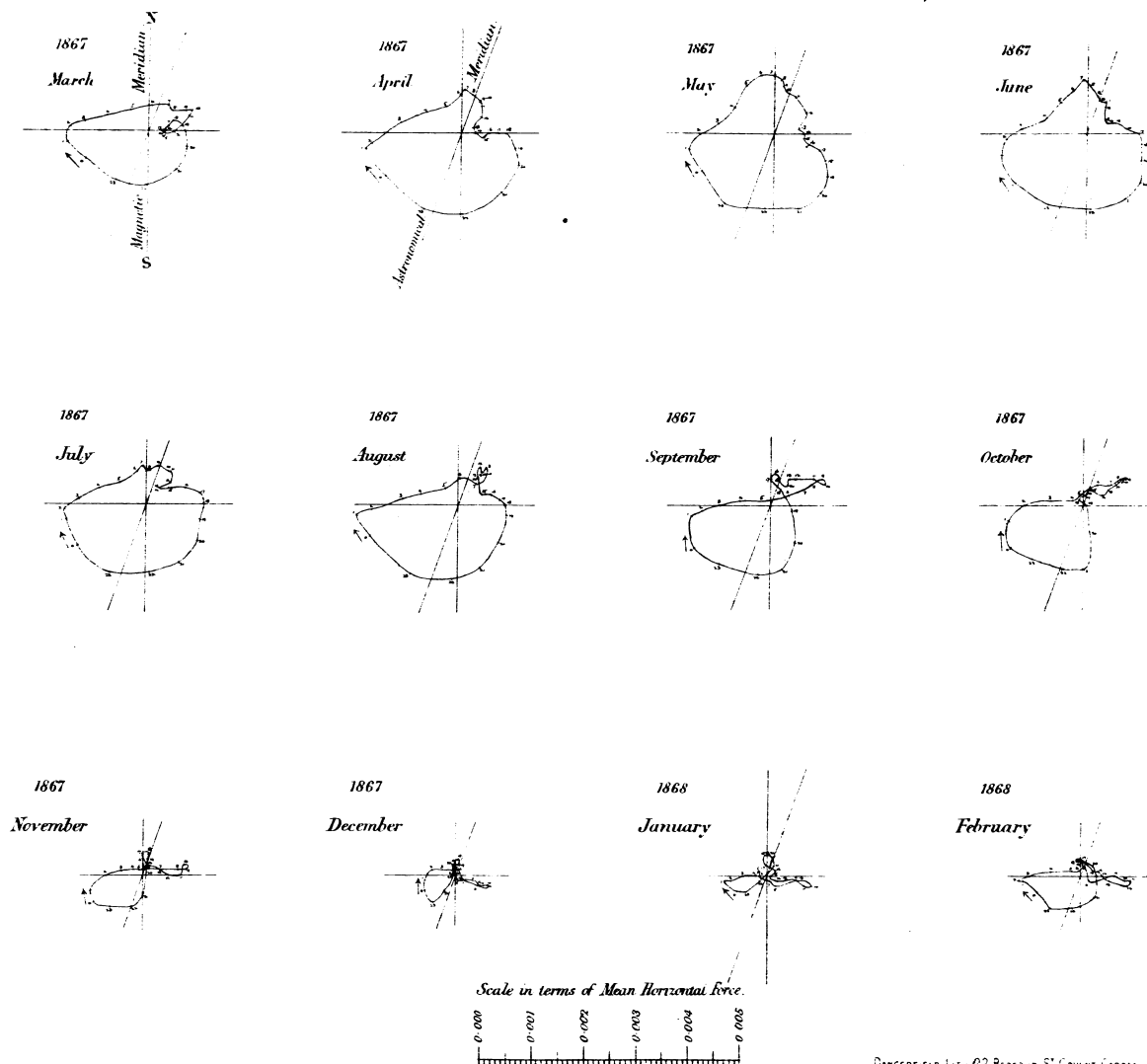
Scale in terms of Mean Horizontal Force.



DANGERFIELD 1114 22 BEDFORD ST COVENT GARDEN LONDON

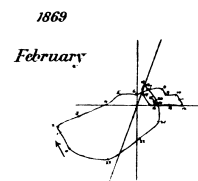
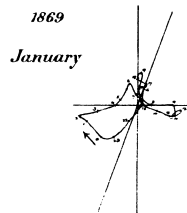
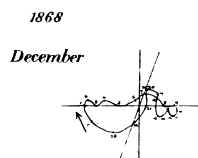
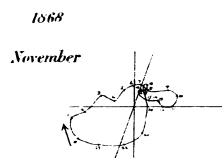
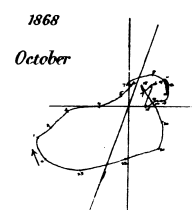
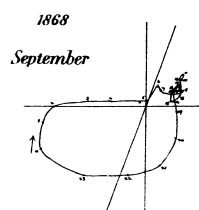
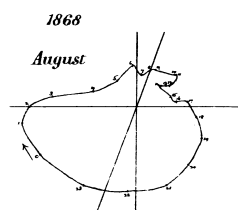
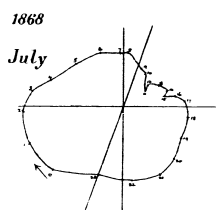
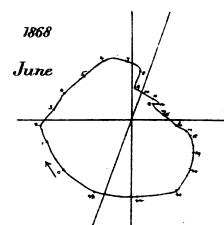
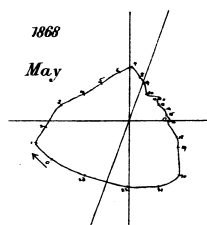
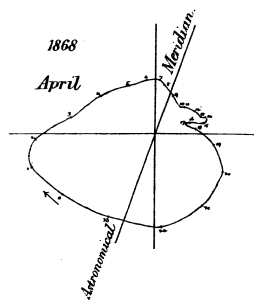
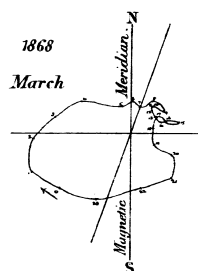
Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1867 March to 1868 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.

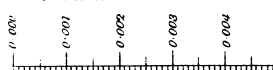


Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1868 March to 1869 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.



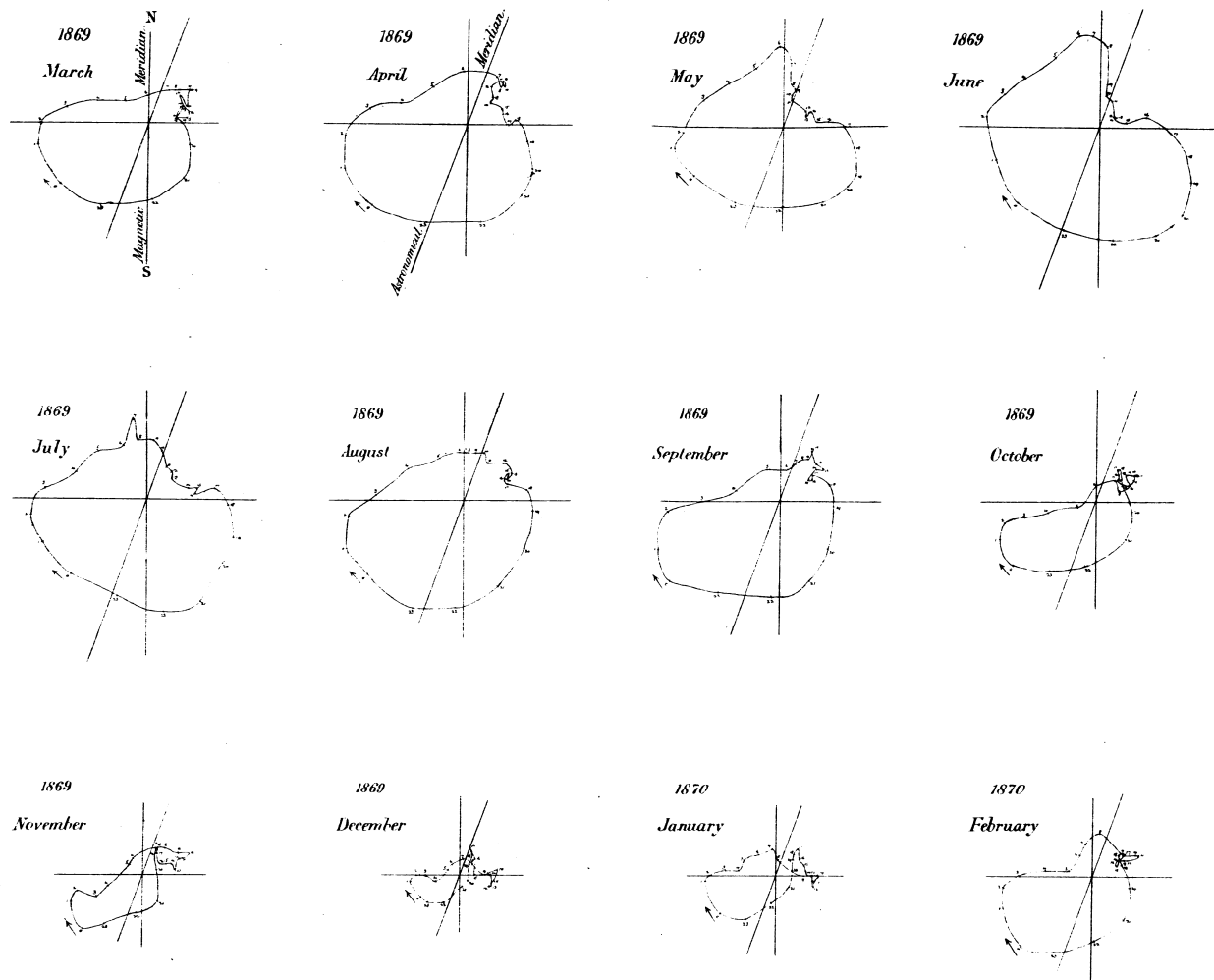
Scale in terms of Mean Horizontal Force.



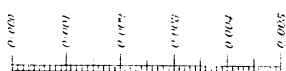
PANGLOSS LITH 22 BEDFORD ST COVENT GARDEN 402

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory Greenwich, for each month in the year 1869 March to 1870 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.



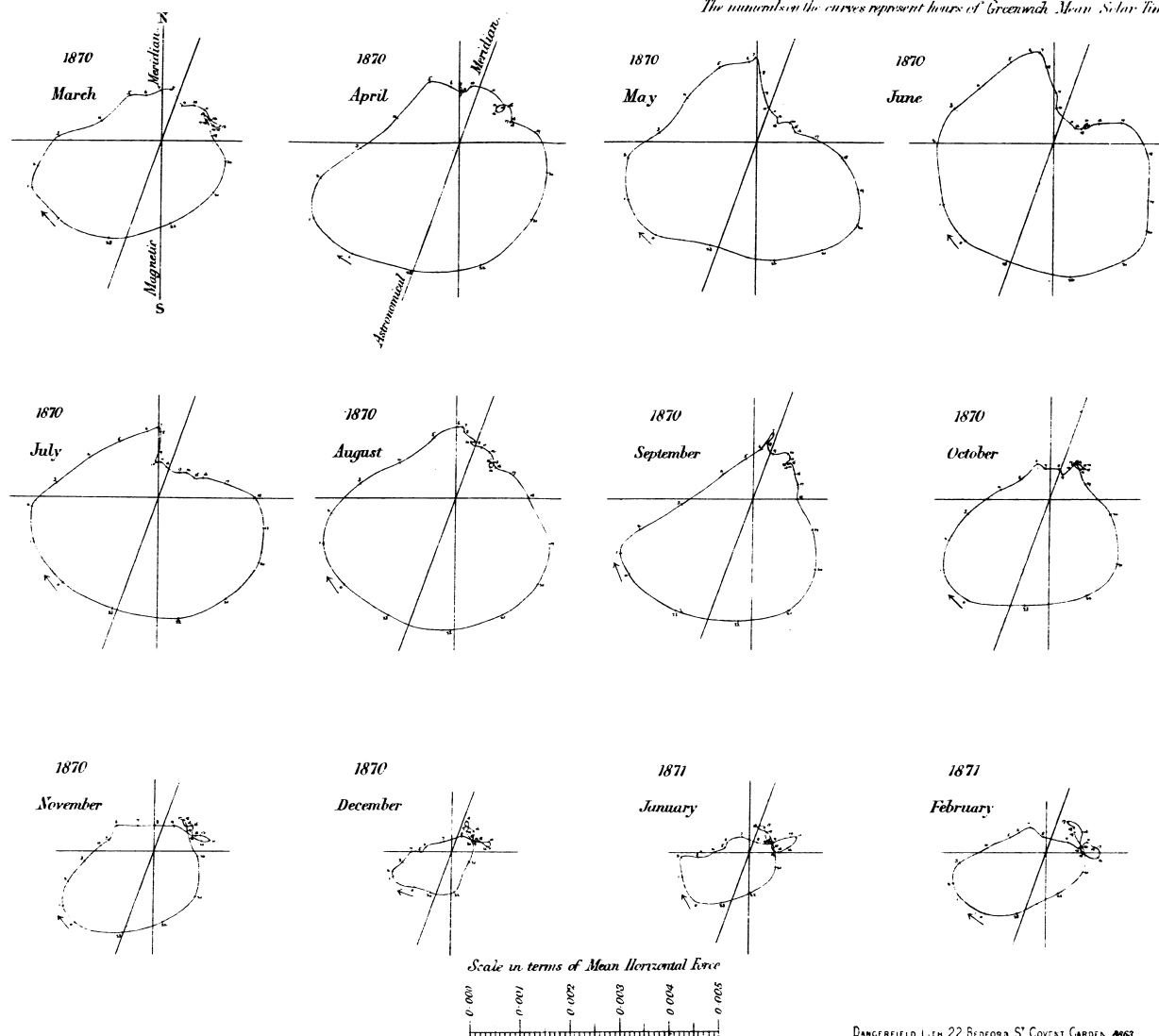
Scale in terms of Mean Horizontal Force.



DANGERFIELD LITH. 22, BEDFORD ST COVENT GARDEN. 6962

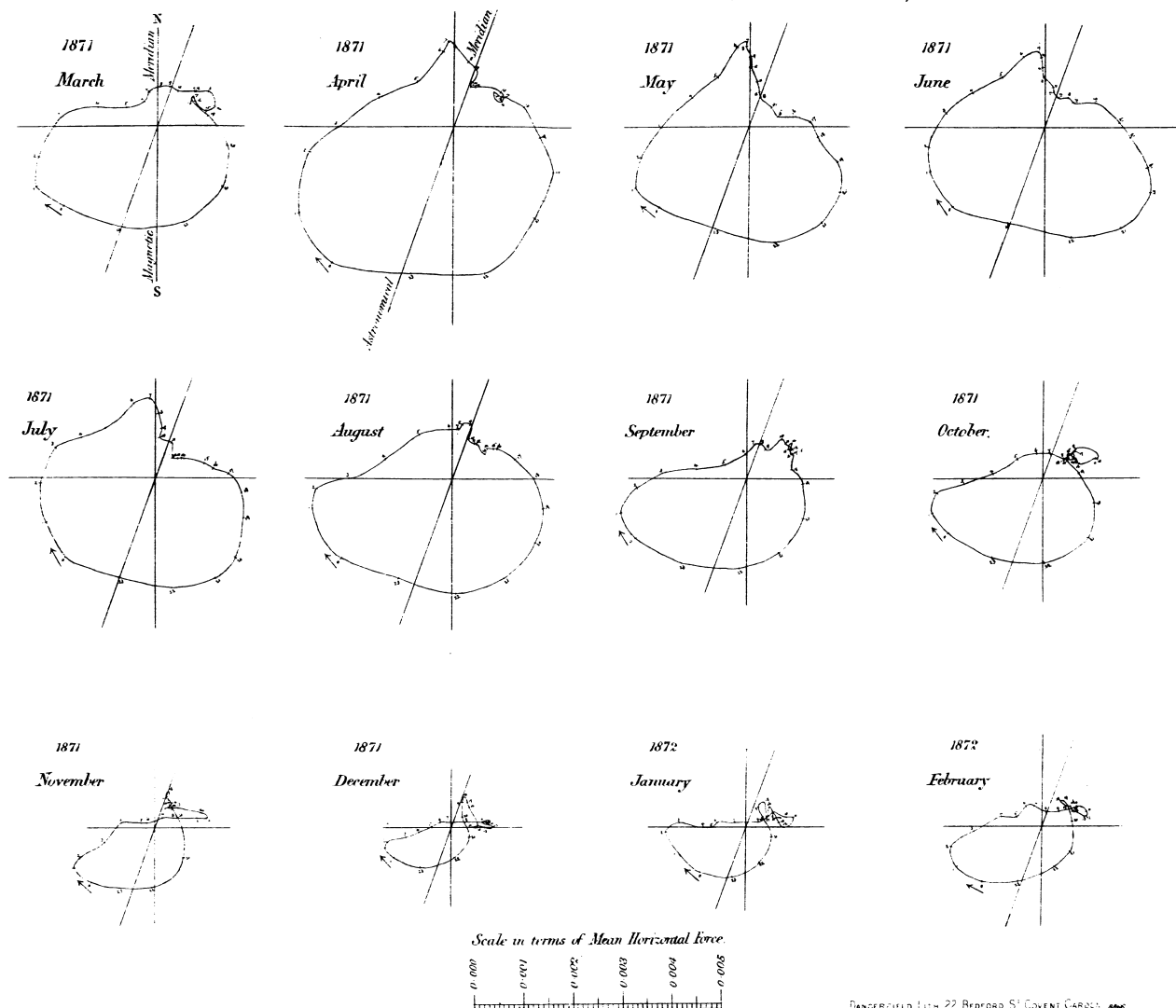
Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1870 March to 1871 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



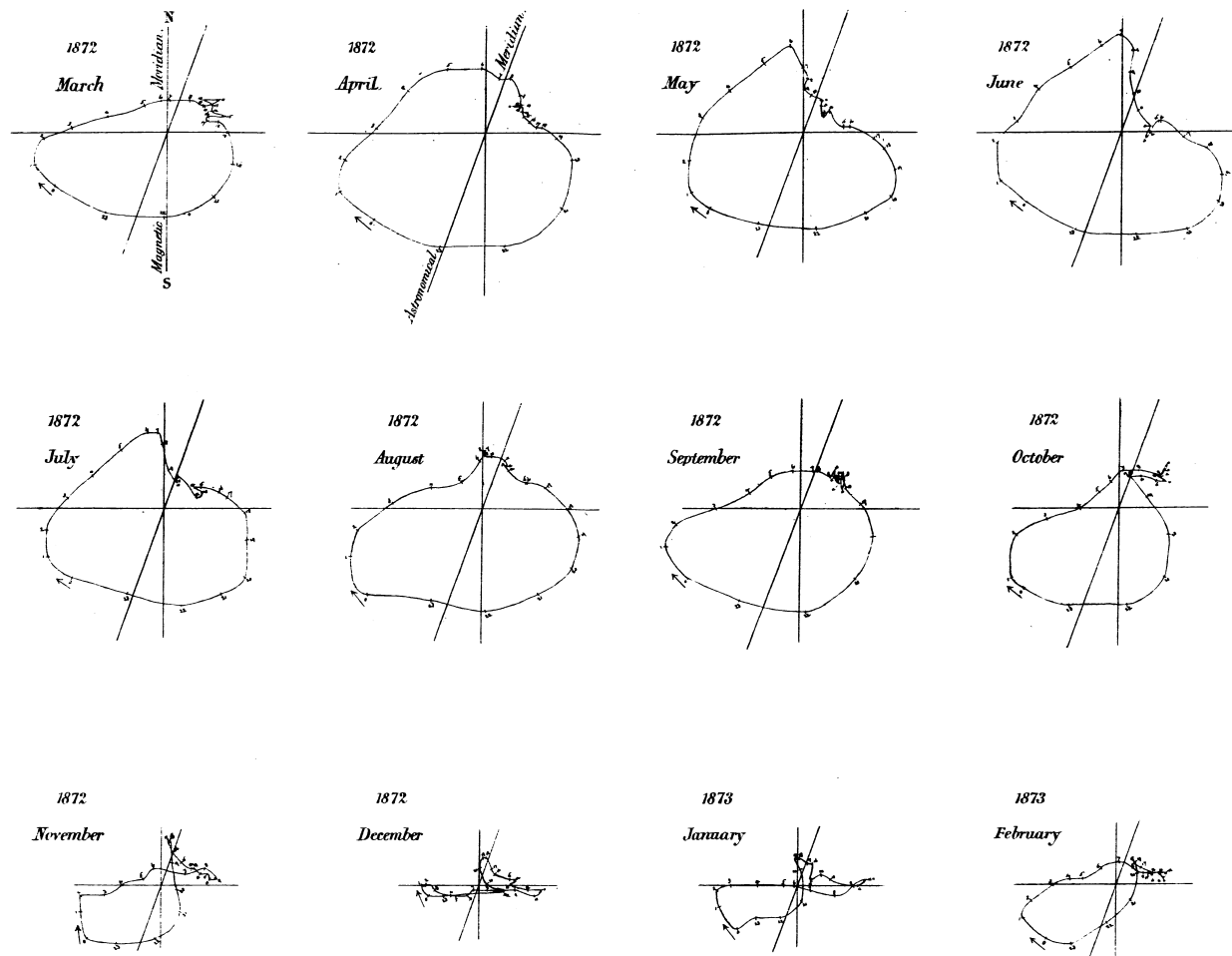
Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1871 March to 1872 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.

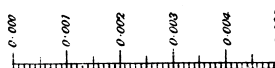


Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1872 March to 1873 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



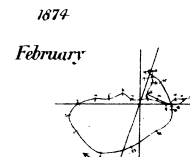
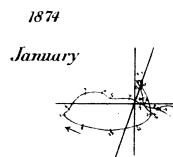
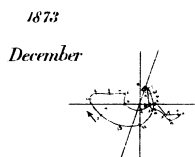
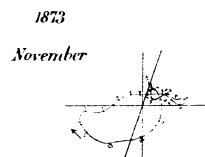
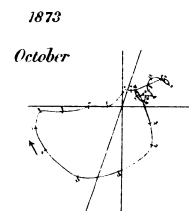
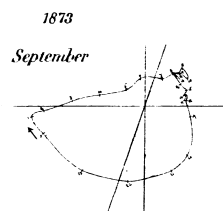
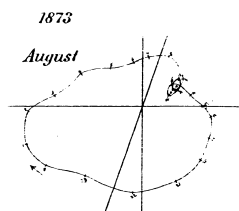
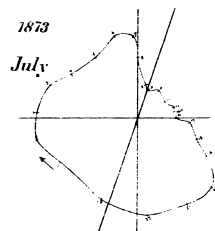
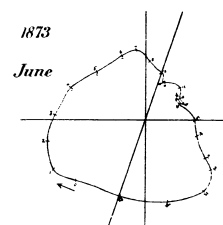
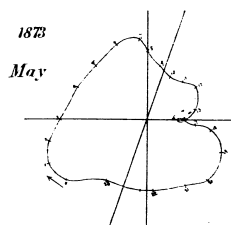
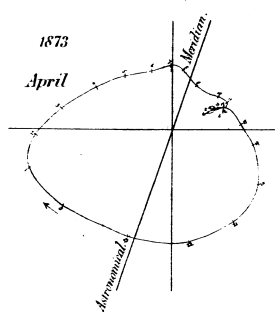
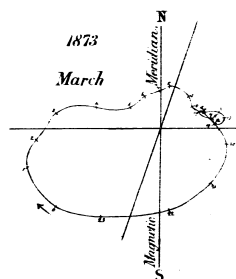
Scale in terms of Mean Horizontal Force.



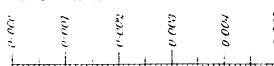
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1873 March to 1874 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.



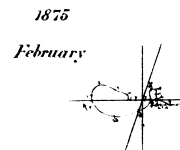
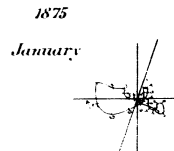
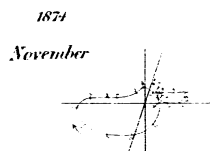
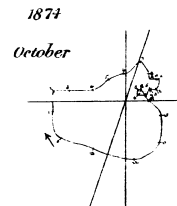
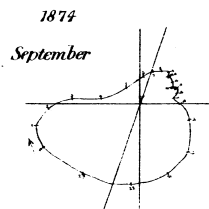
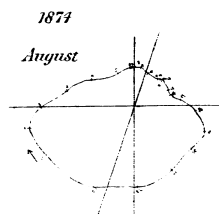
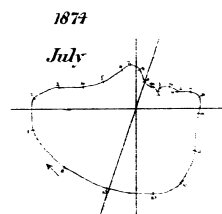
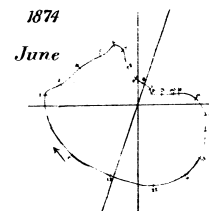
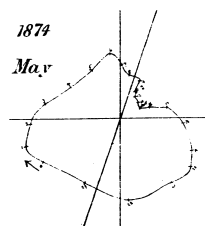
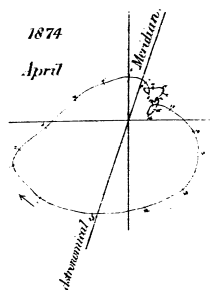
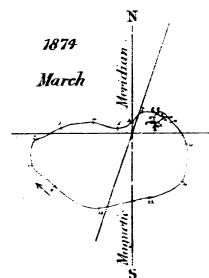
Scale in terms of Mean Horizontal Force.



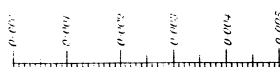
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 6882

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1874 March to 1875 February.

The numbers on the curves represent hours of Greenwich Mean Solar Time.



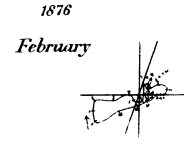
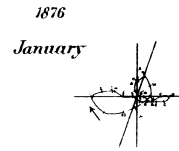
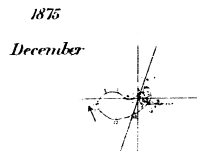
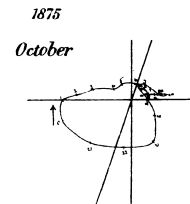
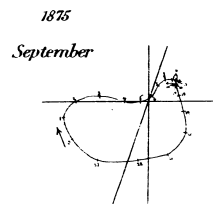
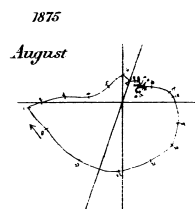
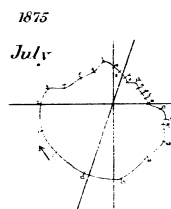
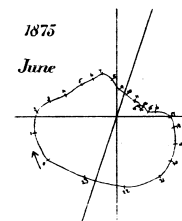
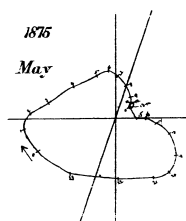
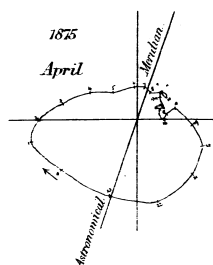
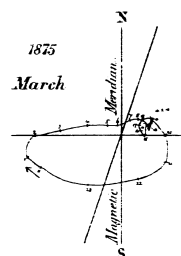
Scale in terms of Mean Horizontal Force



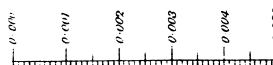
DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 8862

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1875 March to 1876 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.



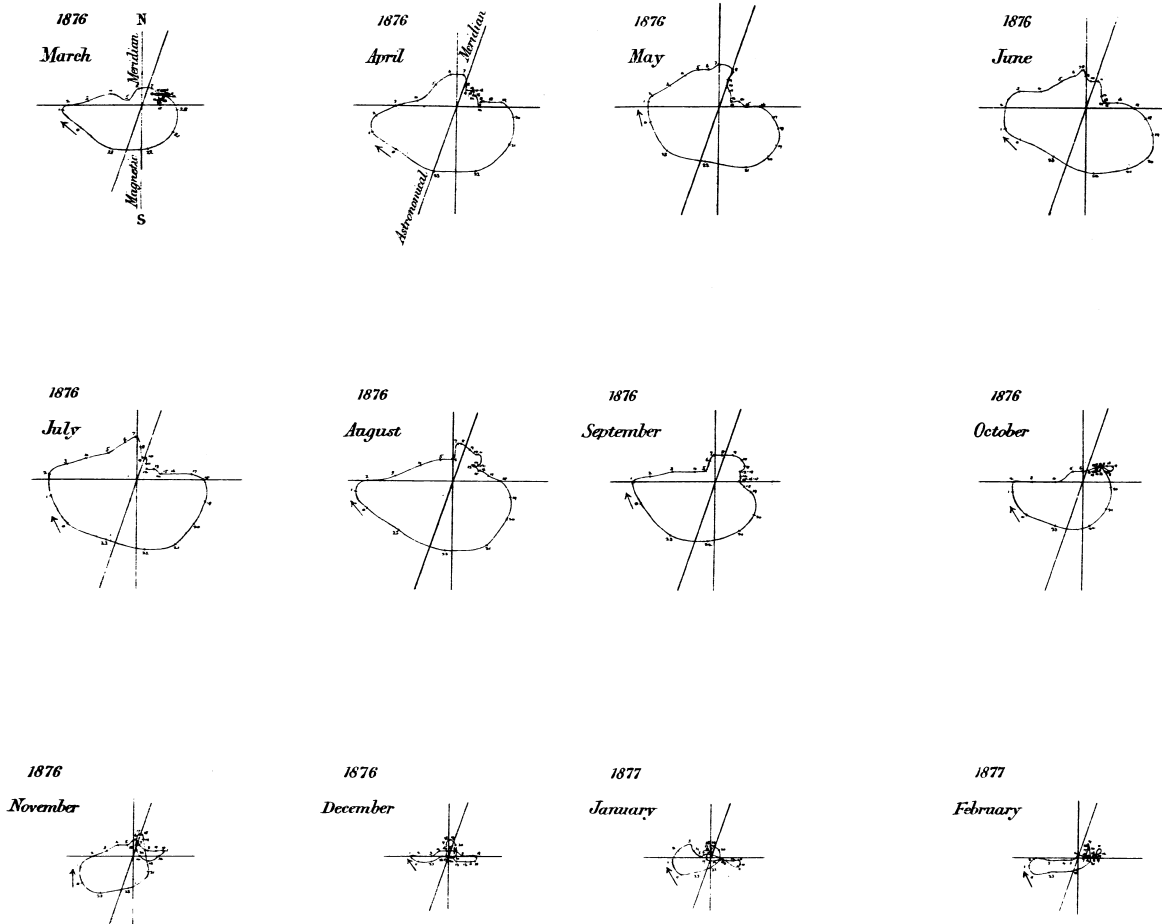
Scale in terms of Mean Horizontal Force.



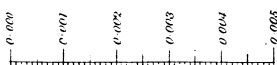
DAINGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 1896

Curves representing the Diurnal Change in Magnitude and Direction of the Magnetic Forces in the Horizontal Plane acting on the North End of the Needle at the Royal Observatory, Greenwich, for each month in the year 1876 March to 1877 February.

The numerals on the curves represent hours of Greenwich Mean Solar Time.



Scale in terms of Mean Horizontal Force.



DANGERFIELD LITH 22 BEDFORD ST COVENT GARDEN 4006