MAGNETIC OBSERVATIONS

MADE AT THE

GOVERNMENT OBSERVATORY, BOMBAY,

FOR THE PERIOD

1846 to 1905

AND

THEIR DISCUSSION

BY

N. A. F. MOOS, Esq., B.Sc., F.R.S.E., L.C.E. &c.
Director, Government Observatories, Bombay and Alibag.

PART I.

MAGNETIC DATA AND INSTRUMENTS.

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TABLE OF CONTENTS.

Colaba Magnetic Record, 1846—1905, Part I.

	PAGE
INTRODUCTION	1
CHAPTER I.—ABSOLUTE INSTRUMENTS—	
Horizontal Force	3
Declination	24
Inclination	28
CHAPTER II.—HORIZONTAL FORCE VARIATION INSTRUMENT—	
H. F. Magnetograph	31
Scale co-efficient	31
The Temperature co-efficient	38
Use of the Differential Instrument	53
The Magnetograph as a recorder of secular change	55
The Magnetograph as a recorder of diurnal variations	61
Temperature errors in the Diurnal Inequality by Horizontal Force Magnetograph	85
Aperiodic element in the Diurnal Inequality	91
Use of the Variation Instrument for the Derivation of the daily means	91
CHAPTER III.—HORIZONTAL FORCE VARIATION INSTRUMENT—	
Grubb's Force Magnetometer	105
Scale co-efficient	105
The Magnetometer as a recorder of secular changes	112
Temperature corrections	117
Comparison of the Horizontal Force inequalities by the Magnetograph and Grubb's Magnetometer ...	121
The Zero of Grubb's Magnetometer	140
The use of the Differential Instrument	142
CHAPTER IV.—DECLINATION VARIATION INSTRUMENT—	
The Declination Magnetograph	148
The Scale co-efficient	148
Use of the Differential Instrument	149
Declination Magnetograph as a recorder of secular change	149
Use of the Magnetograph for the derivation of the daily means	160
Diurnal Variation of Declination	160
CHAPTER V.—DECLINATION VARIATION INSTRUMENT—	
Grubb's Magnetometer	185
Determination of the Zero	190
Use of the Grubb's Instrument	192
CHAPTER VI.—VERTICAL FORCE VARIATION INSTRUMENTS—	
Magnetographs	204
Scale co-efficient of V. F. Magnetograph No. 2	205
Temperature co-efficient of V. F. Magnetograph No. 2	211
Use of the V. F. Magnetograph No. 2 Instrument	214
Temperature corrections to Diurnal Inequality	221
Variation Instrument (Magnetograph No. 1)	229
Temperature co-efficient of V. F. Magnetograph No. 1	240
Use of V. F. No. 1 Magnetograph	240
Comparison of the Diurnal Inequalities of Vertical Force as registered simultaneously by V. F. No. 1 and No. 2 Magnetographs	242

LIST OF PLATES.

Description.	No. of Plate.	Facing page
Comparison of Magnetometers	1	13
Behaviour of the Grubb's H. F. Magnetometer and H. F. Magnetograph, indicating the secular and annual variations of Absolute Horizontal Force	2	55
Comparison of the diurnal inequalities of Horizontal Force as registered by the Grubb's H. F. Magnetometer and H. F. Magnetograph	3	123
Horizontal Force diurnal inequality (magnetometer) ...	17 to 20	136
Behaviour of the Grubb's Declinometer and declination magnetograph indicating the secular and annual variations of Absolute Declination	4	157
Declination diurnal inequality (magnetograph) ...	44 to 49	184
Declination diurnal inequality (magnetometer) ...	35 to 38	196
Comparison of the diurnal inequalities of Vertical Force as registered by the Vertical Force Magnetographs Nos. 1 and 2	5	245
Traces of Vertical Force No. 1 Magnetograms showing different features in its behaviour	6	246
Excesses of the diurnal inequalities of Vertical Force as registered by the Vertical Force Magnetograph No. 1 over those by No. 2	7 & 8	250
Principal magnetic disturbances, Horizontal Force ...	81 and 81A to 81K.	At the end.

ERRATA.

Colaba Magnetic Data, 1846—1905, Part I.

Page 3 Formula (2) for $\frac{Q}{r^1}$ read $\frac{Q}{r^4}$.

„ 4 Table 1, column 4, Mean value of P_o for 1891, for –·0067 read –·00679.

„ 5 Table 1a, column 4, for A Bt read A + Bt.

„ 6 Last but one line, for s read is.

„ 9 Line 8 from bottom, for $H_t^2 = C/D + AD$ read $H_t^2 = C/(D + AD)$.

„ 11 Paragraph 23, line 2, for 8 read 0·8.

„ 13 Table 3, Magnetometer No. 137, Correction for P_o at 1·0 ft., for ·00129 read + ·00129.

„ 14 Line 4 from bottom, for deflecting read deflected.

„ 17 Table 4a, in the foot-note read constants for constantso.

„ 20 Table 5a, for d termined read determined.

„ 31 Line 4 from bottom, for meredian read meridian.

„ 33 Line 4, for substracting read subtracting.

„ 39 Last but one line, for work read works.

„ 46 Table 13, 1890 August, column 12, for ·000053 read –·000053.

„ 47 „ 1894 June, column 4, for 2·6550 read 2·5650.

„ 47 „ 1894 August, column 6, for 3·1766 read 2·1766.

„ 50 „ 1902 September, column 12, for ·000055 read –·000055.

„ 51 „ 1905, column 14: The signs are dropped or are faintly printed: the figures in the column with proper signs are, –·000031, + 8, + 32, – 93, – 52, + 32, – 5, + 6, + 37, – 74, + 32 and + 103.

„ 55 Paragraph 86, line 5, for c nsecutive read consecutive.

„ 64	Table 19,	April	3*h*.,	for	203	read	– 203.
„ 64	„ „	August	19*h*.,	„	135	„	– 135.
„ 64	„ „	September	19*h*.,	„	169	„	– 169.
„ 65	„ 21,	September	7*h*.,	„	92	„	– 92.
„ 65	„ „	March	17*h*.,	„	87	„	– 87.
„ 65	„ 22,	January	21*h*.,	„	97	„	– 97.
„ 65	„ 22,	June last row,		„	21	„	– 21.
„ 67	„ 26,	September	12*h*.,	„	– 244	„	+ 244.
„ 67	„ „	Year	9*h*.,	„	– 171	„	+ 171.
„ 69	„ 29,	„	0*h*.,	„	– 12	„	– 124.
„ 69	„ „	April	21*h*.,	„	– 15	„	– 152.
„ 69	„ „	„	22*h*.,	„	– 15	„	– 156.
„ 69	„ „	Range, year column, for 47 read 474.					
„ 70	„ 31,	August	21*h*.,	for	123	read	– 123.
„ 71	„ 34,	June	6*h*.,	„	50	„	– 50.
„ 72	„ 35,	April	8*h*.,	„	÷ 65	„	+ 65.
„ 72	„ „	Decemcer	10*h*.,	„	183	„	+ 183.
„ 72	„ „	October	12*h*.,	„	248	„	+ 248.

„ 74 Tables 39 and 40. Wherever the signs are dropped read +

„ 74	Table 39,	June	16*h*.,	for	– 8	read	– 87.
„ 75	„ 41,	„	3*h*.,	„	131	„	– 131.
„ 75	„ „	March	4*h*.,	„	121	„	– 121.
„ 75	„ „	January	6*h*.,	„	31	„	– 31.
„ 75	„ „	February	11*h*.,	„	+ 32	„	+ 372.
„ 75	„ „	May	20*h*.,	„	– 74	„	– 174.
„ 75	„ 42,	Year	10*h*.,	„	+ 31	„	+ 316.
„ 76	„ 43,	September	0*h*.,	„	105	„	– 105.
„ 76	„ „	August	5*h*.,	„	34	„	– 34.
„ 76	„ 44,	January	20*h*.,	„	157	„	– 157.
„ 77	„ 45,	Last row, year,		„	2	„	– 2.
„ 77	„ 46,	September	2*h*.,	„	38	„	– 38.
„ 77	„ „	„	22*h*.,	„	72	„	– 72.
„ 77	„ „	Last row, December, for blank read – 2.					
„ 79	„ 49,	April	11*h*.,	for faint figure read 283.			
„ 79	„ „	July	11*h*.,	„		„	237.
„ 79	„ „	„	16*h*.,	for	39	read	– 39.
„ 79	„ „	July, last row,		„	2	„	– 2.
„ 80	„ 52	February	22*h*.	„	139	„	– 139.
„ 81	„ 53	1896 January	6*h*.,	„	·08	„	– ·08.

„ 84 „ „ 1873 April to September 14*h*., for ·01 read –·01.

„ 85 „ 54 1908 April, difference, 10*h*., for +0·5 read +·05.

„ 95 „ 63 (Uncorrected) May 2, for 466 read 366.

„ 95 „ „ (Corrected) May 2 & 3, for 464 and 441 read 364 and 341, respectively.

„ 105 Formula 68, for c t $(\theta - \mu)$ read cot $(\theta - \mu)$.

„ 113 Table 77, Years. column 1, for 1604 read 1904.

„ 126	„ 86,	August, row 9,	5*h*.,	for	9	read	– 9.
„ 128	„ „	Year, „ 8,	6*h*.,	„	48	„	– 48.
„ 129	„ „	November „ 9,	12*h*.,	„	+ 66	„	+ 16.
„ 133	„ 90	1849,	18*h*.,	for	114	read	– 114.
„ 133	„ 91	1862,	19*h*.,	„	200	„	– 200.
„ 135	„ 94	1850,	11*h*.,	„	32	„	320.
„ 135	„ 94	1851,	22*h*.,	„	141	„	– 141.
„ 135	„ 95	1867,	19*h*.,	„	– 1 3	„	– 163.
„ 137	„ 98	Year,	3*h*.,	„	134	„	– 134.
„ 137	„ 99	August	9*h*.,	for	– 149	read	+ 149.
„ 137	„ „	September	16*h*.,	„	76	„	– 76.
„ 143	„ 106	1901 July,		for	99	read	– 99.

Most of the misprints above shown have been corrected by the hand wherever possible, especially in the case of the omissions of signs and figures.

B 1034—*b*

Page 145 Table 108, 1905, February, for 37348 read 37388.
,, 147 ,, 110, 1872, Year, for 0 read ...
,, 147 ,, ,, 1877, ,, ,, 0 ,, ...
,, 151 ,, 111, 1881, December, column 9, for 0 19 read −0 19.
,, 165 ,, 123, May 22, for 6·9 read 16·9.
,, 166 ,, 124, November 1, for 15·5 read 14·5.
,, 167 ,, 126, September 4*h*., for −0·37 read +0·37
,, 167 ,, 127, October 9*h*., ,, 0·03 ,, +0·03.
,, 169 ,, 130, June 16*h*., ,, 0·23 ,, −0·23.
,, 169 ,, 131, April 20*h*., ,, 0·17 ,, −0·17.
,, 171 ,, 134, July 12*h*., ,, 1·68 ,, −1·68.
,, 172 ,, 137, February 16*h*., ,, 0·23 ,, −0·23.
,, 177 ,, 146, January 8*h*., ,, +0·2 ,, +0·32.
,, 181 ,, 154, August 13*h*., ,, +2·00 ,, −2·00.
,, 183 ,, 158, last row, year, ,, 2·6 ,, 2·68.
,, 187 ,, 162, 1892, year, ,, 53·11 ,, 35·11.
,, 194 ,, 167, 1855, 8*h*., ,, +1·1 ,, +1·13.
,, 198 ,, 176, December 14*h*., ,, + ·6 ,, + ·56.
,, 224 ,, 187, 1890, March 22*h*., for −·17 read −·07.
,, 225 ,, ,, 1877, August 22*h*., for ·60 read ·00.
,, 225 ,, ,, 1902 and 1903, July 10*h*., for −·12 and −·12 read +·12 and +·12 respectively.
,, 229 Paragraph 255, line 6, for cycluder read cylinder.
,, 230 Table 192, December 10*h*., −53 should be in thin type.
,, 231 ,, 193, Year 6*h*., +65 should be in thick type.
,, 234 ,, 199, December 11*h*., for −53 read −55.
,, 234 ,, 200, May 11*h*., for +178 read −178.
,, 247 ,, 211, August 13 and 14*h*., for +29 read +59.
,, 249 ,, 214, February 0, 1 and 2 hours, read +26, +24 and +23 respectively.
,, 253 ,, 218, in the year column the faint figures for the hours 0, 1, 3, 4, 16, 17, 18, 19 and 23 are +36, +33, +22, +24 +18, −6, −6, −2 and +36 respectively.
,, 255 ,, Wherever the signs are dropped read +
,, 258 ,, 227 March 12*h*., for +82 read −82.
,, 259 ,, 230 June 11*h*., for the faint figure read −134.
,, 259 ,, ,, ,, 13*h*., for 45 read −45.
,, 261 ,, 233 Wherever the signs are dropped read −.
,, 262 ,, 235 Wherever the signs are dropped read −.
,, 263 ,, 237 June 11*h*., for −20 read −202.
,, 263 ,, ,, July 11*h*., for −16 read −166.
,, 263 ,, 238 January 8*h*., +80 should be in thin type.
,, 263 ,, ,, ,, 9*h*., +96 ,, thick type.
Plate 7, Figures XIV and XIVa, for +0°·1 read −0°·1 and for −0°·1 read +0°·1.
Plate 8, Figures XIV and XIVa, for +0°·1 read −0°·1 and for −0°·1 read +0°·1.

Most of the misprints above shown have been corrected by the hand wherever possible, especially in the case of the omissions of signs and figures.

COLABA MAGNETIC RECORD.
1846–1905.

INTRODUCTION.

Magnetic work was started at the Colaba Observatory in 1840, but it was not till the year 1846, six years later, that a regular system of taking and recording observations was established. The record since has run uninterruptedly for a period of sixty years till March 1906, when it had to be stopped.

Early in 1900 the City of Bombay decided to have its ordinary tram lines converted into electric traction, and it became at once imperative for the observatory to take early action for the protection of its magnetic work thus threatened. With the certainty of the traction line approaching the observatory to within a mile and-a-half of its site, if not actually passing by it, it appeared extremely problematic if means could be devised by which the danger which threatened the magnetic work could be averted, allowing of the work at Colaba to be continued without being seriously vitiated by the disturbing effects of the traction. It was hence deemed advisable to establish a new observatory at some protected site in the close neighbourhood of Bombay as early as possible before the electric traction commenced its operations, in time to allow of at least a two years concurrent series of magnetic record to be secured simultaneously at the new and old sites, which by a critical comparison may enable the continuity of the long and valuable Bombay record to be preserved. A suitable site was selected at Alibág, about 18 miles away, which is distant enough to be beyond the influence of the electric traction, but near enough to have similar and comparable magnetic conditions; and after securing a duplicate record extending over the years 1904 and 1905 the one at Colaba was finally closed on March 31st, 1906.

2. The principal object of the present volume is to put the observations taken at Colaba throughout the period of 60 years on record, in a single volume in as concise and easily available a form as possible. On account of the heavy labour involved in the various operations and computations and owing to insufficiency of the computing staff, some of the less important data have not been prepared to finality; nor has it been possible for the same reason to take up their discussion in the present volume. It is hoped, however, that this deficiency will be made good from year to year, part by part, in the annual publications of the observatory.

The volume has been conveniently divided into two parts: Part I contains full details of the instruments used, and the various processes of reduction adopted which lead to the final results—the Colaba Magnetic Data. In Part II appear the description of the phenomenon and its general discussion. This division allows of the discussion of the Colaba data to be presented to the reader in a continuous narrative form, though here and there it has not been found possible to avoid referring to some of the results of discussion in Part II, which had thus to be anticipated in Part I.

3. The processes usually adopted to eliminate from the results of observations the instrumental and other unrecognised sources of errors require even under ordinary circumstances great consideration. The difficulties are specially accentuated when the series to be dealt with is a long one extending over several decades and is made up of different portions contributed by instruments of different types of construction, which have to be linked up to form one whole continuous and comparable record. Whenever a single set of instruments has been in action, as has been the case in this and other observatories in the earlier period of their existence, however reliable and accurate its records may seem to be, it cannot be really free from instrumental or other sources of error. A critical comparison of the records of two independent sets of instruments working side by side throughout the period under discussion and showing a close agreement in their results, is the best possible criterion of their absolute accuracy; and whenever it has been found possible, such comparison test has been applied to the Colaba record, and the discrepancies in the results, have been fully investigated and explained.

4. The data are subdivided and discussed under two main heads: (1) The eye observation series for the early period of 1846—1872; and (2) the photographic (magnetograph) series of 1872—1905, the year 1872 being common to the two series.

The various processes which have been adopted in the reductions are given as fully in detail as possible and no step of importance is omitted: all calculations have been checked once and, in not a few cases, has the check operation been repeated twice. Every precaution has been taken to avoid errors from creeping in in the computations; but as the mass of figures dealt with covering the record of such a large period as 60 years, is enormous, it is quite likely that many have escaped notice. However as the several processes are given in full detail, the detection of errors could not be a very difficult matter for the reader.

It has been found expedient at some places to take up the discussion in the reverse order, the results of the more recent period having been taken in hand first. The reasons are obvious: The later series has been derived from instruments which claim to greater precision, and the examination of the working of these instruments in all minor details is on that account made directly possible. This ensures a high degree of reliability of the results so examined, which is not possible in the other (older) series, and proves useful also in throwing light upon the behaviour of the older types of instruments and the series derived from them.

5. The degree of accuracy aimed at is referred to in detail separately under each head, as it must obviously depend upon the capability of each instrument as also upon the factors and conditions involved in the various processes and deductions leading up to the final result. Generally the absolute observations of force are depended upon to be reliably accurate only to 1γ and the variations to $\cdot 1\gamma$, and those for declination and dip to ·1 and ·01 minute of arc respectively for the absolute values and the variations. For convenience of discussion, however, at times, the angle has had to be expressed in minutes and seconds instead of in decimals of a minute. In the analysis for Fourier series and other similar data, the computations have been specially carried to one place more than what appear in the data.

CHAPTER I.

ABSOLUTE INSTRUMENTS.

HORIZONTAL FORCE.

6. The absolute values of the horizontal component of the earth's magnetic force, were determined during the period of 1847 to 1867 by a magnetometer of the kind described in Riddel's Magnetic Instructions, page 66, the full details of which are given in the publication of this observatory for the years 1865—1870. For the later period 1868 to 1905, the observations were made with the Kew Pattern Magnetometer No. 23 by Eliott Bros. supplied to the observatory after being tested at Kew, a description of which, with details of the various constants, will be found in the same volume referred to above. A discussion on the use and behaviour of this instrument and of the constants derived from observations for the period of 37 years it has been in use, follows presently.

7. In regard, however, to the instrument with which the absolute observations of the older series 1847 to 1867 were taken, it must be stated at the outset, that owing to the want of completeness in the formulæ adopted for the reductions, owing to instrumental errors, and uncertainties to which the observations then were liable, and to the fact that the rough construction of the instrument itself precluded the determination of some of the constants altogether and other constants to the necessary degree of accuracy usually expected in these observations, the series can hardly be accepted as even roughly approximate without consideration.

Attempts to improve the series by an examination of the instrumental errors and constants having proved abortive, no weight has been attached to the series, its place being more reliably and with considerable accuracy taken up, as will be seen later, by the series derived from the variation instrument, Grubb's Horizontal Force Magnetometer, the detailed process of the derivation of which is fully given in the life history of this variation instrument described in Chapter III.

8. Taking up the absolute observations of the later period first, the instrument used from 1868 to 1905 was the Kew Unifilar Magnetometer No. 23 by Eliott Bros.

The observations, as is well-known, consist of two parts: (1) The vibration experiment which gives mH, 'm' being the moment of the magnet used, and H the horizontal force of the earth's magnetism; and (2) the deflection experiment which gives $\frac{m}{H}$. By combining the results of these two experiments m and H are derived.

In the first experiment the equation which gives the time of a complete vibration of the magnet is

$$T = \sqrt{4\pi^2 k/mH\ (1+\tau)} \text{ or } mH = 4\pi^2 k/T^2\ (1+\tau) \qquad (1)$$

where k is the moment of inertia of the magnet and τ the torsion of the suspension skein.

In the second experiment the equation of equilibrium is

$$\frac{r^3 H}{2m} \sin u = 1 + \frac{P}{r^2} + \frac{Q}{r^4} \ldots\ldots, \text{ or } \frac{m}{H} = \frac{r^3 \sin u}{2} \Big/ 1 + \frac{P}{r^2} + \frac{Q}{r^4} + \ldots\ldots \qquad (2)$$

where u is angle of deflection, P, Q, etc., are constants of distribution of magnetism, and r is the distance between the deflecting and deflected magnets. The corrections for induction, temperature, etc., have been omitted from the above general expression.

Of the constants of importance those of induction and temperature were supplied by the Kew Observatory, and these were accepted as correct, as no means were locally available for their derivation. The two most important of these constants are the moment of inertia of the magnet and the distribution constant, and the latter is taken in hand for examination and discussion first.

TABLE I.—VALUES OF P_0.

COLABA—STANDARD MAGNETOMETER.

Date of Series.	Number of observations used for the reduction of P_0 during the period.	Values of P_0.	Mean values of P_0 for the group.
1	2	3	4
1867 June 25 to Oct. 16 .	36	-·00609	-·00634 Adopted value.
,, Oct. 16 to 1868 Jan. 15.	28	-·00604	
1868 Jan. 15 to April 1 .	26	-·00657	
,, April 8 to July 1 .	24	-·00635	
,, July 1 to Sept. 23 .	27	-·00667	
,, Sept. 30 to Dec. 23.	24	-·00636	
,, Dec. 23 to 1869 March 10.	26	-·00665	-·00642 Mean of first 15 values of P_0 derived from 381 observations.
1869 Mar. 17 to June 9 .	24	-·00669	
,, June 9 to Sept. 2...	26	-·00652	
,, Sept. 8 to Nov. 24.	24	-·00694	
,, Nov. 24 to Dec. 29.	12	-·00643	
1870 Jan. 5 to Mar. 30 .	26	-·00638	
,, April 6 to June 29.	26	-·00622	
,, July 6 to Sept. 28.	26	-·00618	
,, Oct. 5 to Dec. 28 .	26	-·00626	
1871 Jan. to Mar. ...	26	-·00656	-·00650
,, April to June ...	26	-·00687	
,, July to Sept. ...	26	-·00616	
,, Oct. to Dec. ...	26	-·00643	
1872 Jan. to Mar. ...	26	-·00621	-·00632
,, April to June ...	26	-·00603	
,, July to Sept. ...	26	-·00638	
,, Oct. to Dec. ...	26	-·00665	
1873 Jan. to Mar. ...	26	-·00678	-·00667
,, April to June ...	26	-·00643	
,, July to Sept. ...	26	-·00682	
,, Oct. to Dec. ...	28	-·00665	
1874 Jan. to Mar. ...	24	-·00652	-·00647
,, April to June ...	26	-·00625	
,, July to Sept. ...	28	-·00682	
,, Oct. to Dec. ...	26	-·00630	
1875 Jan. to Mar. ...	26	-·00643	-·00641
,, April to June ...	26	-·00652	
,, July to Sept. ...	26	-·00634	
,, Oct. to Dec. ...	26	-·00634	
1876 Jan. to Mar. ...	26	-·00621	-·00603
,, April to June ...	26	-·00608	
,, July to Sept. ...	26	-·00590	
,, Oct. to Dec. ...	26	-·00594	
1877 Jan. to Mar. ...	26	-·00630	-·00625
,, April to June ...	26	-·00603	
,, July to Sept. ...	26	-·00638	
,, Oct. to Dec. ...	26	-·00630	
1878 Jan. to Mar. ...	26	-·00656	-·00668
,, April to June ...	26	-·00696	
,, July to Sept. ...	26	-·00656	
,, Oct. to Dec. ...	26	-·00665	
1879 Jan. to Mar. ...	26	-·00625	-·00671
,, April to June ...	26	-·00674	
,, July to Sept. ...	26	-·00687	
,, Oct. to Dec. ...	28	-·00700	
1880 Jan. to Mar. ...	26	-·00687	-·00673
,, April to June ...	26	-·00687	
,, July to Sept. ...	26	-·00630	
,, Oct. to Dec. ...	26	-·00687	
1881 Jan. to Mar. ...	26	-·00682	-·00668
,, April to June ...	26	-·00687	
,, July to Sept. ...	26	-·00638	
,, Oct. to Dec. ...	26	-·00665	
1882 Jan. to Mar. ...	26	-·00669	-·00672
,, April to June ...	26	-·00674	
,, July to Sept. ...	26	-·00660	
,, Oct. to Dec. ...	26	-·00687	
1883 Jan. to Mar. ...	26	-·00718	-·00667
,, April to June ...	26	-·00691	
,, July to Sept. ...	26	-·00634	
,, Oct. to Dec. ...	26	-·00625	
1884 Jan. to Mar. ...	26	-·00608	-·00645
,, April to June ...	26	-·00608	
,, July to Sept. ...	26	-·00669	
,, Oct. to Dec. ...	28	-·00696	
1885 Jan. to Mar. ...	24	-·00634	-·00683
,, April to June ...	26	-·00726	
,, July to Sept. ...	28	-·00696	
,, Oct. to Dec. ...	26	-·00678	
1886 Jan. to Mar. ...	26	-·00669	-·00694
,, April to June ...	26	-·00691	
,, July to Sept. ...	26	-·00735	
,, Oct. to Dec. ...	26	-·00682	
1887 Jan. to Mar. ...	26	-·00647	-·00650
,, April to June ...	26	-·00660	
,, July to Sept. ...	26	-·00656	
,, Oct. to Dec. ...	26	-·00638	
1888 Jan. to Mar. ...	26	-·00621	-·00629
,, April to June ...	26	-·00599	
,, July to Sept. ...	26	-·00652	
,, Oct. to Dec. ...	26	-·00643	
1889 Jan. to Mar. ...	26	-·00647	-·00658
,, April to June ...	26	-·00647	
,, July to Sept. ...	26	-·00660	
,, Oct. to Dec. ...	26	-·00678	
1890 Jan. to Mar. ...	26	-·00647	-·00644
,, April to June ...	26	-·00621	
,, July to Sept. ...	26	-·00656	
,, Oct. to Dec. ...	28	-·00652	
1891 Jan. to Mar. ...	24	-·00647	-·00679
,, April to June ...	26	-·00665	
,, July to Sept. ...	28	-·00691	
,, Oct. to Dec. ...	26	-·00713	
1892 Jan. to Mar. ...	26	-·00674	-·00682
,, April to June ...	26	-·00687	
,, July to Sept. ...	26	-·00687	
,, Oct. to Dec. ...	26	-·00682	
1893 Jan. to Mar. ...	26	-·00665	-·00666
,, April to June ...	26	-·00687	
,, July to Sept. ...	26	-·00643	
,, Oct. to Dec. ...	26	-·00669	
1894 Jan. to Mar. ...	26	-·00678	-·00661
,, April to June ...	26	-·00647	
,, July to Sept. ...	26	-·00660	
,, Oct. to Dec. ...	26	-·00660	
1895 Jan. to Mar. ...	26	-·00700	-·00683
,, April to June ...	26	-·00682	
,, July to Sept. ...	26	-·00678	
,, Oct. to Dec. ...	26	-·00674	
1896 Jan. to Mar. ...	26	-·00652	-·00690
,, April to June ...	26	-·00696	
,, July to Sept. ...	28	-·00709	
,, Oct. to Dec. ...	26	-·00704	
1897 Jan to Mar. ...	26	-·00674	-·00678
,, April to June ...	26	-·00660	
,, July to Sept. ...	26	-·00687	
,, Oct. to Dec. ...	26	-·00691	
1898 Jan. to Mar. ...	26	-·00704	-·00660
,, April to June ...	26	-·00660	
,, July to Sept. ...	26	-·00643	
,, Oct. to Dec. ...	26	-·00634	
1899 Jan. to Mar. ...	26	-·00656	-·00654
,, April to June ...	26	-·00656	
,, July to Sept. ...	26	-·00647	
,, Oct. to Dec. ...	26	-·00656	
1900 Jan. to Mar. ...	26	-·00674	-·00661
,, April to June ...	26	-·00660	
,, July to Sept. ...	26	-·00647	
, Oct. to Dec. ...	26	-·00665	
1901 Jan. to Mar. ...	26	-·00652	-·00652
,, April to June ...	26	-·00656	
,, July to Sept. ...	26	-·00643	
,, Oct. to Dec. ...	26	-·00656	
1902 Jan. to Mar. ...	26	-·00634	-·00650
,, April to June ...	26	-·00652	
,, July to Sept. ...	26	-·00660	
,, Oct. to Dec. ...	28	-·00656	
1903 Jan. to Mar. ...	24	-·00665	-·00666
,, April to June ...	26	-·00652	
,, July to Sept. ...	28	-·00660	
,, Oct. to Dec. ...	26	-·00687	
1904 Jan. to Mar. ...	26	-·00652	-·00663
,, April to June ...	26	-·00665	
,, July to Sept. ...	26	-·00674	
,, Oct. to Dec. ...	26	-·00660	

Total number of observations ... = 3929

Mean value of P_0 ... ... = -·00658

Adopted value of P_0 ... ... = -·00634

TABLE 1a.—ANNUAL VALUES OF P_0 OBSERVED AND CALCULATED.

$$P_0 = A + Bt.$$

Values of t.	Years.	Observed values of P_0.	Calculated values of P_0 derived from the formula $P_0 = A + Bt$.	Excesses of observed P_0 over calculated P_0.	Mean P_0 from 1868 to the year.
1	2	3	4	5	6
0	1867		−·00645		
1	1868	−·00643	−·00646	+·00003	−·00643
2	1869	−·00665	−·00646	−·00019	−·00654
3	1870	−·00625	−·00647	+·00022	−·00644
4	1871	−·00652	−·00648	−·00004	−·00646
5	1872	−·00630	−·00648	+·00018	−·00643
6	1873	−·00665	−·00649	−·00016	−·00647
7	1874	−·00647	−·00650	+·00003	−·00647
8	1875	−·00638	−·00650	+·00012	−·00646
9	1876	−·00603	−·00651	[+·00048]	−·00641
10	1877	−·00625	−·00652	+·00027	−·00639
11	1878	−·00669	−·00652	−·00017	−·00642
12	1879	−·00674	−·00653	−·00021	−·00645
13	1880	−·00674	−·00654	−·00020	−·00647
14	1881	−·00669	−·00655	−·00014	−·00648
15	1882	−·00669	−·00655	−·00014	−·00650
16	1883	−·00669	−·00656	−·00013	−·00651
17	1884	−·00643	−·00657	+·00014	−·00651
18	1885	−·00682	−·00657	−·00025	−·00652
19	1886	−·00696	−·00658	[−·00038]	−·00655
20	1887	−·00652	−·00659	+·00007	−·00654
21	1888	−·00630	−·00659	+·00029	−·00653
22	1889	−·00656	−·00660	+·00004	−·00653
23	1890	−·00643	−·00661	+·00018	−·00653
24	1891	−·00678	−·00661	−·00017	−·00654
25	1892	−·00682	−·00662	−·00020	−·00655
26	1893	−·00665	−·00663	−·00002	−·00656
27	1894	−·00660	−·00663	+·00003	−·00656
28	1895	−·00682	−·00664	−·00018	−·00657
29	1896	−·00691	−·00665	−·00026	−·00658
30	1897	−·00678	−·00665	−·00013	−·00658
31	1898	−·00660	−·00666	+·00006	−·00659
32	1899	−·00652	−·00667	+·00015	−·00658
33	1900	−·00660	−·00667	+·00007	−·00658
34	1901	−·00652	−·00668	+·00016	−·00658
35	1902	−·00652	−·00669	+·00017	−·00658
36	1903	−·00665	−·00669	+·00004	−·00658
37	1904	−·00665	−·00670	+·00005	−·00658
Mean ...		−·00658	Adopted value ... = −·00634		

Constants: A = −·00645; B = −·0000068.

9. *The Colaba Standard Magnetometer.*—For the determination of the values of horizontal force the deflection observations have been regularly made at two effective distances and the correction of distribution of magnetism, is applied for the first term only The two distances observed at Colaba are 0·8 foot and 1·0 foot. If the correct distribution correction is previously known, observations at two distances are not necessary; and if δr be the probable error of setting a distance, and δd the error of measurement of the deflection arc, the best conditioned single observation would be at that distance r which would satisfy the equation $\frac{\delta d}{d} = \sqrt{3}\,\frac{\delta r}{r}$. With the usual strength of the Kew type magnets and with the value of force to be measured at about ·374 C. G. S., this distance, if $\delta r = 0·001$ inch and $\delta d = 10$ seconds of arc, works out at about 0·8 foot, which and the next higher distance 1·00 foot have been adopted at Colaba as the observational distances, corresponding practically to two positions 30 c.m. and 40 c.m. adopted in England and at places where the force is about ·187 C. G. S. A double set of observations, is taken every week, giving a total number of 104 observations in the year, each observation consisting of a 'vibration' and 'deflection' experiment. The observed yearly means of P_0 (P may be distinguished as P_0 when derived from the two standard distances adopted at the observatory) and of K_m—the moment of inertia—determined periodically are given in tables 1* and 5 as are also the *adopted* values of each and their mean values for the whole period of 37 years. With the *adopted* values both of P_0 and K_m the values of force at Colaba have been determined throughout the period. Table (4) gives similar data for the moment of standard magnet as derived from observations.

10. The question which is of considerable importance is whether the standard instrument does or does not, apart from observational errors, measure the value of H correctly. The most important constants which must be examined for this purpose are P_0 and K_m.

Considering the distribution constants first, an examination of the mean annual values in table (1a) in column 3 (the values of P_0 are in *English units* for the standard instrument), shows that the mean value of P_0 for the whole period of 37 years is —·00658, while the value *adopted initially and since used unaltered in the reductions*, is —·00634 (*vide* table 1). Though the results show a fairly marked constancy in the value, it is not yet certain if the constants of distribution can be depended upon to remain absolutely the same for any unlimited time. They are suspected in some way, to vary with the moment of the magnet and it may be of interest presently to examine the relation between the two series.

11. Assuming, however, that such váriability does exist, it will be seen that the condition in the series of P_0 derived from some 3900 observations is best expressed by the formula $P_0 = A + Bt$ (A and B being some constants the latter depending upon the time 't' in years reckoned from some convenient starting epoch 1867·5). The result as solved by the method of least squares, shows that A the starting value of P_0 about the years 1867-68, was—·00645, and that B the yearly decrement, which equals about —·0000068, brings it down by slow annual decay to its present value —·00670. A small fall in the value has thus been indicated, and this change, if real, shall have to be taken into account and be examined in connection with the special observations for the full distribution correction and the adoption of the final result. If however, P_0† is assumed to remain constant, the mean value —·00658 (of the whole period) being the best ávailable value, shows that the adopted value —·00634 was over-estimated by ·00024 throughout the period, and the values of H have been, therefore, over-estimated throughout by about 6γ. How far this result compares with that obtained when the *full* distribution correction is allowed for, falls next to be considered.

12. The determination of the exact laws of internal distribution of magnetism, including the question of effective pole distances, is more or less an indeterminate problem. Observations have been known to give values of the effective pole lengths ranging from ·9 to ·7 of the actual length of the magnet. The molecular arrangement in a magnet depends in the first instance upon the physical treatment which the magnet receives when under construction and however careful the manipulation, the smallest difference in treatment, however insignificant it may be in practice, may result in an altogether different molecular arrangement. Theory can scarcely explain such effects, much less take them into account in the calculations, though the magnets may outwardly look precisely similar in dimension and character. As shown by Lamont, on the supposition which is not absolutely correct, that the interaction of two magnets is reduceable to that of four poles—the values of P and Q are given by equations

$$P = 2\lambda^2 - 3\lambda_1^2 \text{ and } Q = 3\lambda^4 - 15\lambda^2\lambda_1^2 + \frac{45}{8}\lambda_1^4 \qquad (3) \text{ and } (4)$$

* The values of P_0 and practically the whole process for the derivation of H by the standard instrument, are in English units and in the discussion which follows, the same unit is referred to.

† It may be noted that no violent fluctuations in the value of P_0, as noticed in other observatories, have occurred at Colaba either in the magnet of the standard magnetometer, or in others which have long been under observation, the probable reason of which has been referred to while discussing the series of the moment of the magnet (paragraph 30).

where λ and λ_1 are the effective semi lengths of the deflecting and deflected magnets. These values at best may be taken as a measure, more of the magnitude of the corrections than of the corrections themselves. To adopt equations (3) and (4) nearerto exact conditions obtaining in practice, Borgen and Chree have further expanded the formulæ, introducing additional terms to compensate for finite cross sections, which though theoretically effective in modifying P, have little or no effect upon the values of Q and the higher terms. Still the theoretical result so derived is of little practical utility. From the dimensions etc. of the standard magnet at Colába the values of P and Q assuming ·8 as the effective pole distance derived from formulæ (3) and (4), work out as $P = -·000395$; $Q = -·0010005$; (or in C. G. S. units $P = -·3723$; $Q = -863·42$). These values, even when allowance is made for the finite cross sections when compared with those experimentally derived, clearly indicate how little theory is helpful in the solution of a complex problem where considerable indefiniteness prevails in the knowledge of the exact conditions which determine the phenomenon.

13. The method usually adopted, either to get P_0 from deflection observations at two distances, or to get P' and Q' from observations at three distances, is more or less a rigid process. There are just as many equations as unknown quantities and no elasticity in the treatment is possible as the errors are wiped out only to reappear accentuated in the final value of H. This difficulty is to a considerable extent minimised by taking as many observations at *well placed* distances between 23 c. m. and 40 c. m. as may consistently be selected and combined to provide for the least probable error. The process furnishes *more* equations than unknown quantities which permits of the values being determined by the method of least squares, allowing the errors either observational or instrumental at each of the distances, *to remain as such errors* and not to affect the value of H, and thus affords a higher degree of probability in favour of an accurate value of H than is possible in the usual way.

14. Magnetometer observations are made for the purpose of determining the correct value of H and the choice therefore practically lies, when for example observations are made at three distances for the determination of P and Q, between (1) the rigid straight line passing through the three observational values forced into equality with a more or less serious shift in the value of H and (2) a line *approximating* to a straight line *but* with a nearly correct value of H determined from a greater number of distances than three [*vide* paragraph 27; and Plate 1, figures 1a and 3a: dotted and continuous lines]. The latter method under conditions which prevail in experimental observations, appears to have some decided advantage and has been made use of, for the purposes of the comparison of magnetometers wherever possible.

With proper precautions it is also advantageous occasionally to observe at a nearer distance than 23 c.m. which is the nearest distance observed in routine work. For obvious reasons however it is necessary to make certain that the laws of distribution remain unvitiated upto the limit of the near distance so fixed upon, for observations. Referring to the question as to how far distribution constants may be neglected, Lloyd observes that at the usual distances of observations all terms beyond that containing the inverse 7th power of the distance need not be taken into account and he defines 'the usual distance' as not being less than three times the length of the deflector. Theory on the interaction of two magnets provides that the distance between the two magnets should be *considerably more* than half the length of the (larger) deflecting magnet. Hence four to five times the semi length of deflector may be deemed sufficient for the requirements of the theory and the graph of experimental observations $\left(\text{of uncorrected} \sqrt{mH \div \frac{m}{H}}\right)$ at the near distance and other further distances should be able to show how near one can safely approach without disturbing the law of distribution. On the other hand, at the nearer distances the corrections due to Q which under ordinary circumstances are small and comparable to the probable errors of observation become appreciably large. This if it be an advantage is not materially affected as the shift or error in the value of H due to the omission of the correction due to R which at the same time acquires an appreciably large value at nearer distances, is by no means of the same order as when Q is neglected at the usual distances 30 and 40 c.m. [*vide* paragraphs 17 and 18.] Besides as the correction due to R though appreciable at the near distance is almost *nil* at the other larger distances, when the observations at all the distances are taken together as in the method of least squares, the error or the shift in the value of H is the mean error of the whole combination which is almost always negligibly small.

15. The Colaba standard instrument for the special purposes of comparison was observed at *five* distances ·7 ft., ·8 ft., ·9 ft. and 1·00 ft. and 1·30 ft. The uncorrected results of 12 double sets of observations were in the first instance corrected by the adopted value of P_0 equal to $-·00634$ and it was seen that while the results at all distances from ·8 ft. to 1·3 ft. fairly agreed with each other within probable errors of observation, at the distance of ·7 ft. a deviation of so much as 11γ

was noted. R was assumed in the first instance to be small and was neglected and five equations of the form $H - P_h r_1^{-2} - Q_h r_1^{-4} = H_1$ (where P_h and Q_h are the distribution constants not in absolute values but in terms of $\frac{H}{2}$ and hence marked P_h, Q_h; and H and H_1 are respectively the correct and uncorrected values of force) were, after elimination of H, solved by the method of least squares and the values of P_h and Q_h and thence those of P and Q were derived. For convenience, the expressions were in the first instance used in the above form instead of in the correct form where the distribution constants are applied to $\frac{m}{H}$. Subsequently however the correct equations were also employed and no appreciable difference was found in the final value of H.

The approximation does not affect the result appreciably as the relation may be expressed in the form

$$D_1 = \frac{m}{H}\left\{ 1 + Pr^{-2} + Qr^{-4} \right\}; \text{ where } D_1 = \frac{m_1}{H_1} \tag{5}$$

This when combined with mH the result of the vibration experiment, gives

$$\frac{m\,H}{D_1} = \frac{H^2}{1 + Pr^{-2} + Qr^{-4}} = H^2\left\{ 1 - (Pr^{-2} + Qr^{-4}) + (Pr^{-2} + Qr^{-4})^2 \ldots\ldots \right\} \tag{6}$$

therefore

$$\sqrt{\frac{m\,H}{D_1}} = H - \frac{H}{2}(Pr^{-2} + Qr^{-4}) + \tfrac{3}{8}H(Pr^{-2} + Qr^{-4})^2 - \tfrac{5}{16}H(Pr^{-2} + Qr^{-4})^3 \text{ nearly.} \tag{7}$$

Let $\sqrt{\frac{m\,H}{D_1}} = H_1$ where H_1 is the value of H uncorrected for distribution. As $(Pr^{-2} + Qr^{-4})^3$ in the last term in the above equation is very small we have

$$H_1 = H - \frac{H}{2}(Pr^{-2} + Qr^{-4}) + \left\{ \tfrac{3}{8}H(Pr^{-2} + Qr^{-4})^2 \right\} \tag{8}$$

and when the expression in the bracket on the right is small then we have $H_1 = H - \frac{H}{2}(Pr^{-2} + Qr^{-4})$ (9)

(with the value of force at Colaba at about ·37400 C. G. S., the effect of the omission of the above expression in the bracket which is greatest at ·7 ft. distance is only about 2γ).

The solution of the equations gave the following values :—

$P' = -·00599$; $Q' = -·0002836$; ($P' = -5·562$, $Q' = -243·6$ in C. G. S. unit). The value of H derived from this distribution correction compared with that derived from the old adopted value of $P_0 = -·00634$, shows an error of about 2γ at 0·8 and 1·0 foot—the standard distances at which the usual observations were made.

16. In dealing with experimental observations however carefully taken the results of a *short* series as the one now considered cannot of course be regarded as absolutely faultless, owing as much to observational as to instrumental and other unrecognised sources of error. An attempt at refinement is possible if the series of P′, Q′ was as long as the one of P_0 at Colaba; but in a short experimental series the taking into account of higher terms in the distribution correction in the full expression for the action of one magnet upon another does not necessarily suggest improvement; for if proper precautions are neglected the process may prove more misleading than advantageous. Though the greatest care has been taken, absolute accuracy is not claimed for the above limited observational set and a careful examination is necessary before their result can be finally accepted as correct. Before this is taken in hand a cursory examination of the salient features of the theory may be found useful.

17. The usual co-efficient correcting fully for distribution is of the form :—$1 + Pr^{-2} + Qr^{-4}\ldots\ldots$

We have ordinarily in a convenient form

$$\frac{m_1}{H_1} = \frac{m}{H}\left\{ 1 + Pr^{-2} + Qr^{-4} \ldots\ldots\ldots\ldots \right\} \tag{10}$$

In practice an approximation is usually attempted by observations at two distances only. This involves the assumption that corrections due to Q, R, etc., are negligibly small and then only does the equality become

$$\frac{m_1}{H_1} = \frac{m}{H}\left(1 + Pr^{-2}\right) \tag{10a}$$

If, however, this assumption is incorrect as it usually is, and the correction due to Q, etc., is appreciably large, the relation would really be expressed by

$$\frac{m_1}{H_1} = \frac{m}{H}\left\{1 + P_0 r^{-2}\right\} + \frac{m}{H}A \qquad (11)$$

where P_0 is not the same as P in (10) and $\frac{m}{H}A$ represents the contribution $\left(\text{some fraction of } \frac{m}{H}\right)$ due to the neglected co-efficients : Neglecting R, we have from (10) and (11)

$$1 + P_0 r_1^{-2} + A = 1 + P r_1^{-2} + Q r_1^{-4} \qquad (12)$$

$$\text{and } 1 + P_0 r_2^{-2} + A = 1 + P r_2^{-2} + Q r_2^{-4} \qquad (13)$$

The constant A in (12) and (13) is of the nature of a small fraction of the whole $\frac{m_1}{H_1}$ suppressed in the process of approximation by observational deflections at two distances only. Its value is not the same for different distances r_1, r_2, r_3, but as the difference is very small A may be taken in both the equations to be practically the same.

Substracting (13) from (12) and simplifying we have—

$$P_0 = P + Q(r_1^{-2} + r_2^{-2}) \qquad (14)$$

adding and simplifying we get

$$P_0 = P + Q(r_1^{-2} + r_2^{-2}) - 2\frac{Q r_1^{-2} r_2^{-2}}{r_1^{-2} + r_2^{-2}} - 2\frac{A}{r_1^{-2} + r_2^{-2}} \qquad (15)$$

From (14) and (15) we have the involved equality

$$A = -Q r_1^{-2} r_2^{-2} \qquad (16)$$

If the term Rr^{-6} is not omitted from equations (12) and (13) since P_0 must remain the same as an observed fact, by similar treatment as above we get from the same equations

$$P_0 = P + Q(r_1^{-2} + r_2^{-2}) + R(r_1^{-4} + r_1^{-2} r_2^{-2} + r_2^{-4}) \qquad (17)$$

$$\text{and } A = -Q r_1^{-2} r_2^{-2} - R\,(r_1^{-4} r_2^{-2} + r_1^{-2} r_2^{-4}) \qquad (18)$$

Observe that P, Q and A in (17) and (18) are not the same as in (14), (15) and (16), if R is appreciably large.

We have seen that the constant A measures the shift or error in the value of $\frac{m}{H}$ as some fraction of the whole which affects the final determination of H in the process of approximation. To find what this fraction is in terms of H, let

$$\frac{m}{H} = D \text{ and } mH = C$$

whence we have $H^2 = \frac{C}{D}$. Suppose mH remains unchanged while $\frac{m}{H}$ changes to D + AD where A is some small fraction. Then we have $H_1^2 = C/D + AD$ and

$$H_1^2 : H^2 :: D : D + AD$$

$$\therefore\ H_1 : H :: 1 : \sqrt{1 + A}$$

$$:: 1 : 1 + \frac{A}{2} \text{ nearly}$$

Hence neglecting a quantity $\frac{A^2}{4}$ the fraction $\frac{A}{2}$ measures the shift or error in parts of H which by formula (16) would be equal to $-H\frac{Q r_1^{-2} r_2^{-2}}{2}$ or by formula (18) to $-H\frac{Q r_1^{-2} r_2^{-2} + R(r_1^{-4} r_2^{-2} + r_1^{-2} r_2^{-4})}{2}$

By going a stage further in the approximation and putting the relation in the form

$$1 + P' r^{-2} + Q' r^{-4} + A = 1 + P r^{-2} + Q r^{-4} + R r^{-6}$$

and treating three such equations involving r_1, r_2, r_3, similarly as before, we have

$$P-P'=R(r_1^{-2}r_2^{-2}+r_2^{-2}r_3^{-2}+r_1^{-2}r_3^{-2}) \qquad (19)$$

$$Q-Q'= -R(r_1^{-2}+r_2^{-2}+r_3^{-2}) \qquad (20)$$

$$\text{and } A=R(r_1^{-2}r_2^{-2}r_3^{-2}) \qquad (21)$$

$$=R\ r_2^{-6} \text{ nearly.} \qquad (22)$$

18. The same results could be directly obtained from (14) and (17). Hence the error or shift in H as shown by equation (12), with the usual values of R is very small even when nearer distances like 18 c.m. and 23 c.m. are involved and if no additional difficulties in the evaluation of Q are otherwise incident, the advantage of the nearer distances becomes obvious by comparing equation (22) with either (16) or (18).

A modification in the form of formula (18) is sometimes useful for practical application.

By adding (12) and (13) including the factor for R we have

$$2A=(P-P_o)\frac{r_1^2+r_2^2}{r_1^2r_2^2}+Q\frac{r_1^4+r_2^4}{r_1^4r_2^4}+R\frac{r_1^6+r_2^6}{r_1^6r_2^6} \qquad (23)$$

As $r_1^2+r_2^2=(r_1-r_2)^2+2r_1r_2$; $r_1^4+r_2^4=(r_1^2-r_2^2)^2+2r_1^2r_2^2$ and so on, we have

$$\begin{aligned}2A=&(P-P_o)\frac{2r_1r_2}{r_1^2r_2^2}+Q\frac{2r_1^2r_2^2}{r_1^4r_2^4}+R\frac{2r_1^3r_2^3}{r_1^6r_2^6}\\ &+(P-P_o)\frac{(r_1-r_2)^2}{r_1^2r_2^2}+Q\frac{(r_1^2-r_2^2)^2}{r_1^4r_2^4}+R\frac{(r_1^3-r_2^3)^2}{r_1^6r_2^6}\end{aligned} \qquad (24)$$

Assuming $r_1 = 23$ c.m. and $r_2 = 30$ c.m. and simplifying we have

$$A=\frac{29}{28}\left(\frac{P-P_o}{r_1r_2}\right)+\frac{8}{7}\frac{Q}{r_1^2r_2^2}+\frac{4}{3}\frac{R}{r_1^3r_2^3} \qquad (25)$$

neglecting expressions in the lower line of equation (24) we have

$$A=\frac{P-P_o}{r_1r_2}+\frac{Q}{r_1^2r_2^2}+\frac{R}{r_1^3r_2^3} \text{ nearly.} \qquad (26)$$

19. If sets of observations at two distances are taken (1) at 18 and 23 c. m., (2) at 23 and 30 c. m., (3) at 30 and 40 c. m., (4) at 20 and 26 c. m. and (5) 26 and 34 c m., any two sets would furnish values of P′ and Q′ which ought theoretically to be the same for all combinations. They may not, however, exactly agree, as more likely they will not, on account of probable errors of observations, or if R is not negligible, or if there are other unrecognised instrumental errors ; but if there is no apparent reason why the result of any one set should be preferred over that of the other as being more accurate, the method of least squares enables the best probable values of P′ and Q′ to be obtained from the slightly discrepant results of individual sets.

20. The process generally adopted in observations is to correct for the natural change in the value of the horizontal force by reducing the result of the deflection experiment as a whole to the mean horizontal force recorded during the vibration experiment. Where refinement is aimed at for any particular investigation, it becomes also necessary to secure readings or tabulations from curves of a variation instrument corresponding to the exact time of the deflection at each distance observed which may perhaps be not necessary if the day is a quiet day.

21. In passing it may also be noted that *ordinarily* the distribution has been applied in the form :—

$$\frac{m}{H}=\frac{m_1}{H_1}\left\{1-P_or_1^{-2}\right\}. \qquad (27)$$

Instead of in the correct form

$$\frac{m}{H}\left(1+Pr_1^{-2}\right)=\frac{m_1}{H_1} \text{ or } \frac{m}{H}=\frac{m_1}{H_1}\frac{1}{1+Pr_1^{-2}} \qquad (28)$$

This is because the correct value of $\frac{m}{H}$ is not initially known and the observed values of $\frac{m}{H}$ are not all the same at all the distances. This will introduce small errors appreciably large at nearer distances, which have to be guarded against if the values of the distribution constants are obtained by including the correction due to Q in the correct formula (28).

22. For the usual process adopted in observations at two distances we have by the approximate formula (27) for *two* distances r_1 and r_2

$$P'_0 = \left(\frac{m_1}{H_1} - \frac{m_2}{H_2}\right) \div \left(\frac{m_1}{H_1} r_1^{-2} - \frac{m_2}{H_2} r_2^{-2}\right) \qquad (29)$$

while with the correct formula we should have

$$P_0 = \left(\frac{m_1}{H_1} - \frac{m_2}{H_2}\right) \div \left(\frac{m}{H} r_1^{-2} - \frac{m}{H} r_2^{-2}\right) \qquad (30)$$

Hence P'_0 in (29) is not the same as P_0 in (30) but bears the ratio of $P_0 : P'_0 :: \frac{m_1}{H_1} r_1^{-2} - \frac{m_2}{H_2} r_2^{-2} : \frac{m}{H} r_1^{-2} - \frac{m}{H} r_2^{-2}$ (30A)

From the relation expressed in (28) for two distances r_1, r_2 substitute in (30A) the values of $\frac{m_1}{H_1}$ and $\frac{m_2}{H_2}$ in terms of $\frac{m}{H}$, and eliminating $\frac{m}{H}$ we have

$$P_0 : P'_0 :: (1 + P_0 r_1^{-2}) r_1^{-2} - (1 + P_0 r_2^{-2}) r_2^{-2} : (r_1^{-2} - r_2^{-2})$$

$$:: (r_1^{-2} - r_2^{-2}) + P_0 (r_1^{-4} - r_2^{-4}) : (r_1^{-2} - r_2^{-2})$$

$$:: 1 + P_0 (r_1^{-2} + r_2^{-2}) : 1$$

$$\therefore P_0 = P'_0 + P_0 P'_0 (r_1^{-2} + r_2^{-2}) \qquad (31)$$

and $$P_0 - P'_0 = P'^2_0 \{r_1^{-2} + r_2^{-2}\} \text{ nearly.}$$

If for example the value of P'_0 is about 7·50 at distances 23 c.m. and 30 c.m, the correct value will be greater by about 1/45 of the whole and work out as 7·67.

23. Having incidentally referred in detail to the various points of importance connected with the question the results of special observations of the standard instrument at ·7, ·8, ·9. 1·00 and 1·30 ft. may now be examined. If the values of P′ and Q′ (as R is neglected P′ and Q′ so derived are not the same P and Q in the full expression, $1 + Pr^{-2} + Qr^{-4} + Rr^{-6}$) derived as the result of the special series of observations are accepted as correct the *theoretical* value of P_0 can be rederived by equation (14) if R is supposed, as it presumably appears to be, negligible. This value is −·00672. The special observations were taken in 1902-1903 and it will be seen from the progression of the series evidenced in the analysis (column 4 table 1*a*) that if the steady fall in the value of P_0 is a real phenomenon, its calculated value about the period 1902-1903 would be −·00669. This is almost the same value (−·00672) indicated by the special observations. If as Borgen points out the ratio of the pole distance of a magnet to its length, the usual initial value of which is ·8, tends to increase as the moment of the magnet diminishes, P theoretically must vary with the moment of the magnet. The moment of the Colába magnet has diminished from ·716 to ·618 (*vide* table 4) and the relation between the two will presently be referred to. Hence accepting for the present this decay as real, it appears that the value −·00634 adopted initially from the beginning was fairly close to the calculated value −·00645. In fact the value −·00642 was obtained by averaging the subsequent series of observations [*vide* Vol. 1865/70 : also table (1) column (4)] but for obvious reasons the old adopted value was allowed to continue. If therefore there was a slow fall in the value of P_0 from −·00645 to −·00670 during the period of 1868—1903, it would follow that the values of P and Q would correspondingly alter ; and as in 1902-1903 corresponding to the value of P_0 = −·00670 we have the values of P′ = −·00599 and Q′ = −·0002836 ; we should have in the year 1868 for the value of P_0 = −·00645 some other corresponding values of P′ and Q′ which however we have no known means to ascertain correctly.

24. The change in the value of P_0 from −·00645 to −·00670 means a shift in the value of H by about 6γ. Whether this is contributed by a change in both P′ and Q′ or in P′ alone, or in Q′ alone is, though valuable from other considerations, a point of secondary importance so long as the shift in H is ascertained correctly. The values of H have been derived at Colába not from a changing value of P_0 but from a constant value = −·00634 ; it is therefore obvious that in 1868 the value of H was over-estimated (by not adopting the full distribution correction) by about 8γ and this over-estimation steadily diminished and stood 35 years later about 1903 at about 2γ or 1γ.

25. Which of the two distribution factors has changed and affected the above progression it is difficult to ascertain. We have a long series of P_0 but not of P′ and Q′. Theory shows that in the process of approximation by observations at two distances, the error in H depends upon an expression involving Q′, etc. (*vide* formula 16 and 18). If therefore the shift in H of 6γ may be ascribed to a change in the

value of P alone, in 1868 the value of the distribution constants would appear to be $P' = -·00575$, $Q' = -·0002836$. Hence only on the correctness of the assumption that Q being small it may remain practically unaffected, is it possible to link up observations extended over a large number of years by an attempt like the above without relying too much on the results of theory so well expounded by Borgen and Chree which involve the complex, and incomplete and not fully understood question of the inter-relation of the distribution constants to the dimensions and pole distances of magnets.

26. On the other hand as the constant (B) in table 1a varying with time in the distribution correction is very small only ·0000068—(*vide* table 1a) much less than the probable errors shown in column (5) table 1a, the evidence as to the reality of the decay may not be regarded as either strong or even sufficient. The mean value of P_0 (—·00658) therefore must be accepted as the best approximation to the true value of P_0. In order to satisfy hence the theoretical relations, it becomes necessary to consider how the difference in the values of P_0 (—·00672 the result of special observation and of —·00658 the average value of the whole period of 37 years) could be reconciled. The former must be considered as faulty by ·00014 and putting P_0 in formula (17) equivalent to —·00658, the difference may then be allowed for and suggested as being due to observational error which is not improbable or to omission of R or some other unknown error. If it is due to R, its value works out to be + ·0000271 (or + 21702 C. G. S.) and the value of P′ and Q′ as obtained from equations (19a) and (20) would alter slightly. In any case the shift in H however, which is the most important and real point for consideration, would remain practically unaffected [*vide* formula (28)].

27. Whichever of the explanations is correct the fact remains that about the year 1902-1903 by the use of the old adopted constant (—·00634) the standard instrument measured the value of H correctly to about 2γ. And this conclusion is strengthened considerably by the comparison of the standard instrument with four other magnetometers by different makers the indications of all of which fall within 2γ of each other. The following table summarises the intercomparison of the results of each instrument by itself, as also their comparison with the results of each other.

TABLE 2.

Name of Instrument.	Maker's Name.	Length of Suspended Magnet.	Length of Deflector Magnet.	Values of P_0 determined with usual two distances. P_0	Difference in H from that of standard instrument using P correction only.	Value of P and Q as determined from several distances. P	Q	Shift in value of H by using P and Q corrections instead of P_0	Difference in H from that of Standard Instrument using P and Q corrections.
1	2	3	4	5	6	7	8	9	10
		Cms.	Cms.		C. G. S. unit.			C. G. S. unit.	
Colába Standard Magnetometer.	Elliot Brothers ...	7·62	9·27	− 5·886	......	− 5·562	− 243·6	− ·00002	......
Magnetometer No. 137 ...	A. Dover Charlton ...	6·40	9·19	+ 6·234	− 00007	+ 7·298	− 556·5	+ ·00005	·00000
Do. No. 7 ...	T. Cooke and Sons ...	6·38	8·94	+ 7·398	− ·00032	+ 9·549	− 569·0	+ ·00032	+ ·00002
Do. No. 3 ...	Cambridge Scientific Instrument Co.	7·62	9·35	− ·4432	− ·00042	+ 2·660	− 1,033·5	+ ·00040	·00000
Do. No. 5 ...	T. Cooke and Sons ...	...	...	+ 6·912	− ·00022	+ 8·335	− 463·5	+ ·00019	− ·00001

The close agreement in the five independent measures of the value of force as shown by the results in the last column of the above table, when the full distribution correction is used, seem to indicate fairly conclusively that the determinations of the Colába Standard instrument can be relied upon so far.

In the inter-comparison of the results of each instrument by itself, when either P_0 or P′ and Q′ corrections are applied, it can be seen at once that if the adopted value of P_0 is not correct, discrepant shifts of H as given in column 9 of the above table must result, as the shift depends theoretically upon Q alone or upon Q and R if the latter is significant (*vide* formula 16 and 18). The apparently wrong shifts indicated in column 9 are in all probability due to observational errors; but it is not equally improbable that they may be due to some unrecognised (instrumental) source of error.

Plate 1, figs. 1 to 10, set forth in detail the results of observations of each instrument at various distances, data of which also appear in table (3).

Colaba Observatory.

Comparison of Magnetometers for the determination of the distribution constants.

Plate I

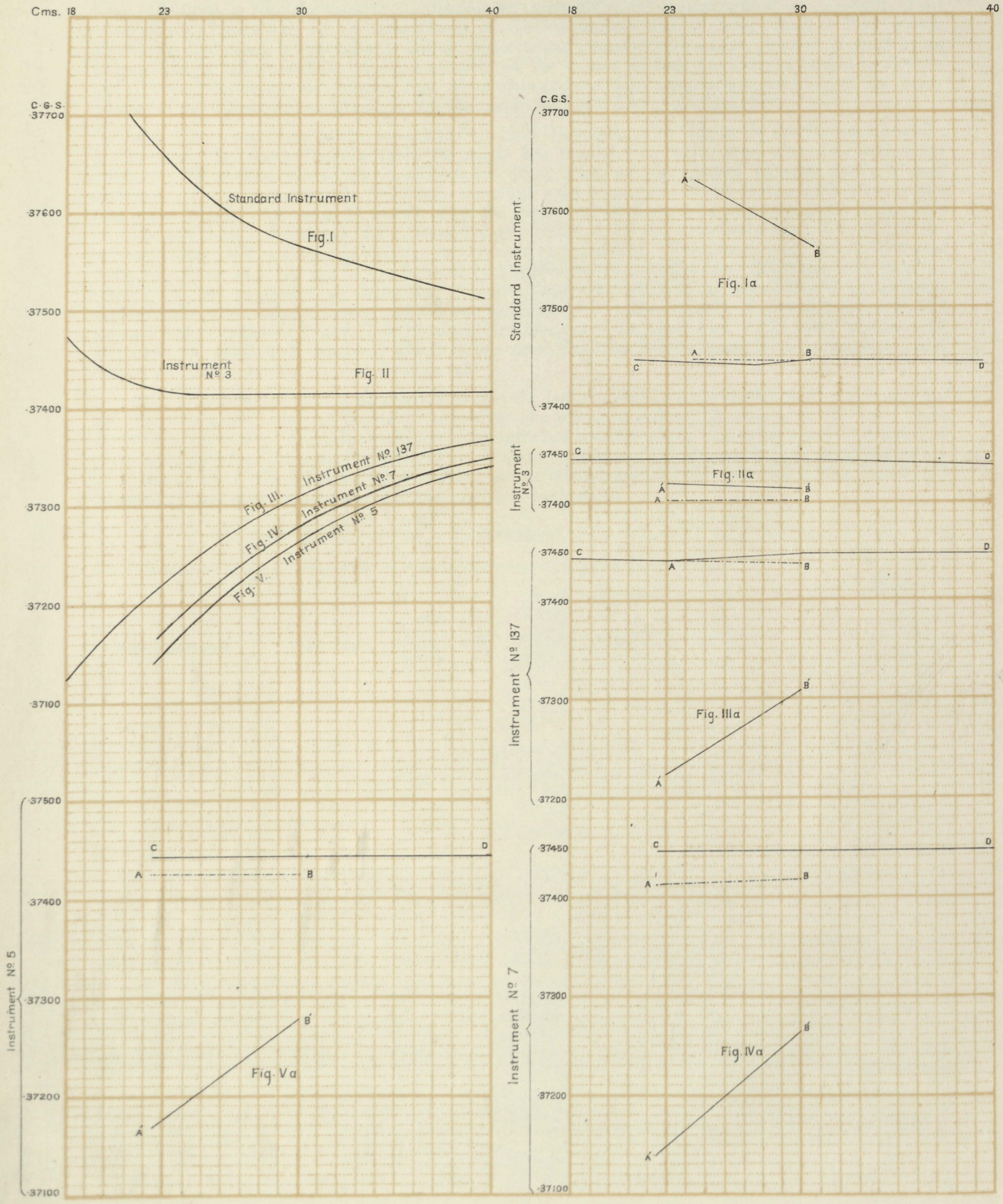


Fig. I to V represent the crude values of force uncorrected for distribution for various instruments.

Fig. Ia to Va:
- A′ B′: curves derived from observations at two distances (uncorrected)
- A B: " " " " " " " corrected for P
- C D: " " " " " several " fully corrected for P & Q

Govt. Photozinco. Office, Poona, 1909.

TABLE 3.—*Comparison of Magnetometers.*

	Distance in Feet.	0·7	0·8	0·9	1·0	1·3	Means.
Standard Magnetometer.	Observed uncorrected values of H	0·37697	0·37630	0·37586	0 37562	0·37510	......
	Correction for the adopted value of P_o (– ·00634) P_o = – 5·886 C. G. S. unit.	- ·00241	– ·00184	– ·00146	– ·00118	– 0·00070	......
	Values of H corrected for P_o	0·37456	0·37446	0 37440	0·37444	0·37440	0·37445
	Correction for P and Q (P = – ·00599, Q = – ·00028) P = – 5·562, Q = – 243·6 C. G. S. unit.	– ·00252	– ·00188	– ·00146	– ·00117	– ·00067	......
	Values of H corrected for P and Q	0 37445	0·37442	0·37440	0·37445	0·37443	0·37443
	Distance in C. M.	18·0	23·0	......	30·0	40·0	......
Magnetometer No. 137.	Observed uncorrected value of H	0·37125	0·37221	......	0·37308	0 37365	......
	Correction for P_o (P_o = +6·234)	+·00355	+ ·00219	......	+·00129	+ ·00073	......
	Values of H corrected for P_o	0·37480	0·37440	.. ...	0·37437	0·37438	0·37438
	Correction for P and Q (P= + 7·298, Q = – 556·5) ...	+·00317	+ ·00219	......	+ ·00138	+ ·00081	......
	Values of H corrected for P and Q	0·37442	0·37440	......	0 37446	0·37446	0·37443
	Distance in C. M.	18·0	23·0	......	30·0	40·0	......
Magnetometer No. 3.	Observed uncorrected values of H	0·37473	0·37418	......	0 37412	0·37420	......
	Correction for P_o (P_o = – ·4432)	· ·00025	– ·00015	......	– ·00009	– ·00006	......
	Values of H corrected for P	0·37448	0·37403	......	0·37403	0·37414†	0 37403
	Correction for P and Q (P=+2·660, Q = + 1033·5) ...	– ·00030	+ ·00025	......	+ ·00031	+ ·00023	......
	Values of H corrected for P and Q	0·37443	·037443	......	0·37443	0·37443	0·37443
	Distance in C. M.	.....	22 5	......	30·0	40·0	......
Magnetometer No. 7.	Observed uncorrected values of H	......	0·37141	......	0·37263	0·37339	......
	Correction for P_o, (P_o* =+7·558)	......	+·00272	......	+ ·00154	+ ·00087	......
	Values of H corrected for P	......	0·37413	......	0·37417	0·37426	0·37415
	Correction for P and Q, (P = +9·549, Q = – 569·0) ...	......	+ ·00304	......	+ ·00182	+ 00106	......
	Values of H corrected for P snd Q	......	0·37445	......	0·37445	0·37445	0·37445
	Distance in C. M.	......	22·5	......	30·0	40 0	......
Magnetometer No 5.	Observed uncorrected values of H	......	·37166	......	0·37279	0·37348	.....
	Correction for P_o (P_o*= +7·084)	......	+·00259	......	+·00146	+ ·00082	......
	Values of H corrected for P	......	0·37425	......	0·37425	0 37430	0·37425
	Correction for P and Q, (P* = 8·325, Q = – 400·1) ...	......	+ ·00276	......	+ ·00163	+ ·00094	......
	Values of H corrected for P and Q	.....	0·37442	......	0·37442	0·37442	0·37442

* All distribution corrections in the table are derived by the use of formula (28).
The values here differ from those in Table 2 due to use of formula (27) in Table (2) for this instrument.

† This value of H at 40 c. m. distance equivalent to about 55 c. m. at places where the force equals ·18000 C. G. S., is uncertain involving either observational or instrumental error at that distance.

28. Whenever a discrepancy is observed between the *adopted* value and the theoretical value of P_o derived from P and Q by the equation $P_o = P+Q\ (r_1^{-2}+r_2^{-2}) + R\ (r_1^{-4}+r_1^{-2}\ r_2^{-2}+r_2^{-4})$ whether partly explainable as above or otherwise it is perhaps advantageous to put the shift or correction in H as determined by experimental observations in the approximate form (*vide* formula (26))

$$\delta H = \frac{H}{2}\left\{\frac{P-P_o}{r_1\, r_2} + \frac{Q}{r_1^2\, r_2^2} + \ldots\ldots\right\} \qquad (32)$$

or in the correct form (*vide* formula (23))

$$\delta H = \frac{H}{4}\left\{(P-P_o)\ \frac{r_1^2+r_2^2}{r_1^2\, r_2^2} + Q\ \frac{r_1^4+r_2^4}{r_1^4\, r_2^4} + \ldots\ldots\right\} \qquad (32A)$$

instead of in the form

$$\delta H = -\frac{H}{2}\left\{Q r_1^{-2} r_2^{-2} + \ldots\ldots\right\} \tag{33}$$

The discrepancy may be due as much to observational error as to R; to unrecognised peculiarities of the magnet, *to a progression in the value of P*; to instrumental error so well pointed out lately in detail by Chree; or to all these causes combined. Observational errors of the nature of personal habit or bias though constant like some instrumental errors introduce, errors in the value of H, different at different distances, vitiating the correct law of distribution. When R is negligibly small the instrumental factors perfect and no observational errors are involved then only is the relation.

$$P - P_c = -Q\,\frac{r_1^2 + r_2^2}{r_1^2\, r_2^2} \tag{34}$$

satisfied and the shift $\delta H = -\frac{H}{2} Q\, r_1^{-2} r_2^{-2}$

29. Incidentally it may be mentioned that the instrumental errors discussed by Chree cannot be isolated from the observational values. Using Chree's* notations and formula we have :—

ϕ inclination of the deflected magnet to the meridian.

$90+\theta$,, ,, to the line joining the magnets.

χ = inclination of the deflecting magnet.

ψ = ,, ,, to horizon.

z = height of centre of deflecting magnet.

r = distance between the two magnets.

and

$$H \sin\phi = 2\, m\, r^{-3} \cos\psi \cos\chi \cos\theta\, (1 - \tfrac{1}{2}\tan\theta\tan\chi) \times \left[1 - \frac{3z^2}{r^2}(1 + \ldots\ldots + \frac{2\lambda^2}{r^2}(1 - \ldots\ldots - \frac{3\lambda_1^2}{r^2}(1 + \ldots\ldots + \frac{3}{2}\frac{z}{r}\tan\psi\,(1 + \ldots\ldots\right] \tag{35}$$

The expression on the right may be taken for all practical purposes to be roughly equivalent to

$$A + Br^{-1} + Cr^{-2} + Dr^{-3} + Er^{-4} + \ldots\ldots$$

where the co-efficients of r^{-1} and r^{-3} may be taken to depend upon the probable errors and instrumental and other defects due to various causes. As constants A, C, E, would already be involved and represented in the results as given by the usual process ín the evaluation of P and Q, the remaining factors particularly Br^{-1} may be specially taken as an appreciable and effective vitiating factor, and be requisitioned to explain away the small discrepancies like those noted in the observations referred to.. The inclusion of the alternate factors Br^{-1} ...... in the equations for finding P and Q as used in paragraph (15) would at any rate serve a useful purpose by indicating that the results of observations are not seriously faulty.

30. From the consideration of the distribution constants by themselves, the next step is to see how far the interrelation between them and the moment of the standard magnet is evidenced in the Colába series.

From the usual weekly observations of force, the monthly and annual means of the moment of the standard magnet (No. 23) have been derived. The weekly observational values have been published from year to year in the volumes of the Observatory. The monthly and annual means are collected in table 4 in the last column of which are also given the annual decrement in the moment.

The magnetic moment of a magnet diminishes rapidly at first and then slowly as time advances. This change is however, interfered with, in its regular decay by mechanical concussions or from a too near proximity of other magnets or any heavy mass of iron. The disturbing effects of these causes have been minimised at Colába as much as practicable. The magnet has been very carefully handled and when not in use it has been carefully placed in a special receptacle away from all heavy mass of iron and always with the marked end in one direction—in the magnetic meridian. The deflector and deflecting magnets were besides kept in separate boxes and away from each other. These precautions have not improbably contributed to the steadiness in the value of P_0 which is known elsewhere in other observatories to have large fluctuations.

* Proc. Phys. Society, London, Vol. XIX.

TABLE 4.—*Mean monthly values of (observed) moment of standard magnet of Colába Standard Magnetometer.*

Years.	Month.												Year.	Yearly decrement.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.		
1867 ...	...	...	...	...	...	...	...	·77324	·76902	·76670	·76314	·76099	...	
1868 ...	·75850	·75730	·75455	·74928	·74347	·74019	·73831	·73652	·73421	·73195	·72723	·72427	·74131	
1869 ...	·72358	·72365	·72170	·72023	·71886	·71597	·71389	·71262	·71118	·71004	·70874	·70694	·71562	·02569
1870 ...	·70672	·70582	·70552	·70437	·70378	·70258	·69964	·69924	·69804	·69607	·69578	·69380	·70095	·01467
1871 ...	·69323	·69284	·69253	·69228	·69125	·69015	·68937	·68942	·68908	·68883	·68785	·68689	·69031	·01064
1872 ...	·68605	·68621	·68597	·68572	·68543	·68389	·68229	·68195	·68191	·68153	·68095	·68067	·68355	·00676
1873 ...	·67955	·67924	·67916	·67891	·67831	·67746	·67666	·67544	·67514	·67512	·67507	·67462	·67706	·00649
1874 ...	·67382	·67378	·67373	·67364	·67336	·67279	·67239	·67233	·67180	·67186	·67120	·67102	·67264	·00442
1875 ...	·67051	·67009	·67019	·66995	·66960	·66895	·66860	·66826	·66796	·66781	·66764	·66737	·66891	·00373
1876 ...	·66697	·66699	·66711	·66732	·66722	·66665	·66612	·66594	·66597	·66575	·66549	·66498	·66638	·00253
1877 ...	·66432	·66405	·66391	·66380	·66346	·66306	·66292	·66277	·66255	·66222	·66217	·66170	·66308	·00330
1878 ...	·66163	·66129	·66120	·66100	·66078	·66038	·65992	·65973	·65955	·65962	·65936	·65921	·66031	·00277
1879 ...	·65886	·65873	·65852	·65838	·65798	·65787	·65773	·65761	·65755	65723	·65711	·65692	·65787	·00244
1880 ...	·65648	·65674	·65664	·65639	·65611	·65554	·65549	·65525	·65514	·65494	·65475	·65476	·65569	·00218
1881 ...	·65469	·65425	·65434	·65407	·65384	·65353	·65337	·65306	·65321	·65297	·65295	·65256	·65357	·00212
1882 ...	·65251	·65236	·65236	·65212	·65193	·65162	·65140	·65129	·65106	·65075	·65079	·65082	·65158	·00199
1883 ...	·65058	·65051	·65063	·65053	·65054	·65030	·64976	·64952	·64940	·64960	·64936	·64936	·65001	·00157
1884 ...	·64914	·64907	·64891	·64885	·64915	·64898	·64831	·64813	·64798	·64800	·64759	·64715	·64844	·00157
1885 ...	·64725	·64706	·64703	·64700	·64673	·64648	·64624	·64616	·64614	·64595	·64597	·64586	·64649	·00195
1886 ...	·64561	·64547	·64548	·64541	·64535	·64489	·64512	·64472	·64464	·64469	·64427	·64405	·64497	·00152
1887 ...	·64414	·64438	·64409	·64390	·64404	·64372	·64361	·64345	·64337	·64346	·64353	·64353	·64377	·00120
1888 ...	·64337	·64339	·64307	·64299	·64288	·64265	·64237	·64233	·64239	·64246	·64218	·64210	·64268	·00109
1889 ...	·64196	·64186	·64183	·64176	·64162	·64140	·64142	·64121	·64118	·64122	·64107	·64076	·64144	·00124
1890 ...	·64088	·64077	·64069	·64059	·64052	·64041	·64007	·64008	·63995	·64002	·63986	·63976	·64030	·00114
1891 ...	·63983	·63968	·63945	·63933	·63924	·63910	·63892	·63887	·63868	·63875	·63866	·63851	·63908	·00122
1892 ...	·63853	·63849	·63849	·63827	·63825	·63762	·63781	·63792	·63798	·63803	·63803	·63791	·63811	·00097
1893 ...	·63779	·63769	·63743	·63727	·63706	·63699	·63690	·63674	·63677	·63685	·63684	·63665	·63708	·00103
1894 ...	·63658	·63661	·63628	·63657	·63649	·63612	·63616	·63606	·63607	·63599	·63601	·63563	·63621	·00087
1895 ...	·63581	·63560	·63569	·63570	·63570	·63526	·63508	·63513	·63522	·63539	·63523	·63498	·63540	·00081
1896 ...	·63500	·63496	·63484	·63476	·63475	·63477	·63454	·63435	·63452	·63445	·63462	·63452	·63467	·00073
1897 ...	·63441	·63415	·63413	·63399	·63385	·63369	·63337	·63373	·63368	·63369	·63363	·63356	·63382	·00085
1898 ...	·63358	·63305	·63327	·63304	·63299	·63277	·63281	·63276	·63270	·63267	·63269	·63281	·63293	·00089
1899 ...	·63202	·63141	·63122	·63122	·63083	·63092	·63092	·63069	·63086	·63082	·63079	·63068	·63103	·00190
1900 ...	·63063	·63068	·63069	·63041	·63059	·63037	·63045	·63033	·63032	·63031	·63020	·63029	·63044	·00059
1901 ...	·63019	·63028	·63032	·62991	·62990	·62981	·62985	·62977	·62971	·62980	·62979	·62987	·62993	·00051
1902 ...	·62984	·62975	·62960	·62951	·62929	·62926	·62929	·62931	·62933	·62918	·62928	·62940	·62942	·00051
1903 ...	·62933	·62928	·62913	·62899	·62894	·62851	·62856	·62875	·62869	·62847	·62831	·62887	·62882	·00060
1904 ...	·62792	·62808	·62833	·62829	·62822	·62823	·62822	·62822	·62812	·62811	·62825	·62810	·62817	·00065

31. An examination of the series in column 3, table $4a$ showed that it was possible to reduce it to some simple law and after trials the following equation was used :—

$$\Delta\ M = A + Bt^{-1}$$

where ΔM is the annual decrement of the moment, t is the time in years reckoned from the starting year 1868·0 and A and B are some constants. The values of the constants were derived in the usual way by the method of least squares and the calculated values of ΔM were found to agree fairly well throughout the period with the observed values, except for the year intervals 1868-69, 1870-71, 1872-73, 1875-76, 1884-85 and 1898-99. These faulty intervals were hence omitted from the 36 values and fresh calculations were made from which the values of the constants A and B were finally rederived. These are given at the foot of the table $4a$ while column 4 gives the calculated values of ΔM from which the figures in the succeeding columns have been calculated.

Column 9 which gives the differences between the observed and calculated moments, shows how far the equation actually represents the true conditions.

The faulty years are clearly marked and show that with the exception of the interval 1875-76 which indicates a small retardation in the rate of loss, all the other cases exhibit an abrupt excess in the decrement of the moment. These dislocations appear in column 6 the most serious of which is that of 1898-99 indicating an abrupt loss of moment of ·00119, when the annual decrement amounts to ·00071 only. This is due to the severe concussion which the magnet was known to have received (it had dropped from the observer's hand on to the top of the observation pillar fortunately without any other serious injury) on 4th January 1899. The observations, that day [*vide* Volume 1898-99, Table of results of absolute magnetical observations, page 15], clearly show the effect of the mischief. There is a sudden drop in the observed value of the moment, as compared with those of previous observations and what is of graver significance, it had resulted also in a sudden and temporary dislocation of the distribution constant. The value of H which by the application of the correction due to the adopted value of P_0 should give almost equal values at the two distances of observation, gave that day a difference of as much as ·0050 English Units or ·00022 C. G. S. Units (page 15, Table of results of absolute observation Volume, 1898-99). Subsequent weekly observations, however, showed that while the loss in the moment of the magnet was of course permanent, the disturbing effect on the distribution constant was of a temporary character only and had passed away before the next observation day leaving no appreciable permanent change.

32. The magnitudes of similar abrupt losses or dislocations in other years had, it will be seen from columns 5 and 6, never been nearly so large, and being within the limit of the annual rate of loss they are well masked by irregularities and probable errors of observation. The accident of January 1899, so well marked in the series of M, has no corresponding movement indicated in the annual means of P_0 (table 1a) as naturally such parallel movement would be exhibited if the disturbance had permanently affected the distribution constant.

33. Evidence of such abrupt and parallel movements in the annual means of P_0 (*vide* column 5, table 1a) though very small and unconvincing, is, however, noticeable in the year 1876 and 1885-1886 which record the large errors, ·00048, ·00025 and ·00038. These years happen to be common to the disturbed years indicated in column 6 of the moment series, and the parallelism of the movements in magnitude and direction is fairly marked. If the calculated series of P_0 and M and the two formulæ are accepted as correctly representing the condition and progressive decay of each element in the Colába magnet, it follows that $P_0\sqrt[4]{M}$ would approximately be a constant quantity. This is shown in columns 6 and 7, table 4b.

34. We have seen how far, in view of the small uncertainty in the distribution constant, the absolute determinations of force by the Colába standard magnet can be relied upon for accuracy; and the constant which falls next to be examined is that of the moment of inertia. The values of π^2 K communicated from Kew, and those adopted in the reductions of the standard and other instruments, with their mean observed values to date, have been collected for reference in table 5a.

A detailed examination of the values of *moment of inertia* of the standard magnet derived from observations at Colába may be of special interest as the values collected extend over a period of 37 years.

In the vibration experiment which gives the values of mH the most important constant involved is K_m the moment of inertia of the magnet. The equation of motion is

$$K_m \frac{d^2\theta}{dt^2} + mH \sin\theta = 0; \qquad (36)$$

and if θ, the arc of vibration, is kept as small as possible,

we have $K_m \frac{d^2\theta}{dt^2} + m\,H\theta = 0$ (37)

Hence T, the time of a small oscillation, is given by the equation $T = 2\pi\sqrt{\frac{K_m}{mH}}$ (38)

We have also $mH = \frac{4\pi^2 K_m}{T^2}$ (39)

TABLE 4*a*.—*Annual values of observed and calculated moment of the standard magnet calculated* $\Delta M = A + Bt^{-1}$.

Year.	Values of M or (moment).	Yearly decrement of M or ΔM.	Calculated ΔM.	Difference of ΔM and calculated ΔM or column 3—column 4.	Dislocation or abrupt change in the value of M.	Values of t.	Calculated values of M.	Difference of M and calculated M or column 2—column 8.
1	2	3	4	5	6	7	8	9
1869 ...	·71562	...	...	...	...	...	·71577	−·00015
1870 ...	·70095	·01467	·01445	+·00022	...	2	·70132	−·00037
1871 ...	·69031	·01064	·00956	...	+·00108	3	·69068	−·00037
1872 ...	·68355	·00676	·00711	−·00035	...	4	·68357	−·00002
1873 ...	·67706	·00649	·00564	...	+·00085	5	·67708	−·00002
1874 ...	·67264	·00442	·00466	−·00024	...	6	·67242	+·00022
1875 ...	·66891	·00373	·00396	−·00023	...	7	·66846	+·00045
1876 ...	·66638	·00253	·00343	...	−·00090	8	·66593	+·00045
1877 ...	·66308	·00330	·00303	+·00027	...	9	·66290	+·00018
1878 ...	·66031	·00277	·00270	+·00007	...	10	·66020	+·00011
1879 ...	·65787	·00244	·00243	+·00001	...	11	·65777	+·00010
1880 ...	·65569	·00218	·00221	−·00003	...	12	·65556	+·00013
1881 ...	·65357	·00212	·00202	+·00010	...	13	·65354	+·00003
1882 ...	·65158	·00199	·00186	+·00013	...	14	·65168	−·00010
1883 ...	·65001	·00157	·00172	−·00015	...	15	·64996	+·00005
1884 ...	·64844	·00157	·00160	−·00003	...	16	·64836	+·00008
1885 ...	·64649	·00195	·00149	...	+·00046	17	·64641	+·00008
1886 ...	·64497	·00152	·00139	+·00013	...	18	·64502	−·00005
1887 ...	·64377	·00120	·00131	−·00011	...	19	·64371	+·00006
1888 ...	·64268	·00109	·00123	−·00014	...	20	·64248	+·00020
1889 ...	·64144	·00124	·00116	+·00008	...	21	·64132	+·00012
1890 ...	·64030	·00114	·00110	+·00004	...	22	·64022	+·00008
1891 ...	·63908	·00122	·00104	+·00018	...	23	·63918	−·00010
1892 ...	·63811	·00097	·00098	−·00001	...	24	·63820	−·00009
1893 ...	·63708	·00103	·00094	+·00009	...	25	·63726	−·00018
1894 ...	·63621	·00087	·00089	−·00002	...	26	·63637	−·00016
1895 ...	·63540	·00081	·00085	−·00004	...	27	·63552	−·00012
1896 ...	·63467	·00073	·00081	−·00008	...	28	·63471	−·00004
1897 ...	·63382	·00085	·00077	+·00008	...	29	·63394	−·00012
1898 ...	·63293	·00089	·00074	+·00015	...	30	·63320	−·00027
1899 ...	·63103	·00190	·00071	...	+·00119	31	·63130	−·00027
1900 ...	·63044	·00059	·00068	−·00009	...	32	·63062	−·00018
1901 ...	·62993	·00051	·00065	−·00014	...	33	·62997	−·00004
1902 ...	·62942	·00051	·00062	−·00011	...	34	·62935	+·00007
1903 ...	·62882	·00060	·00060	·00000	...	35	·62875	+·00007
1904 ...	·62817	·00065	·00058	+·00007	...	36	·62817	·00000

Constants ; A = −·0002430 ; B = +·029387.

TABLE 4*b*

Year.	Values of M derived from observations.	Values of P_o derived from observations.	Values of M calculated by a formula.	Values of P_o calculated from a formula.	Values of $P_o \sqrt[4]{M}$ from observed series.	Values of $P_o \sqrt[4]{M}$ from calculated series.	Difference or column 6—column 7.
1	2	3	4	5	6	7	8
1869 ...	·71562	−·00665	·71577	−·00646	·00612	·00594	+·00018
1870 ...	·70095	−·00625	·70132	−·00647	·00572	·00592	−·00020
1871 ...	·69031	−·00652	·69068	−·00648	·00594	·00591	+·00003
1872 ...	·68355	−·00630	·68357	−·00648	·00573	·00589	−·00016
1873 ...	·67706	−·00665	·67708	−·00649	·00603	·00589	+·00014
1874 ...	·67264	−·00647	·67242	−·00650	·00586	·00589	−·00003
1875 ...	·66891	−·00638	·66846	−·00650	·00577	·00588	−·00011
1876 ...	·66638	−·00603	·66593	−·00651	·00545	·00588	−·00043
1877 ...	·66308	−·00625	·66290	−·00652	·00564	·00588	−·00024
1878 ...	·66031	−·00669	·66020	−·00652	·00603	·00588	+·00015
1879 ...	·65787	−·00674	·65777	−·00653	·00607	·00588	+·00019
1880 ...	·65569	−·00674	·65556	−·00654	·00606	·00588	+·00018
1881 ...	·65357	−·00669	·65354	−·00655	·00602	·00589	+·00013
1882 ...	·65158	−·00669	·65168	−·00655	·00601	·00589	+·00012
1883 ...	·65001	−·00669	·64996	−·00656	·00601	·00589	+·00012
1884 ...	·64844	−·00643	·64836	−·00657	·00577	·00590	−·00013
1885 ...	·64649	−·00682	·64641	−·00657	·00612	·00589	+·00023
1886 ...	·64497	−·00696	·64502	−·00658	·00624	·00590	+·00034
1887 ...	·64377	−·00652	·64371	−·00659	·00584	·00590	−·00006
1888 ...	·64268	−·00630	·64248	−·00659	·00564	·00590	−·00026
1889 ...	·64144	−·00656	·64132	−·00660	·00587	·00591	−·00004
1890 ...	·64030	−·00643	·64022	−·00661	·00575	·00591	−·00016
1891 ...	·63908	−·00678	·63918	−·00661	·00606	·00591	+·00015
1892 ...	·63811	−·00682	·63820	−·00662	·00610	·00592	+·00018
1893 ...	·63708	−·00665	·63726	−·00663	·00594	·00592	+·00002
1894 ...	·63621	−·00660	·63637	−·00663	·00589	·00592	−·00003
1895 ...	·63540	−·00682	·63552	−·00664	·00609	·00593	+·00016
1896 ...	·63467	−·00691	·63471	−·00665	·00617	·00594	+·00023
1897 ...	·63382	−·00678	·63394	−·00665	·00605	·00593	+·00012
1898 ...	·63293	−·00660	·63320	−·00666	·00589	·00594	−·00005
1899 ...	·63103	−·00652	·63130	−·00667	·00581	·00595	−·00014
1900 ...	·63044	−·00660	·63062	−·00667	·00588	·00594	−·00006
1901 ...	·62993	−·00652	·62997	−·00668	·00581	·00595	−·00014
1902 ...	·62942	−·00652	·62935	−·00669	·00581	·00596	−·00015
1903 ...	·62882	−·00665	·62875	−·00669	·00592	·00596	−·00004
1904 ...	·62817	−·00665	·62817	−·00670	·00592	·00596	−·00004

It is possible to work out the value of K_m theoretically if the magnet is of some regular shape, but as it is usually carried by a stirrup of irregular form, its moment of inertia can only be indirectly obtained by experiment. This is done by observing the period of the magnet first by itself and then with its moment of inertia increased by a known amount by the addition of an auxiliary cylinder in the carrier of the magnet. If T_1 and T are the periods of vibration with and without the auxiliary cylinder and K_c the known moment of inertia of the auxiliary bar, we have

$$\frac{K_m}{T^2} = \frac{K_m + K_c}{T_1^2} \tag{40}$$

$$\text{whence } K_m = K_c \frac{T^2}{T_1^2 - T^2} \tag{41}$$

Applying the necessary correction we have

$$K_m = K_c \frac{T^2 \{1 + 2\ (e\text{-}é)\ (t'_v - 80°)\}}{T_1^2 \left(1 + \frac{dH}{H}\right)\{1 + 2é\ (t^o_v - t'^o_v)\} - T^2} \tag{42}$$

e and é being the linear expansion of brass and steel respectively; t^o_v and t'^o_v being the temperature during the vibration experiment without and with the inertia cylinder respectively.

The value of K_m so derived experimentally from month to month and year to year from 1868 to 1904 are given in table 5.

The value of K_m communicated in 1868 in the certificate from Kew was 4·2071 while that adopted at Colaba —the mean of a series of five sets of observations was 4·2030 *which value has been* used throughout the period in the reductions.

35. A glance at the table shows that while the mean values of K_m to date in column 5 show a fairly close approximation to the adopted value used in the reductions throughout the period of 37 years, their values as given by single determinations however are somewhat divergent. It is difficult to believe how observers who have been trained for years to their work and whose probable error of a single determination of the value of horizontal force (which among other factors involves the determination of the time of vibration of the magnet without the inertia cylinder) is not greater than ·00025 of the whole force, can in the vibration experiment *with* the inertia cylinder allow errors of a considerably large magnitude to creep in in their results.

36. Another feature disclosed in the series is a small but unmistakable growth in the value of K_m which should theoretically be an absolute constant. The mean annual values of K_m for the period 1868 to 1888 (*vide* column 4) are as consistently above 4·2000 as they are thereafter in the later period below this value. It can hardly be explained as a result of probable errors, and this discrepancy, along with that alluded to in paragraph 35 tends to strengthen the suspicion that the observations are probably affected by some as yet unrecognised source of error which the theory of the experiment possibly omits to take into account.

37. Referring to the cause of the uncertainty in the accurate determination of the exact period of vibration of the magnet loaded with the inertia bar, it may be noted that the same force has to move almost treble the mass when the inertia bar is mounted and the period becoming slow (the period of vibration of the Colaba Standard Magnet with the inertia bar is over 5 seconds) the laboured motion may become sensitive and susceptible to interference by what in other circumstances would be regarded as insignificant factors. Small convective and other irregular currents of air in the magnet chamber, however well closed it may be, may be sufficiently effective in disturbing the weakened and slow swing of the magnet. To those familiar with the behaviour of delicately adjusted horizontal or other pendulums of a large and sometimes even moderate period of oscillations, this disturbing effect is well known. It is therefore, conceivable that such disturbing effects may be responsible to some extent at least for the large fluctuations noticed in the values of single observations. This effect, it was experimentally ascertained could to some extent be reduced by increasing the semi-arc of vibration which has been usually kept here within 25′, to the maximum allowable limit 100′ which, with the proper correction, enables more consistent values of K_m to be secured.

38. Another seemingly plausible though not probable source of error was also examined. The magnet rests in its carrier once for all initially adjusted and compensated for dip. The centre of gravity of the mass would thus have a definite position in relation to the axis of rotation. When the auxiliary cylinder is introduced, this departure of the centre of mass from the axis of rotation may be appreciably altered by the cylinder resting in slightly different positions in different experiments. Though this source of error is fairly secured against by the reading of the vertical scale, the steady growth in the dip extending over a period of 37 years, may introduce an alteration of conditions. To find whether this could have any appreciable effect, experiments were performed by setting the cylinder in two extreme positions in the carrier so as to allow the vertical scale in the magnet to be just visible at the top and at the bottom alternately in the field of view. In both cases the change in the value of K_m was found to be small, but from the magnitude of the change it appeared to be unlikely that any small variation in the position of the cylinder

TABLE 5.—*Values of K_m.*

Date of observation.	Number of observations upto date.	Values of Km. of each observation.	Yearly mean values of Km.	Mean value of Km. to date.
1	2	3	4	5
1868.				
July 16 ...	1	4·2036		
,, 22 ...	2	4·2045		Adopted value = 4·2030
,, 29 ...	3	4·1968		
Aug. 5 ...	4	4·2046		
,, 12 ...	5	4·2055		
,, 19 ...	6	4·2042		
,, 26 ...	7	4·2064		Value communicated from Kew = 4·2071
Sept. 2 ...	8	4·2082		
,, 9 ...	9	4·1995		
,, 23 ...	10	4·1963		
,, 30 ...	11	4·2003		
Oct. 7 ...	12	4·2034	4·2017	4·2017
,, 14 ...	13	4·2054		
,, 21 ...	14	4·2085		
,, 28 ...	15	4·1986		
Nov. 4 ...	16	4.1917		
,, 11 ...	17	4·1959		
,, 18 ...	18	4·2053		
,, 25 ...	19	4·2024		
Dec. 2 ...	20	4·2040		
,, 9 ...	21	4·2050		
,, 16 ...	22	4·1905		
,, 30 ...	23	4·1994		
1869.				
Jan. 13 ...	24	4·1954		
,, 20 ...	25	4·2001		
,, 27 ...	26	4·1916		
Feb. 3 ...	27	4·1812		
,, 10 ...	28	4·1786		
,, 17 ...	29	4·1875		
Mar. 3 ...	30	4·1814		
April 7 ...	31	4·1960	4·1969	4·1998
May 12 ...	32	4·2136		
June 2 ...	33	4·1991		
July 7 ...	34	4·1887		
Aug. 7 ...	35	4·2072		
Sept. 2 ...	36	4·2017		
Oct. 6 ...	37	4·2185		
Nov. 10 ...	38	4·1985		
Dec. 1 ...	39	4·2113		
1870.				
Jan. 5 ...	40	4·2031		
Feb. 9 ...	41	4·2109		
Mar. 2 ...	42	4·2029		
April 6 ...	43	4·2061		
May 11 ...	44	4·2208		
June 1 ...	45	4·2244		
July 6 ...	46	4·1960	4·2061	4·2013
Aug. 3 ...	47	4·1942		
Sept. 14 ...	48	4·1964		
Oct. 5 ...	49	4·2044		
Nov. 9 ...	50	4·2062		
,, 16 ...	51	4·2111		
Dec. 7 ...	52	4·2024		
1871.				
Jan. 11 ...	53	4·2019		
Feb. 1 and 2	54	4·2047		
Mar. 8 ...	55	4·2055		
April 12 ...	56	4·2020		
May 17 ...	57	4·2126		
June 7 ...	58	4·2060	4·2043	4·2019
July 12 ...	59	4·2088		
Aug. 2 ...	60	4·1990		
Sept. 6 ...	61	4·2045		
Oct. 6 ...	62	4·1719		
Nov. 1 ...	63	4·2128		
Dec. 6 ...	64	4·2221		

Date of observation.	Number of observations upto date.	Values of Km. of each observation.	Yearly mean values of Km.	Mean value of Km. to date.
1	2	3	4	5
1872.				
Jan. 10 ...	65	4·2109		
Feb. 14 ...	66	4·2141		
Mar. 6 ...	67	4·2148		
April 10 ...	68	4·2133		
May 1 ...	69	4·2087		
June 5 ...	70	4·2154		
July 10 ...	71	4·2134	4·2121	4·2035
Aug. 14 ...	72	4·2037		
Sept. 4 ...	73	4·2063		
Oct. 9 ...	74	4·2066		
Nov. 13 and 15.	75	4·2204		
Dec. 4 ...	76	4·2173		
1873.				
Jan. 10 ...	77	4·2129		
Feb. 12 ...	78	4·2096		
Mar. 19 ...	79	4·2075		
April 9 ...	80	4·2070		
May 14 ...	81	4·2091		
June 4 ...	82	4·2040	4·2086	4·2042
July 9 ...	83	4·2068		
Aug. 13 ...	84	4·2047		
Sept. 3 ...	85	4·2077		
Oct. 8 ...	86	4·2067		
Nov. 12 ...	87	4·2132		
Dec. 3 ...	88	4·2141		
1874.				
Jan. ...	89	4·2069		
Feb. ...	90	4·2094		
Mar. ...	91	4·2092		
April ...	92	4·2086		
May ...	93	4·2076		
June ...	94	4·2062	4·2055	4·2044
July ...	95	4·2052		
Aug. ...	96	4·2080		
Sept. ...	97	4·2073		
Oct. ...	98	4·1958		
Nov. ...	99	4·2042		
Dec. ...	100	4·1980		
1875.				
Jan. ...	101	4·2018		
Feb. ...	102	4·2058		
Mar. ...	103	4·2042		
April ...	104	4·1969		
May ...	105	4·2010		
June ...	106	4·2055	4·2013	4·2040
July ...	107	4·1929		
Aug. ...	108	4·2012		
Sept. ...	109	4·1988		
Oct. ...	110	4·2016		
Nov. ...	111	4·2005		
Dec. ...	112	4·2057		
1876.				
Jan. ...	113	4·2049		
Feb. ...	114	4·2085		
Mar. ...	115	4·2092		
April ...	116	4·2062		
May ...	117	4·2078		
June ...	118	4·2097	4·2067	4·2043
July ...	119	4·2104		
Aug. ...	120	4·2102		
Sept. ...	121	4·2059		
Oct. ...	122	4·2044		
Nov. ...	123	4·2018		
Dec. ...	124	4·2012		

Date of observation.	Number of observations upto date.	Values of Km. of each observation.	Yearly mean values of Km.	Mean value of Km. to date.
1	2	3	4	5
1877.				
Jan. ...	125	4·2068		
Feb. ...	126	4·2053		
Mar. ...	127	4·2045		
April ...	128	4·2125		
May ...	129	4·2049		
June ...	130	4·2086	4·2047	4·2043
July ...	131	4·2018		
Aug. ...	132	4·1993		
Sept. ...	133	4·2011		
Oct. ...	134	4·2040		
Nov. ...	135	4·2052		
Dec. ...	136	4·2029		
1878.				
Jan. ...	137	4·2036		
Feb. ...	138	4·2042		
Mar. ...	139	4·1992		
April ...	140	4·1997		
May ...	141	4·2004		
June ...	142	4·2082	4·2012	4·2041
July ...	143	4·1982		
Aug. ...	144	4·1959		
Sept. ...	145	4·2024		
Oct. ...	146	4·1986		
Nov. ...	147	4·2003		
Dec. ...	148	4·2032		
1879.				
Jan. ...	149	4·2035		
Feb. ...	150	4·1996		
Mar. ...	151	4·2008		
April ...	152	4·2024		
May ...	153	4·2002		
June ...	154	4·2000	4·1996	4·2037
July ...	155	4·1973		
Aug. ...	156	4·1933		
Sept. ...	157	4·1993		
Oct. ...	158	4·1987		
Nov. ...	159	4·2015		
Dec. ...	160	4·1985		
1880.				
Jan. ...	161	4·1993		
Feb. ...	162	4·2055		
Mar. ...	163	4·2071		
April ...	164	4·2075		
May ...	165	4·2036		
June ...	166	4·2061	4·2029	4·2037
July ...	167	4·1973		
Aug. ...	168	4·2024		
Sept. ...	169	4·1988		
Oct. ...	170	4·2006		
Nov. ...	171	4·1971		
Dec. ...	172	4·2093		
1881.				
Mar. ...	173	4·2038		
June ...	174	4·2050	4·2057	4·2037
Sept. ...	175	4·2006		
Dec. ...	176	4·2136		
1882.				
Mar. ...	177	4·1966		
June ...	178	4·2032	4·2014	4·2037
Sept. ...	179	4·1969		
Dec. ...	180	4·2089		

Up to 1880 the determination of the inertia constant was made once every month. From 1881 the values were obtained once every quarter.

TABLE 5—continued—*Values of K_m.*

Date of observation.	Number of observations upto date.	Values of Km. of each observation.	Yearly mean values of Km.	Mean value of Km. to date.
1	2	3	4	5
1883.				
Mar. ...	181	4·2091	4·2074	4·2038
June ...	182	4·2064		
Sept. ...	183	4·2091		
Dec. ...	184	4·2052		
1884.				
Mar. ...	185	4·2078	4·2153	4·2040
June ...	186	4·2130		
Sept. ...	187	4·2154		
Dec. ...	188	4·2251		
1885.				
Mar. ...	189	4·2274	4·2096	4·2041
June ...	190	4·2177		
Sept. ...	191	4·1961		
Dec. ...	192	4·1974		
1886.				
Mar. ...	193	4·1966	4·2005	4·2040
June ...	194	4·2009		
Sept. ...	195	4·1990		
Dec. ...	196	4·2055		
1887.				
Mar. ...	197	4·1967	4·2003	4·2040
June ...	198	4·2122		
Sept. ...	199	4·1958		
Dec. ...	200	4·1965		
1888.				
Mar. ...	201	4·1941	4·1997	4·2039
June ...	202	4·2097		
Sept. ...	203	4·1937		
Dec. ...	204	4·2014		
1889.				
Mar. ...	205	4·1927	4·1942	4·2037
June ...	206	4·1965		
Sept. ...	207	4·1923		
Dec. ...	208	4·1954		
1890.				
Mar. ...	209	4·1942	4·1963	4·2036
June ...	210	4·2027		
Sept. ...	211	4·1946		
Dec. ...	212	4·1939		
1891.				
Mar. ...	213	4·1948	4·1891	4·2033
June ...	214	4·1948		
Sept. ...	215	4·1852		
Dec. ...	216	4·1818		
1892.				
Mar. ...	217	4·1917	4·1937	4·2031
June ...	218	4·2055		
Sept. ...	219	4·1921		
Dec. ...	220	4·1857		

Date of observation.	Number of observations upto date.	Values of Km. of each observation.	Yearly mean values of Km.	Mean value of Km. to date.
1	2	3	4	5
1893.				
Mar. ...	221	4·1951	4·1947	4·2030
June ...	222	4·1958		
Sept. ...	223	4·1943		
Dec. ...	224	4·1937		
1894.				
Mar. ...	225	4·1926	4·1917	4·2028
June ...	226	4·1938		
Sept. ...	227	4·1867		
Dec. ...	228	4·1936		
1895.				
Mar. ...	229	4·1973	4·1985	4·2027
June ...	230	4·2005		
Sept. ...	231	4·1963		
Dec. ...	232	4·2001		
1896.				
Mar. ...	233	4·1990	4·1980	4·2026
June ...	234	4·2013		
Sept. ...	235	4·1996		
Dec. ...	236	4·1923		
1897.				
Mar. ...	237	4·1832	4·1889	4·2024
June ...	238	4·1977		
Sept. ...	239	4·1931		
Dec. ...	240	4·1815		
1898.				
Mar. ...	241	4·1694	4·1856	4·2021
June ...	242	4·1903		
Sept. ...	243	4·1916		
Dec. ...	244	4·1910		
1899.				
Mar. ...	245	4·1855	4·1896	4·2019
June ...	246	4·1901		
Sept. ...	247	4·1892		
Dec. ...	248	4·1936		
1900.				
Mar. ...	249	4·1788	4·1851	4·2016
June ...	250	4·1907		
Sept. ...	251	4·1837		
Dec. ...	252	4·1874		
1901.				
Mar. ...	253	4·1822	4·1890	4·2015
June ...	254	4·1904		
Sept. ...	255	4·1907		
Dec. ...	256	4·1929		
1902.				
Mar. ...	257	4·1918	4·1926	4·2013
June ...	258	4·1903		
Sept. ...	259	4·1939		
Dec. ...	260	4·1945		

Date of observation.	Number of observations upto date.	Values of Km. of each observation.	Yearly mean values of Km.	Mean value of Km. to date.
1	2	3	4	5
1903.				
Mar. ...	261	4·1927	4·1948	4·2012
June ...	262	4·1959		
Sept. ...	263	4·1936		
Dec. ...	264	4·1971		
1904.				
Mar. ...	265	4·2072	4·1966	4·2011
June ...	266	4·1892		
Sept. ...	267	4·1985		
Dec. ...	268	4·1916		

TABLE 5*a*.

Mean Values of log π^2K.

Unifilar Magnetometer.	Mean Values of log π^2K.		
	Supplied with the Kew certificate.	Adopted mean value determined in Bombay.	Mean value of all available determinations upto date.
No. 137 by Dover Charlton.	3·40273	3·40194	3·40182
No. 7 by Cooke and Sons.	3·39931	3·40031	3·39995
No. 3 by Cambridge Scientific Instrument Co....	3·44108	3·44098	3·44100
No. 5 by Cooke and Sons ...	3·37888	Adopted as at Kew. 3·37888	...
No. 23 Colába Standard* ...	1·61828	1·61786	1·61766

* The values are in English Unit.

possible under ordinary conditions of observations, could introduce any error of the order noticed. Nor does it seem probable that a change of about 3° which occurred in the inclination from 1868 to 1904 at Colaba could appreciably affect a magnet with the type of suspension arrangement used for supporting the magnet and inertia bar with a bunch of about 4 fibres of silk which having an appreciable breadth, could hardly affect the value of K_m appreciably.

39. Referring however, to the slow change noted in K_m it is possible that it may be affected by a change in the mass of the magnet which, by long use especially in a warm and moist climate like that of Bombay, may by the slow process of oxidation lose some of its mass. The original weight of the auxiliary brass bar was 1028·03 grains (*vide* volume for 1865-70, page XXXIII); when lately weighed, the weight was found to be the same. But the original weight of the magnet with its carrier (*vide* idem) was 655 grs. Its weight carefully taken lately was however found to be about 652 grs. That the mass of the magnet has diminished there seems to be little doubt. It would be impossible however to get any idea of the effect as the erosion could not be either regular or uniform and could not be located definitely. But whether this fully explains the discrepancy, appears to be doubtful. Whatever be the cause assuming, however, for the moment that the value of K_m which stood in 1868 at 4·2030, was correct and that it has gradually and uniformly diminished by an amount equal to twice the difference between the starting value and the mean value to date (*vide* col. 5, table 5) [that is by 2 (4·2030 − 4·2011) = ·0038] and thus stands now at (4·2030 − ·0038) = 4·1992, it would mean that an error of 0·4γ in the absolute value of force was steadily growing every year and after 37 years, the overestimation now amounts to so much as 15γ in the value of H; the effect of this would be to accentuate to some extent the growth in the value of H due to slow change in P_0 which happens to have a similar effect. Whether this conclusion can be consistently accepted after the unexpectedly close agreement between the determinations of the standard instrument with those of other magnetometers, appears to be problematic. At Colaba one value of K_m as of P_0 has been adopted in the reductions. The constancy of these factors has of course been taken for granted, the reason being that the use in the reductions, of fresh values of K_m and P_0 derived every month or every quarter of a year would hardly be admissible as the observational errors would be certain to vitiate the fine changes in the annual and secular growth of H. The points disclosed suggest at any rate the absolute necessity of the duplication of the absolute work by two independent sets of instruments at least in all large observatories. With regard to the small uncertainty revealed in the above discussion after considering the question in all its bearings whatever can be urged for the close agreement in the result of the comparison of the five magnetometers it cannot be denied that some uncertainty in regard to the result does prevail, and this is inevitable in the present type of instrument and magnets; and refined accuracy in the final value of H is hardly possible under conditions which obtain at present. The series of absolute values however has not been in any way modified and the results of the observations with the Kew standard magnetometer as defining the phenomenon have been taken up for discussion in Part II of this volume without being otherwise tampered with.

40. In regard to the character of the observational work in connection with the determination of the values of H the probable errors have been derived from observations of a few years arbitrarily selected and these are given below. The total number of observations during each year is 104 or 106 the monthly means of the observed values are collected in table 6.

The observations of any particular month are averaged to determine the constant of the magnetograph for the month. It is obvious that if there are no observational errors and if the zero of the magnetograph does not appreciably vary during the month, the observed and the computed values would all be the same. The magnetograph zero after being corrected for creep and temperature (*vide* Chapter II) may be assumed to remain steady for the month and hence the difference if any between the observed and the calculated values practically measures the probable error of a single determination. All observations in the year have been treated together in the usual way by least squares and the errors found were as follows:—

Table 7—Probable errors.

Unity = 1γ = ·00001 C. G. S.

	1878.	1879.	1884.	1885.	1894.	1895.	1904.	1905.
Probable error of a single determination.	±7·0	±7·7	±8·9	±7·6	±6·5	±6·2	±8·1	±9·2
Probable error of the monthly mean ...	±2·4	±2·6	±3·0	±2·6	±2·2	±2·1	±2·7	±3·1
Probable error of the annual mean ...	± ·7	± ·7	± ·9	± ·7	± ·6	± ·6	± ·8	± ·9

TABLE 6.—*Mean monthly (observed) Values of Horizontal Force by Colaba Standard Magnetometer, No 23.*

37,000γ +

Years.	Month.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1868 ...	167	143	162	161	170	194	187	112	138	180	190	158	163
1869 ...	170	204	188	170	139	201	207	178	214	184	205	175	186
1870 ...	188	195	236	208	212	264	235	241	209	203	200	249	220
1871 ...	241	251	243	229	229	251	264	259	266	255	235	214	245
1872 ...	222	229	264	289	290	276	260	261	259	234	241	253	256
1873 ...	232	260	269	281	282	289	296	277	268	280	274	278	274
1874 ...	288	279	289	288	301	300	315	324	310	307	305	309	301
1875 ...	306	308	316	321	324	331	326	327	324	337	335	324	323
1876 ...	323	321	341	355	356	353	361	362	349	351	355	340	347
1877 ...	349	355	358	356	352	340	356	349	341	365	360	360	353
1878 ...	366	349	376	358	350	347	383	374	377	370	377	383	367
1879 ...	368	378	389	399	378	378	394	389	378	388	364	377	382
1880 ...	397	402	393	419	387	377	387	384	342	363	347	362	380
1881 ...	374	369	378	372	383	383	390	388	368	377	346	360	374
1882 ...	364	369	379	353	354	356	367	363	359	353	341	345	359
1883 ...	365	367	352	354	389	395	396	404	398	410	422	412	389
1884 ...	420	412	437	461	450	460	450	454	432	422	422	427	437
1885 ...	428	426	437	420	421	436	434	427	412	433	433	419	427
1886 ...	412	427	430	420	421	424	414	430	417	411	396	380	415
1887 ...	411	425	416	414	413	425	425	417	421	434	430	416	421
1888 ...	426	445	454	432	433	441	437	435	437	444	415	435	436
1889 ...	430	442	431	445	432	443	442	442	430	444	437	443	438
1890 ...	438	437	448	445	447	450	459	456	434	443	440	441	445
1891 ...	450	449	433	421	442	443	450	437	425	438	445	454	441
1892 ...	413	426	409	434	399	413	386	424	444	435	458	447	424
1893 ...	430	437	438	442	456	449	447	431	423	428	431	430	437
1894 ...	416	406	438	427	446	442	422	416	410	439	408	444	426
1895 ...	422	439	433	442	453	448	442	447	434	448	459	459	444
1896 ...	473	444	479	460	460	471	460	460	455	468	469	463	463
1897 ...	460	475	469	438	464	473	483	459	474	459	454	444	463
1898 ...	447	465	421	440	450	454	450	441	428	447	443	453	445
1899 ...	457	438	433	447	458	454	445	450	431	448	457	457	448
1900 ...	456	444	451	460	437	461	452	453	466	457	465	446	454
1901 ...	448	446	449	453	458	459	453	453	437	431	445	433	447
1902 ...	439	446	445	448	441	450	443	437	430	436	439	431	440
1903 ...	430	436	442	431	425	437	439	418	404	415	392	390	422
1904 ...	430	411	422	398	416	410	425	408	414	399	390	403	410
1905 ...	398	402	413	397	408	410	410	391	379	402	397	385	400

41. The details of the method of taking absolute observations will be fully seen from the annexed forms A, B used for the observations :—

FORM A.

GOVERNMENT OBSERVATORY, BOMBAY.

Wednesday, ______ *190*

OBSERVATIONS OF VIBRATION. NO. OF OBSERVATION ______

CHRONOMETER ERROR = m. DAILY RATE = s.

	Civil Time. h. m.	Temp. of Magnet. o	H. F. Magh. Sc. div.	H. F. Thermr. o	Semi-arc of vibration. Sc. div.
At commt.					
At end.					
Means.					
Means corrected.					

SCALE MOVING APPARENTLY.

To the Right. No of Vibn.	Time of passing Wire. h. m. s.	Time of 180 Vibns. m. s.	To the Left. No. of Vibn.	Time of passing Wire. m. s.	Time of 180 Vibns. m. s.
0			9		
180			189		
18			27		
198			207		
36			45		
216			225		
54			63		
234			243		
72			81		
252			261		
90			99		
270			279		
90-0			99-9		
Time for 180th			Time for 189th.		
	Mean =		Time of 90 Vibns.		
Mean time of 180 Vibrations =			Time of 1 Vibn.	T′ =	

TORSION FORCE.

Torsion.	Scale divn.	Means and Diffs. 90°	360°
0°			
+90			
0		For 90	
−90			
0			
+360		For 360°	
0		For 90°	
−360		Adopt. Effect of 90° Torsion.	
0		Sc. div.	

VERTICAL SCALE READING.		
	Level below.	
	Level above.	
	Mean.	

Observer.

Seen.

FORM B.

GOVERNMENT OBSERVATORY, BOMBAY.

Wednesday, ______ *190*

OBSERVATIONS OF DEFLECTION. NO. OF OBSERVATION ______

	H. F. Magh.		H. F. Thermr.		
At commencement.					OBSERVER,
At end.					CHECKER OF REDUCTION.
Means.					Seen,
Means corrected.					

Civil Time by Chronometer.	Deflecting Magnet. Distance E. or W.	N. End.	Temp.	Scale Reading.	Readings of Verniers.	Mean of Verniers.	Means and Differences.
h. m.	c.m.		″	Divn.	° ′ ″	° ′ ″	° ′ ″
	23 E.	E. {					
	30 E.	E. {					
	30 E.	W {					
	23 E.	W. {					
	23 W.	W. {					
	30 W.	W. {					
	30 W.	E. {					
	23 W.	E. {					

	Sums.	Observed Angles of Deflection } r_o = 23 ; u = ° ′ ″
	Means.	
	} Time corrected.	r_o = 30 ; u′ =

For the Colaba standard the distances used are ·8 ft. and 1·0 ft.

Absolute Instruments.

2. *Declination.*

42. The absolute observations of this magnetic element did not commence till the year 1868, when the advent of the Kew Unifilar made it possible to have independent absolute determinations.

43. In the earlier period 1846—1867 the indications of the variation instrument—Grubbs' Declinometer—so far as they could be relied upon for absolute work have been made use of. A description of this instrument is given in the report of the Committee of Physics (1840) of the Royal Society and also in the Observatory Volume for the years 1879—1882. A life history of the instrument with the discussion of its behaviour and the processes of reduction are also given in the Observatory Volume for the year 1896, which is summarised for special reference in Chapter V, where the process adopted to extend the record of the absolute series to earlier years has been fully described in detail.

44. It will also be seen from the description that a portion of the earlier years of the period, *viz.* that from 1846 to 1861, has been punctuated by repeated adjustments while, after the adjustment in 1861 the instrument was allowed to lie undisturbed till 1896. It may be sufficient for our purpose here to note that apart from the small changes which may be expected always to occur in the zero of the instrument at every fresh adjustment and thereafter, due to residual torsion and other instrumental defects, the values of the zero—that is the scale reading corresponding to the true astronomical North—appear to be fairly consistent from January 1856 and thereafter, as the values lie all about 28·3 of the scale division. But prior to this, the values are found to be widely divergent introducing a considerable amount of uncertainty for which no precise explanation can be given. The results of the period before 1856 have hence been regarded as unreliable.

45. Passing on to the later period of 1868—1905, the absolute observations have been made with the Kew Unifilar Magnetometer and the same magnet has been in use for the Declination observations throughout the whole period.

The results of observations have been compared with those of four other magnetometers—magnetometer No. 7 by Cooke, No. 3 by the Cambridge Scientific Instrument Company, No. 137 by Dover Charlton, and No. 131 by Nalder Bros. and found to be in fairly close agreement, the differences made out being within 0′·2.

46. The reference marks used at Colába throughout the period are (1) the chimney of the Tárdeo Mill some four miles away to the north, and (2) the tower of the Kennery light-house some ten miles away to the south.

The azimuths of these marks were previously very carefully determined by star observations. The same have been rederived and checked lately and found to be in close agreement. The values derived and adopted in the reductions are 0° 26′ 26″ E. of N. and 179° 49′ 30″ E. of N. respectively for the Tárdeo chimney and the Kennery light-house.

The values determined lately are: 0° 26′ 30″, and 179° 49′ 40″ both E. of N. respectively.

TABLE 8.—*Differences between observed Circle Readings of Tardeo Chimney and Kennery Light-house.*

179° +

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
1868 ...	22 45	23 0	22 58	22 51	22 49	23 0	23 8	...	23 33	23 31	23 27	23 14	23 5
1869 ...	23 3	23 2	23 4	23 10	23 10	22 45	...	23 26	23 15	23 14	23 20	23 26	23 12
1870 ...	23 22	23 29	23 18	23 13	23 9	22 59	...	23 0	23 20	23 14	23 15	23 24	23 16
1871 ...	23 16	23 1	23 6	23 18	23 12	23 12	...	23 10	23 22	23 25	23 15	23 21	23 15
1872 ...	23 23	23 6	23 1	22 56	22 51	22 33	...	...	22 51	23 1	23 3	23 3	23 1
1873 ...	23 6	23 21	23 14	23 5	22 59	...	22 55	23 10	22 56	23 14	23 17	23 9	23 8
1874 ...	23 18	23 21	23 23	23 31	23 25	23 27	...	23 28	23 29	23 25	23 30	23 33	23 27
1875 ...	23 30	23 31	23 35	23 44	23 35	23 42	...	23 32	23 22	23 35	23 21	23 21	23 32
1876 ...	23 17	...	23 33	23 26	23 42	23 18	...	...	23 12	23 14	22 57	23 21	23 20
1877 ...	23 17	23 17	23 6	22 52	23 5	...	...	22 35	23 33	23 32	23 26	23 8	23 12
1878 ...	23 42	...	23 15	23 25	22 59	23 0	23 46	23 37	...	22 49	23 17	23 17	23 13
1879 ...	23 33	23 27	...	23 0	...	22 46	...	23 5	23 15	23 10	23 1	22 56	23 11
1880 ...	23 9	23 20	23 22	23 12	22 54	...	23 12	23 39	23 21	23 20	23 6	22 53	23 12
1881 ...	22 49	22 49	23 25	23 13	23 8	23 18	23 8	...	23 10	23 6	22 57	22 42	23 2
1882 ...	22 50	22 54	22 50	23 19	22 54	22 55	...	23 7	23 7	23 26	23 31	23 54	23 13
1883 ...	23 50	23 54	23 27	23 14	23 24	23 25	...	23 25	23 24	23 21	23 18	22 52	23 23
1884 ...	22 52	22 49	23 9	23 26	23 4	22 50	...	23 7	23 30	23 7	23 40	23 30	23 10
1885 ...	23 9	22 59	23 6	23 12	23 25	23 20	23 0	22 50	23 12	23 14	23 19	23 20	23 12
1886 ...	23 8	23 15	23 14	23 13	23 18	23 18	23 30	23 25	23 18	23 6	23 19	23 14	23 15
1887 ...	23 7	23 20	23 26	23 42	23 30	23 35	...	23 30	23 22	23 11	23 22	23 18	23 23
1888 ...	23 25	23 19	23 36	23 27	23 34	23 35	...	23 25	23 25	23 27	23 25	23 25	23 28
1889 ...	23 13	23 27	23 26	23 24	23 41	...	...	...	23 13	23 4	23 12	23 7	23 18
1890 ...	23 10	23 22	23 22	23 22	23 17	23 10	...	23 57	23 33	23 22	23 35	23 27	23 24
1891 ...	23 10	...	23 22	23 23	23 16	23 12	...	...	23 24	23 13	22 55	22 54	23 12
1892 ...	23 8	23 19	23 22	23 6	23 12	23 22	23 12	23 8	23 2	23 14	23 10	23 31	23 15
1893 ...	23 24	23 8	23 5	23 21	23 7	23 5	...	...	22 56	23 0	23 5	23 19	23 9
1894 ...	23 24	23 35	23 32	23 30	23 16	23 15	...	23 33	23 12	22 49	23 5	23 5	23 16
1895 ...	22 59	22 58	22 47	22 48	23 24	23 33	23 42	...	...	22 56	22 57	22 47	23 1
1896 ...	22 55	23 12	23 40	...	23 12	23 10	...	23 10	23 27	23 30	23 22	23 0	23 15
1897 ...	23 25	23 18	23 10	23 18	23 1	23 27	...	...	23 24	23 27	23 25	23 26	23 21
1898 ...	23 14	23 15	24 13	23 15	23 5	23 33	...	...	23 29	23 28	23 15	23 48	23 27
1899 ...	23 37	22 57	23 13	22 47	23 30	23 0	...	23 30	23 22	22 58	23 15	23 5	23 12
1900 ...	23 5	23 20	23 16	22 58	22 47	23 10	23 1	23 20	23 28	23 19	23 17	23 28	23 14
1901 ...	23 16	23 4	23 31	23 4	23 2	...	...	...	23 28	23 6	23 19	23 17	23 14
1902 ...	22 52	23 13	23 12	23 28	23 15	23 25	...	23 8	23 27	23 26	23 4	23 14	23 15
1903 ...	23 17	23 10	23 38	23 27	23 35	23 19	23 25	23 7	23 11	23 4	22 59	23 14	23 16
1904 ...	22 44	22 37	22 44	22 44	22 49	23 20	...	22 40	21 51	22 40	23 19	23 13	22 48
1905 ...	22 42	22 49	23 6	23 12	23 17	23 54	...	...	23 2	22 58	22 51	21 58	23 4
Number of observations.	121	110	129	119	139	63	15	37	98	161	160	156	1,308

47. The readings of the Tárdeo chimney alone however have invariably been used in the reductions of the Absolute determinations of Declination. Observations of the two reference marks were always made at every weekly determination unless heavy rain or fog rendered the Kennery light-house invisible during the monsoon months and occasionally also during the winter. The circle readings for these reference marks have been examined, especially the included angle between the two, the constancy of which throughout the period may presumably be held to indicate that the readings of the Tárdeo chimney, the azimuth of which determines the Declination, are reliably accurate. In table 8 are collected the monthly and annual values of the subtended angle derived from the circle readings for the two reference marks. The lower figures denote the number of observations every month from which the angle is derived, the Kennery light-house not being available on every occasion as just mentioned.

48. In view of the accuracy of the readings of the reference mark and as also no other troublesome constants are involved in the derivation of the values of this element, the observations may be regaided as reliable and free from inaccuracy. The monthly means of the observed values of Declination are all collected and given in table 9.

49. The following table gives the probable errors of observations derived as described in paragraph 40 for the Horizontal Force determinations. Results of some of the earlier years have already appeared in the volume of the Observatory for the year 1896 :—

Table 10—Probable Errors.

	1872.	1873.	1884.	1885.	1894.	1895.	1904	1905
Probable error of a single determination.	±13″	±13″	±10″	±8″	±17″	±9″	±15″	±13″
Probable error of the monthly mean ...	±6	±6	±4	±4	±6	±4	±8	±7
Probable error of the annual mean ...	±2	±2	±1	±1	±2	±1	±2	±2

The form C below illustrates fully in detail the process of observation for the determination of absolute declination the results of which are discussed in Chapter II, Part II :—

FORM C.

[Form No. 11.

Torsion.	Reading Sc. div.	Means and Diffs. 90°	360°
0°			
+ 90			
+360			
0			
—360			
— 90		Adopt.	
0			

GOVERNMENT OBSERVATORY, BOMBAY

OBSERVATIONS OF ABSOLUTE DECLINATION made with the Kew Unifilar (Elliott Bros. No. 23) on 190

No. of Observation......... Chronr. Error = m

Collr. mark of La. Declination Transit apparently to the........................Reading of Az. Screw.................

Standard..................... ,, ,, ,, ,, ...

Civil Time by Chronr.	La Decln. Magnr.	Declination Magnetograph.	Collimator Magnet. Scale apparently Erect.	Inverted.	At	Reading of Verniers.	Tárdeo Chimney.	Torsion
h. m.	Sc. div.	Sc. div.	Sc. div.	Sc. div		° ′ ″	° ′ ″	°
					Commencement.			
					Mean.			
					Conclusion			
					Mean			
					Mean of Means.			
					"(Er.—Inv.)/2"			Azim. of T. Chimney.
								True Merid. Reading.
					Correction for Torsion.			
	Mean.	Mean.		Sc. Inverted				
Mean of Times Corrected.	Reduced to arc.			Er.—Inv.	True Merid. Circle Reading.			
				(Er—Inv.)/2	Absolute Decln. E			
				"Converted"	Observer.		Seen.	

TABLE 9.—*Mean monthly (observed) Absolute Declination by Colaba Standard Magnetometer No. 23.*

Year.	Month.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
1867 ...	...	...	...	...	...	...	41 34	41 15	41 20	42 18	43 38	43 58	...
1868 ...	44 16	44 2	44 56	43 19	42 27	42 24	43 24	43 39	42 31	44 51	46 4	45 34	43 57
1869 ...	46 15	46 56	46 22	45 7	45 26	45 38	45 57	45 16	45 15	46 29	47 13	47 43	46 8
1870 ...	47 9	47 4	48 4	46 36	47 0	46 54	47 17	46 43	47 23	49 15	49 47	50 7	47 47
1871 ...	49 7	50 18	49 32	48 31	49 11	48 37	48 48	49 10	48 50	50 6	51 31	51 52	49 38
1872 ...	53 11	52 43	50 57	50 45	50 29	51 6	50 6	51 6	50 8	52 46	52 35	52 58	51 34
1873 ...	53 6	53 2	52 35	53 14	52 0	52 20	52 52	51 15	51 49	52 46	52 59	53 36	52 38
1874 ...	53 17	54 36	54 8	52 16	52 33	53 26	53 30	52 50	52 37	53 49	53 38	54 27	53 26
1875 ...	54 3	54 13	55 41	54 53	53 52	54 8	54 35	53 57	53 11	53 55	54 51	55 53	54 26
1876 ...	56 4	55 36	55 30	54 44	53 34	53 33	54 28	54 51	55 0	54 52	55 42	56 37	55 3
1877 ...	56 21	55 57	56 22	55 23	55 11	54 52	55 32	54 23	54 23	55 34	56 6	56 24	55 32
1878 ...	56 56	56 32	56 21	55 59	55 31	55 53	56 0	55 22	55 21	55 8	56 31	56 31	56 0
1879 ...	56 58	57 20	57 29	56 41	55 48	56 21	55 44	55 45	56 21	55 52	55 50	56 59	56 26
1880 ...	57 25	57 23	57 26	56 14	55 25	55 30	56 0	55 5	55 50	56 15	56 50	56 47	56 21
1881 ...	56 10	57 8	57 9	55 33	54 51	54 59	55 51	54 36	55 18	56 3	56 43	56 40	55 55
1882 ...	56 29	56 50	55 42	56 6	54 41	55 6	55 11	54 38	55 27	56 15	56 52	57 39	55 55
1883 ...	56 54	57 32	57 1	55 32	55 12	55 56	56 28	56 7	54 29	55 8	55 46	54 55	55 55
1884 ...	55 33	56 24	55 21	54 8	53 37	53 26	54 32	52 42	53 44	54 53	54 14	56 0	54 33
1885 ...	55 43	54 32	55 8	54 2	53 6	53 44	53 32	52 3	52 21	54 6	53 46	54 25	53 52
1886 ...	54 0	54 5	53 57	52 25	51 6	52 20	52 49	51 25	51 13	52 8	52 28	52 56	52 34
1887 ...	52 30	53 1	53 3	51 0	50 39	50 38	50 18	49 56	49 56	50 32	51 9	51 49	51 13
1888 ...	51 1	51 4	51 27	50 16	49 56	50 0	49 15	49 10	48 53	49 59	50 5	49 42	50 4
1889 ...	49 35	49 1	49 38	47 57	47 39	48 10	48 6	47 36	46 54	48 1	47 50	48 14	48 13
1890 ...	47 48	48 35	47 29	46 47	46 9	45 34	45 5	45 16	44 34	45 49	46 18	47 4	46 22
1891 ...	46 22	46 16	46 8	44 54	43 24	43 33	43 43	43 13	42 33	43 44	44 34	44 53	44 26
1892 ...	43 40	44 19	44 11	42 15	42 15	41 31	41 52	41 16	41 29	42 8	43 16	43 46	42 40
1893 ...	42 2	41 25	41 13	41 8	39 19	39 34	39 7	38 15	38 32	40 12	41 27	41 29	40 19
1894 ...	41 24	40 29	39 53	38 17	38 4	37 36	37 13	37 1	37 3	37 39	38 50	39 15	38 34
1895 ...	38 4	38 8	37 3	36 26	35 18	35 30	35 40	34 55	34 50	35 46	36 2	36 12	36 9
1896 ...	35 12	35 0	34 13	33 34	33 19	33 51	33 39	32 51	33 1	33 22	33 46	33 20	33 46
1897 ...	32 49	32 47	33 8	32 5	31 25	30 25	30 58	29 17	29 44	30 46	30 54	31 35	31 19
1898 ...	30 33	30 13	31 41	28 16	27 30	28 20	28 4	27 37	27 6	27 52	27 59	27 43	28 34
1899 ...	26 19	26 32	26 30	25 50	24 36	25 36	25 9	24 4	24 14	25 8	25 24	25 17	25 23
1900 ...	25 1	25 37	23 55	23 10	23 9	23 15	22 52	22 0	20 20	22 31	22 33	22 44	23 6
1901 ...	23 16	22 30	21 22	21 11	20 35	20 30	20 22	19 40	19 8	20 15	21 9	21 12	20 56
1902 ...	20 53	20 30	20 0	19 41	18 35	17 20	18 4	16 26	16 46	17 52	17 59	17 25	18 28
1903 ...	18 17	18 1	17 58	16 29	15 8	16 0	16 36	15 29	15 26	16 48	16 45	16 54	16 39
1904 ...	16 28	15 47	15 49	14 33	14 44	14 31	14 42	12 43	12 38	13 15	14 21	14 2	14 28
1905 ...	14 39	15 17	13 4	12 39	12 39	12 34	11 18	11 55	11 10	12 15	12 53	13 55	12 51

Absolute Instruments.

3. Inclination.

50. The instrument employed for the observations of inclination for the earlier period (1846—1867) was an old pattern Dip Circle by Barrow of London: It carried no microscopes and the inclinations were read off by the coincidence of the fine point of the needle with the scale on the limb of the circle which was divided to minutes. The needle (a single one) used, was 6 inches long and it appears that to keep it clean, the axle was now and again rubbed with emery paper.

51. Hence whatever may have been the capability of the instrument at first when it was received in a new condition, it is obvious that the indications under such treatment must very soon have lost the little accuracy they could have claimed initially. No value hence has been attached to the series given by the instrument, and the annual means alone are given in thin type, at best as very *rough measures* of the probable values of dip for the period (*vide* table 245, Chapter III, Part II).

52. The Kew Dip Circle No. 49 by Barrow of London was received in April 1867 with which the observations of inclination of the later period have throughout been made. A description of this instrument, with its behaviour, etc., with the different needles used has been given in the Observatory volumes of 1865—1870 and 1891-1892 reference to which is invited.

53. Observations for the years 1867 to 1871 were made on the ground floor of the electrometer tower. In October 1871 the instrument was removed to the top of the tower where all absolute observations have since been taken. A difference of three minutes of arc has been made out by observations at the two places and hence the values of 1867 to 1871 have to be corrected for this difference to link them up to the series taken at the electrometer tower after 1871.

Observations of inclination have been made every Tuesday and Friday, and each day's observation is made up of *two* complete sets. There are hence 416 observations in the year, and the results of the monthly and annual means of these observations are given in table 11.

54. The observations made with this instrument gave very satisfactory results till about the year 1873, after which year however the instrument unfortunately seems to have given considerable trouble. Attempts to improve upon the unsatisfactory behaviour of the circle were made from time to time in—1877, 1881, and 1888—and it was not till the last attempt—that of 1888—that the instrument appears to have been brought to a satisfactory state of correct adjustment. The results of the observations between 1873 and 1887 are absolutely unreliable as will be seen later in the discussion in Chapter III, Part II.

Form D sets forth in detail the process of observations for the determination of absolute dip.

FORM D. [Form No. 16.

Government Observatory, Bombay,

day of 190 .

Needle by		No.			
Begun at Ended at		h. m.	h. m.	h. m.	h. m.
Face of Needle.	End of Needle.	Poles Direct.		Poles Reversed.	
		Face of Circle.			
		E.	W.	E.	W.
With face of Circle.	Upper ...				
	Lower ...				
From face of Circle.	Upper ...				
	Lower ...				
Sums.					
Means.					
				Sum ...	
Mean of Means or Dip............ =					

Observed by Seen by

TABLE II.—*Mean (observed) monthly values of Inclination By Dip Circle No. 49 and mean annual Inequality.*

Years.	Month.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1867 ...	...	...	...	19 1·1	19 1·9	19 1·5	19 0·8	19 2·2	19 2·5	19 2·5	19 2·8	19 2·7	19 2·0
1868 ...	19 2·7	19 3·4	19 3·8	19 4·1	19 4·1	19 4·3	19 4·3	19 4·2	19 4·3	19 4·2	19 3·6	19 3·5	19 3·9
1869 ...	19 3·7	19 4·8	19 5·2	19 6·0	19 6·2	19 6·3	19 6·8	19 6·4	19 5·7	19 6·2	19 6·5	19 5·6	19 5·8
1870 ...	19 5·6	19 5·8	19 6·0	19 10·6	19 12·4	19 8·0	19 7·0	19 2·5	19 1·3	19 7·4	19 6·4	19 8·8	19 7·1
1871 ...	19 1·9	19 12·8	19 12·7	19 14·1	19 7·0	19 0·9	19 5·7	19 9·3	19 11·5	19 9·7	19 9·2	19 11·2	19 8·8
1872 ...	19 11·5	19 11·9	19 11·7	19 12·8	19 14·3	19 14·4	19 15·0	19 14·9	19 14·9	19 15·3	19 14·7	19 15·6	19 13·9
1873 ...	19 14·4	19 14·4	19 16·7	19 16·7	19 16·4	19 15·6	19 14·6	19 12·8	19 12·9	19 14·2	19 13·7	19 13·7	19 14·7
1874 ...	19 14·2	19 14·9	19 13·8	19 13·4	19 15·9	19 15·4	19 16·1	19 15·1	19 14·3	19 13·9	19 14·0	19 14·4	19 14·6
1875 ...	19 14·4	19 14·0	19 14·2	19 13·8	19 14·3	19 13·4	19 11·5	19 11·4	19 12·5	19 12·8	19 13·2	19 13·6	19 13·3
1876 ...	19 12·8	19 12·1	19 11·4	19 11·8	19 11·0	19 12·6	19 11·8	19 10·9	19 12·9	19 11·8	19 11·1	19 11·1	19 11·8
1877 ...	19 22·6	19 21·7	19 22·8	19 19·1	19 19·4	19 19·8	19 19·4	19 19·6	19 18·8	19 19·9	19 20·0	19 19·1	19 20·2
1878 ...	19 20·0	19 17·5	19 18·4	19 18·0	19 19·5	19 19·8	19 20·7	15 21·9	19 21·1	19 21·8	19 21·1	19 20·5	19 20·0
1879 ...	19 21·3	19 22·0	19 22·0	19 23·2	19 21·9	19 21·7	19 21·9	19 22·6	19 22·2	19 22·6	19 23·0	19 21·9	19 22·2
1880 ...	19 21·8	19 22·1	19 20·2	19 20·7	19 23·4	19 22·7	19 22·6	19 21·3	19 22·6	19 20·6	19 20·6	19 20·2	19 21·6
1881 ...	19 22·1	19 21·3	19 20·7	19 20·9	19 21·8	19 20·2	19 18·7	19 18·1	19 19·8	19 41·6	19 42·4	19 45·0	19 43·0
1882 ...	19 43·5	19 43·5	19 43·6	19 43·2	19 43·2	19 43·3	19 41·8	19 42·1	19 42·3	19 43·4	19 41·6	19 42·2	19 42·8
1883 ...	19 42·5	19 42·4	19 42·6	19 42·2	19 43·0	19 42·5	19 43·1	19 44·7	19 44·2	19 44·8	19 44·0	19 44·5	19 43·4
1884 ...	19 44·4	19 44·7	19 43·9	19 44·7	19 43·7	19 44·3	19 43·8	19 45·2	19 46·3	19 46·0	19 46·7	19 46·0	19 45·0
1885 ...	19 46·5	19 46·2	19 46·8	19 47·3	19 47·2	19 46·4	19 46·2	19 47·1	19 45·2	19 45·5	19 45·8	19 45·6	19 46·3
1886 ...	19 46·1	19 45·9	19 46·1	19 45·1	19 45·6	19 45·6	19 46·3	19 45·8	19 45·9	19 45·9	19 45·7	19 46·4	19 45·9
1887 ...	19 46·1	19 46·1	19 46·0	19 45·4	19 45·4	19 45·8	19 46·1	19 46·9	19 43·8	19 47·2	19 46·5	19 57·2	19 46·9
1888 ...	20 9·6	20 8·3	20 7·6	20 9·9	20 10·8	20 10·8	20 10·6	20 9·3	20 9·2	20 13·1	20 13·6	20 14·5	20 10·6
1889 ...	20 19·4	20 19·4	20 17·0	20 16·6	20 18·4	20 19·5	20 18·5	20 19·4	20 19·2	20 18·9	20 20·5	20 20·5	20 18·9
1890 ...	20 20·7	20 20·4	20 21·7	20 22·7	20 23·1	20 23·3	20 24·4	20 25·7	20 24·0	20 25·3	20 26·7	20 26·5	20 23·7
1891 ...	20 26·9	20 28·0	20 28·0	20 27·1	20 27·7	20 28·9	20 28·9	20 29·7	20 29·3	20 30·2	20 31·5	20 31·0	20 28·9
1892 ...	20 32·5	20 32·3	20 32·9	20 34·6	20 33·9	20 34·7	20 34·4	20 34·3	20 30·4	20 30·1	20 33·5	20 35·9	20 33·3
1893 ...	20 35·2	20 34·9	20 33·9	20 34·8	20 35·4	20 36·1	20 35·8	20 33·4	20 34·5	20 34·5	20 35·6	20 37·1	20 35·1
1894 ...	20 35·5	20 37·7	20 38·7	20 39·9	20 40·6	20 41·0	20 41·9	20 41·3	20 41·4	20 41·5	20 43·8	20 44·8	20 40·7
1895 ...	20 44·9	20 46·4	20 46·4	20 45·9	20 46·6	20 48·7	20 49·4	20 48·9	20 49·5	20 49·9	20 51·8	20 53·8	20 48·5
1896 ...	20 54·1	20 54·6	20 55·3	20 55·5	20 56·7	20 57·3	20 57·2	20 54·3	20 56·3	20 54·4	20 56·1	20 55·2	20 55·6
1897 ...	20 56·1	20 55·8	20 57·3	20 58·6	20 58·9	20 59·5	20 58·3	20 59·4	21 0·1	21 0·8	21 1·8	21 3·0	20 59·1
1898 ...	21 3·8	21 4·1	21 3·9	21 5·2	21 4·8	21 5·5	21 6·3	21 6·6	21 8·6	21 8·2	21 8·3	21 8·7	21 6·2
1899 ...	21 9·8	21 11·6	21 11·8	21 11·6	21 13·0	21 12·9	21 13·9	21 14·6	21 15·6	21 16·8	21 17·0	21 18·2	21 13·9
1900 ...	21 18·5	21 20·1	21 20·6	21 20·1	21 21·1	21 20·8	21 21·3	21 23·1	21 23·6	21 24·0	21 24·5	21 25·4	21 21·9
1901 ...	21 26·4	21 26·6	21 27·5	21 27·4	21 28·5	21 29·2	21 30·1	21 31·4	21 31·6	21 31·8	21 32·4	21 33·7	21 29·7
1902 ...	21 33·4	21 33·8	21 33·7	21 33·9	21 34·9	21 34·6	21 36·0	21 38·2	21 37·5	21 38·2	21 39·9	21 39·5	21 36·1
1903 ...	21 40·7	21 40·3	21 41·3	21 40·7	21 41·0	21 42·0	21 43·7	21 45·4	21 45·3	21 45·4	21 47·6	21 47·6	21 43·4
1904 ...	21 48·1	21 48·7	21 48·0	21 47·3	21 47·5	21 48·2	21 49·0	21 48·5	21 48·8	21 49·9	21 51·7	21 52·7	21 49·0
1905 ...	21 53·5	21 55·3	21 55·0	21 54·0	21 54·8	21 56·2	21 59·5	21 59·3	22 0·5	21 59·3	21 59·9	22 1·0	21 57·4
Annual Inequality, 1888-1905.	+0 0·4	+ 0·4	0·0	− 0·2	0·0	+ 0·2	+ 0·1	− 0·2	− 0·6	− 0·7	+ 0·1	+ 0·3	

55. The probable errors of observation of inclination for a few years arbitrarily selected are given in table below.

TABLE 10*a*.—*Probable Errors.*

	1891.	1896.	1904.
Probable Error of a Single Determination ...	±1′·2	±1′·5	±1′·0
Probable Error of the monthly mean ...	±0·4	±0·5	±0·3
Probable Error of the annual mean ...	±0·1	±0·1	±0·1

CHAPTER II.

HORIZONTAL FORCE.

VARIATION INSTRUMENTS.

H. F. Magnetograph.

56. This differential instrument, one of the self-recording Kew type magnetographs, was received in 1870 along with similar instruments for recording Declination and Vertical Force variations, and was mounted in a specially constructed under-ground room. A full description of the installation will be found in the observatory publication of 1879—1882 to which reference is invited for details

57. The magnet of this instrument, as is well known, is suspended by two fine platinum wires some little distance apart forming what is called the bifilar suspension. It is clear that when there is no torsion in the system the magnet would lie in the magnetic meridian and the planes passing both through the upper and the lower extremities of the bifilar wires would also lie coincident with the magnetic meridian. If now torsion is applied to the upper ends of the wires, the plane passing through the lower extremities cannot follow this motion completely as the force of the magnet to keep itself in the magnetic meridian would restrain free movement. An angular difference in the planes through the upper and lower extremities of the bifilar system thus results, and this gives rise to two couples—one caused by the force of torsion which tends to twist the magnet away from the magnetic meridian, while the other caused by the action of the terrestrial magnetic force acting on the moment of the magnet which constitutes an equal and opposite couple, tends to retain the magnet in the meridian. When the torsion is sufficiently large to compel the magnet to lie east and west (magnetic) the torsion couple is balanced by the couple formed by the horizontal component of the earth's force and the moment of the magnet, and for the time being there is an equilibrium.

58. The torsion couple on one side and the moment of the magnet on the other may be regarded for a short time to remain constant and hence any change in the equilibrium which may occur, must be caused by a change in the terrestrial horizontal force. A mirror is attached to the magnet and just below it, in juxta-position is permanently fixed another mirror to the base plate of the instrument. So that a beam of light reflected from the fixed mirror being focussed on a photographic paper mounted on a cylinder rotating once in 24 hours, gives a steady line called the zero line; while that reflected from the mirror which is attached to the magnet and moves with it, gives a curve which indicates the variation of the horizontal force; and the ordinates between this curve and the zero line furnish a measure of this variation. The instrument carries a telescope to which is attached a fine scale and the image of this scale reflected from the mirror attached to the magnet, is observed through the telescope. This serves to furnish an additional series corresponding to the changes of the horizontal force registered on the photographic paper.

59. From measurements given in detail in Volume 1879—1882, Appendix I, page [5], the following angular values and factors for conversion have been obtained:—

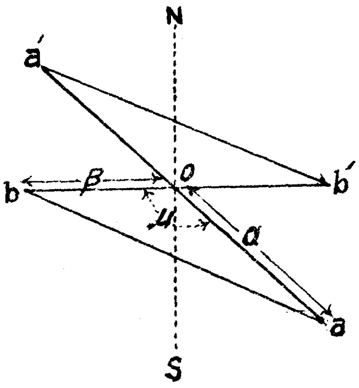
Angular value of 1 scale division.	Angular value for 1 inch of increase of ordinate.	Angular value for 1 c. m. of increase of ordinate.	Factor for converting scale reading into ordinate of 1 inch.	Factor for converting scale reading into ordinate of 1 c. m.	Factor for converting ordinate of 1 inch into scale reading.	Factor for converting ordinate of 1 c. m. into scale reading.
8'·29 or ·00241	28'·67 or ·00834	11'·29 or ·00328	·289	·734	3·46	1·363

2. *Scale Coefficient of the H. F. Magnetograph.*

60. The mechanical theory of the bifilar is briefly as follows:—

The equilibrium in the bifilar suspension is maintained by (1) the weight of the magnet, its carrier, &c., (2) the reaction of the pulley against the tension of the wire, and (3) the horizontal tension in the wire balancing half the moment of the terrestrial magnetic force acting on the magnet.

Let $2a$ be the distance apart of the wire at the top, the points of attachment being called a and a'; and 2β the distance of the wire at the lower extremity (equal to the diameter of the pulley round which the wire passes) the points of departure of the wire from the pulley being b and b'. Initially both aa' and bb' lie on the magnetic meredian. Now turn aa' through an angle θ. As bb' carries the suspended magnet, it will not follow this movement to the same extent; and suppose it is compelled to lie west-east, so that the north point of the magnet at *b* is directed to west (*vide* fig. below projected on the horizontal plane).



Let θ be the angle which aa′ makes with the magnetic meridian, μ be the angle formed between the planes passing through aa′ and bb′, the upper and lower points of the wire; l the length of each arm of the suspension wire and w the weight of the magnet with its appendages.

The tension of each arm of the wire is $\frac{w}{2}$ and the component of this force resolved in the direction ab, is $\frac{w}{2l}$ab. The moment of this force to rotate the magnet, is $\frac{w}{2l}$ab . p, where p is the perpendicular from o upon the base ab of the Δ abo. Now ab$\times$p equals twice the area of the triangle abo $= \alpha . \beta \sin \mu$. Hence substituting this value of ab$\times$p we have the force equal to $\frac{w}{2l} \alpha . \beta . \sin \mu$. This force acts in the direction of the line ab. We have a similar and equal force in the direction of a′b′ due to the other arm of the wire, hence the total moment causing the rotation is $\frac{w}{l} \alpha . \beta \sin \mu$. As this is balanced by the couple formed by the moment m of the magnet and H the terrestrial force, the moment of these equals mH . sin $(\theta - \mu)$ and we have

$$\frac{w}{l} \alpha . \beta . \sin \mu = mH . \sin (\theta - \mu) \tag{43}$$

If the magnet is lying true magnetic east-west, $\theta - \mu = 90°$ and we have

$$\frac{w}{l} \alpha . \beta . \sin \mu = mH \tag{44}$$

Differentiating

$$\frac{w}{l} \alpha . \beta . \cos \mu . d\mu = m . dH \tag{45}$$

Dividing (45) by (44) we get

$$\cot \mu \, d\mu = \frac{dH}{H} \tag{46}$$

61. Now suppose that in the magnetograph either the distance of the photographic paper, or of the scale of the reading telescope from the centre of the magnet, is n c.m. then as the image on the paper, or that of the scale as seen through the telescope, is reflected from a mirror attached to the magnet an ordinate of 1 c.m. on the photographic paper, or of an unit of the scale division of the attached scale, upon a base of 2n c. m. would be a measure of the change $d\mu$ in the angle and as such used for the scale co-efficient.

62. The form in which the formula is used at Colaba for the derivation of the monthly values of the scale co-efficient *adopted to the scale divisions* of the instrument is obtained as follows:—

As sin $(\theta - \mu)$ is not exactly equal to one, instead of equation (46), we have to deal with the equation

$$\left\{ \cot \mu + \cot (\theta - \mu) \right\} d\mu = \frac{dH}{H} \tag{47}$$

This, as $\theta - \mu = \frac{\pi}{2}$ nearly, may now be written

$$\cot \mu + \left(\frac{\pi}{2} + \mu - \theta \right) = \frac{1}{d\mu} \frac{dH}{H} \tag{48}$$

If $\mu = \mu_0 + \Delta\mu$, μ_0 being some value of μ and nearly equal to $\theta - \frac{\pi}{2}$; and H and H_0 are the values of force corresponding to μ and μ_0 respectively so that when $\Delta\,\mu$ vanishes $\frac{dH}{H} = \frac{dH_0}{H_0}$ we may also have the equality

$$\cot \mu_0 + \left(\frac{\pi}{2} + \mu_0 - \theta\right) = \frac{1}{d\mu}\,\frac{dH_0}{H_0} \tag{49}$$

Substracting (49) from (48) and simplifying we have

$$\frac{1}{d\mu}\,\frac{dH}{H} = \frac{1}{d\mu}\,\frac{dH_0}{H_0} - \cot^2\mu_0\,\Delta\mu \tag{50}$$

Now $\Delta\,\mu$ in terms of scale divisions* equals $(s - S)a$ where, s is the scale reading for which the co-efficient is sought, a the angular value (in this case ·00241) of one scale division, and S the zero value of the scale corresponding to condition $\mu = \mu_0$ and the equation thus becomes

$$\frac{1}{d\mu}\,\frac{dH}{H} = \frac{1}{d\mu}\,\frac{dH_0}{H_0} - \cot^2\mu_0\,(s - S)\,a. \tag{51}$$

Whence multiplying by Ha we get the scale co-efficient

$$\frac{dH}{ds} = Ha\,.\frac{1}{d\mu}.\frac{dH}{H} = Ha\,.\cot\mu_0 - Ha^2.\cot^2\mu_0\,(s - S) \tag{52}$$

63. The experimental determination of the angles θ, μ &c. is of course possible in a direct way from which the scale co-efficient is derivable: but the method of deflections affords a much more accurate and easy method than the direct experimental one, and it has been taken advantage of in preference to the former.

64. In this method a magnet (whose moment if not previously determined) is used first as a deflector by being placed end on, on the north and south side of the magnetograph magnet at a distance r. The deflections produced on the photographic curve (or in the scale reading if eye readings are secured) are noted. The second operation is to find the disturbing force which has produced the deflections in the first operation. For this the same deflector is used on the declination magnetograph magnet which is similar in shape and dimension as the H. F. magnetograph magnet, and θ the angle of deflection is noted. It is clear that $H\tan\theta$ is here the measure of the disturbing force. Hence the deflection in the first operation is due to a disturbing force equivalent to $H\tan\theta$. If the deflection measured on the paper is n c.m. then the scale co-efficient or the value in force for an unit of scale viz. 1 c.m. equals $\frac{H\tan\theta}{n}$. The distance r in the experiment is supposed to be large enough to provide for the exclusion of any correction due to the distribution of magnetism. If this is not possible it is necessary to repeat the deflections at more distances than one to allow of this correction to be applied to the results.

The deflection method.

65. If however the moment of the magnet is previously known, as for example when the standard magnet used for absolute déterminations is requisitioned, the second operation is for obvious reasons superfluous. For the condition of equilibrium during observations of H and m in absolute determinations, by the method of tangents, is given by the equation $m = \frac{Hr^3\tan\theta}{2}$ and therefore $H\tan\theta = \frac{2m}{r^3}$. Hence the disturbing force which produces in the first operation a deflection of n c.m. on the photographic curve equals $\frac{2m}{r^3}$; and as m and r are known quantities the value of force for 1 c.m. of deflection which equals $\frac{2m}{r^3 n}$ or more correctly $\frac{2m}{r^3 n}\left(1 + \frac{p}{r^2}\right)$ when the distribution correction is applied, is easily secured. The use of a magnet with a correct moment previously determined, it will thus be seen, reduces the labour considerably and introduces no additional uncertainties in the distribution correction which in every experiment, depends upon both the deflecting and deflected magnet.

66. As however it is generally undesirable to use the standard magnet employed for absolute determinations for purposes of this kind which bring it in close proximity of other magnets, the deflector used in the Colaba deflection experiments is another magnet E_1 (solid cylindrical) which was sent out initially with the instrument for this special purpose. This deflector has been used throughout in the experiments.

The details of the process are as follows :—

(1) The deflections on the force magnetograph are made by deflector magnet E_1.

* The north end of the magnet, in adjustment, points to west, and the movement of this end towards the north causes an increase of scale reading as also increase in the value of μ.

(2) Deflections of magnet N_3* which is used in a suitable magnetometer suspended by a single thread, are made by deflector E_1. These deflections are made at the electrometer tower where the usual absolute determinations are made.

(3) Deflection of magnet N 23 c. are made by E_1 as in (2).

The magnet N 23 c is the mirror magnet of the Kew unifilar magnetometer and the above operations are usually performed during night hours when the magnetic traces are least disturbed.

In the first operation the deflections are taken at 2·0, 2·2, 2·5, and 3·0 ft. distances on either side (N and S) of the force magnet, the deflector taking four positions for one distance.

At Colába the deflections are recorded in scale divisions by eye readings and whenever necessary the results are checked by tabulation ordinates.

In the second operation the deflections of magnet N_3 are taken at the same distances as in (1) with an additional near distance—1·25 ft.

The third operation consists in deflecting the magnet N 23 c. by the deflector E_1 at a single distance 1·0 ft. the method of sines being used, the angular value of the deflection being secured by turning the deflection bar until the first position of rest on the magnet scale is obtained. The angle of deflection is read off on the circle of the magnetometer. This secures a measure of the moment of the magnet E_1 also.

67. The whole process for the determination of the scale co-efficient is best illustrated by an example. The results of observations and experimental data taken on the 26th February 1900 are as follows :—

Experiment (1).—The observed deflections d in scale readings at various distances were :—

	ft.	ft.	ft.	ft.	
	3·0	2·5	2·2	2·0	
double deflections d =	8·21	14·24	20·83	27·64;	Σd= 70·92.

The mean scale reading in the away position during the experiment—that is when the deflector is taken away and is not in action, was noted before and after each deflection. This mean scale reading was 30·85.

Experiment (2).—At the electrometer tower.

The observed deflections in scale readings of the magnetometer were :—

	ft.	ft.	ft.	ft.	ft.
	3·0	2·5	2·2	2·0	1·25
double deflections =	1·99	3·38	4·97	6·63	26·41 ;

the torsion co-efficient $1 + \frac{H}{F} = 1·00151$.

Experiment (3).—At the electrometer tower.

The observed angle of deflection θ' at 1·0 ft. distance was $6° \; 23' \; 45''$.

Calculations.

The first operation determines the constant of distribution, which enables us to see whether or not the value of p derived, continues to remain within passable limits of the adopted value ($p = -·06234$) derived initially from a long series of observations at the five distances observed in experiment (2). In the calculations full weight is given to the deflection at the nearest distance, and two equations are formed—one derived from the sum of the deflections at the four remoter distances taken altogether, and the other from that of the single nearest distance 1·25 ft.

$$\text{They are } \Sigma d = \Sigma \frac{D}{r^3} + \Sigma \frac{pD}{r^5} \text{ and } d_{1·25} = \frac{D}{r_1^3} + \frac{pD}{r_1^5}$$

* This magnet which is similar in shape and dimensions as the force magnet in the magnetograph, is, by experiments, found to have symmetrical distribution of magnetism as in the magnetograph magnet.

where D is some constant, d the deflections in scale readings, and p the *differential* distribution correction (*vide* paragraph 69). Solving the equations by substitution in them of data in experiment, (2) we get the value of $p = -\cdot06214$, which, it will be seen, is fairly within passable limits of the adopted value.

The second operation for the determination of the value of the disturbing force is as follows. The moment of the deflector magnet E_1 as derived from experiment (3) may for all practical purposes be equated as

$$m = J \cdot H \cdot \sin\theta' \tag{53}$$

where J is some constant, θ' the angle of deflection in experiment (3). Hence calling the disturbing force as Y we have

$$Y = \frac{2\,J \cdot H \cdot \sin\theta'\left(1 + \frac{p}{r^2}\right)}{r^3} \tag{54}$$

Similarly in experiment (2) if $\acute{a}$ is the angular value in circular measure of the scale division of the magnetometer used in that experiment, $1 + \frac{H}{F}$ —the co-efficient of torsion, and Σd the sum of the deflections in scale value as the angle is small we have also

$$Y = \acute{a}\left(1 + \frac{H}{F}\right)\frac{\Sigma d}{2} \times H \tag{55}$$

whence

$$J = \frac{\acute{a}\left(1 + \frac{H}{F}\right)\Sigma d}{4\sin\theta'\,\Sigma\frac{1}{r^3}\left(1 + \frac{p}{r^2}\right)} \tag{56}$$

Solving the last equation for the value of J from data in experiment (2) we have $J = \cdot50230$.

The value of J was initially derived from a large series of experiments and the adopted value is $\cdot50015$. Thus its value for the experiment of 26th February 1900, it will seen, is also within passable limits of the adopted value, and does not affect the co-efficient more than $\frac{1}{200}$ of the whole.

The value of cot μ can now be derived from equation 46 for

$$\cot\mu = \frac{1}{d\mu}\cdot\frac{dH}{H} = \frac{\Sigma\Delta H}{H\Sigma d\mu} = \frac{\Sigma Y}{H \cdot a \cdot \Sigma\frac{d}{2}} \tag{57}$$

where other notations remaining the same d = the deflections observed in experiment (1) and a = the angular value in circular measure of a division of the scale of the reading telescope of the magnetograph. Substituting in (57) the value of Y given in (54) we have

$$\cot\mu = \frac{1}{d\mu}\cdot\frac{dH}{H} = \frac{4J\sin\theta'\left\{\Sigma\left(\frac{1 + \frac{p}{r^2}}{r^3}\right)\right\}}{a\Sigma d} \tag{58}$$

Solving (58) by the data of experiment (1) and subtituting the adopted values of p and J we get as first approximation the value of cot μ, which may for convenience be called cot μ_1.

Thus $\cot\mu_1 = \cdot41189$.

Then from equations

$$\cot\mu_2 = \cot\mu_1 + a\cot^2\mu_1\,(s - S) \tag{59}$$

$$\cot\mu_3 = \cot\mu_2 + a\cot^2\mu_2\,(s - S) \tag{60}$$

where s = mean scale reading of the away position in the deflection experiment (1) and S = the zero of the scale corresponding to condition $\mu = \mu_0$. We can derive successive values of cotμ until when the second expression on the right of the above equations does not change, the final value of cotμ may be obtained. Usually three operations are sufficient.

TABLE 12.—*Scale-coefficients of Horizontal Force Magnetograph.*

Unity = 0·1 γ = ·000001 C. G. S. Unit.

Year.	Month.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1872 ...	4369	4384 4144	4130	4138	4156	4179	4199	4216	4228	4244	4253	4263
1873 ...	4276	4282	4292	4301	4312	4327	4338	4347	4356	4112	4120	4126
1874 ...	4134	4140	4144	4150	4154	4162	4170	4176	4184	4191	4196	4201
1875 ...	4204	4210	4217	4219	4226	4232	4241	4247	4255	4260	4265	4270
1876 ...	4274	4279	4282	4286	4291	4297	4302	4308	4313	4319	4323	4327
1877 ...	4331	4333 4084	4088	4092	4099	4104	4108	4114	4119	4124	4129	4133
1878 ...	4136	4139	4142	4146	4150	4155	4158	4161	4165	4169	4172	4176
1879 ...	4178	4181	4184	4186	4189	4192	4195	4198	4202	4204	4207	4209
1880 ...	4212	4214	4218	4219	4223	4224	4226	4232	4232	4234	4237	4239
1881 ...	4240	4244	4244	4246	4247	4250	4252	4253	4258	4259	4262	4264
1882 ...	4256	4258	4259	4264	4265	4266	1037	1038	1038	1039	1040	1040
1883 ...	1039	1040	1040	1040	1041	1041	1041	1042	1042	1042	1043	1043
1884 ...	1045	1045	1046	1046	1047	1047	1048	1048	1048	1049	1049	1049
1885 ...	1250	1250	1250	1251	1252	1252	1252	1253	1254	1254	1254	1255
1886 ...	1253	1257	1262	1262	1263	1263	1263	1264	1264	1264	1265	1265
1887 ...	1265	1265	1265	1266	1266	1267	1267	1267	1268	1268	1268	1268
1888 ...	1269	1269	1270	1270	1271	1256	1257	1257	1257	1258	1258	1258
1889 ...	1259	1259	1259	1259	1260	1261	1261	1261	1262	1262	1262	1262
1890 ...	1263	1263	1265	1268	1273	1273	1273	1273	1274	1274	1274	1274
1891 ...	1275	1275	1275	1276	1277	1277	1277	1277	1278	1278	1278	1278
1892 ...	1278	1279	1279	1279	1280	1280	1266	1266	1266	1266	1266	1266
1893 ...	1266	1266	1266	1266	1266	1267	1267	1269	1270	1270	1270	1270
1894 ...	1272	1273	1273	1273	1273	1274	1274	1278	1278	1278	1278	1278
1895 ...	1277	1277	1277	1278	1278	1278	1278	1278	1283	1284	1284	1284
1896 ...	1285	1286	1286	1286	1287	1287	1287	1287	1291	1292	1292	1292
1897 ...	1292	1292	1292	1293	1293	1294	1293	1294	1294	1294	1294	1295
1898 ...	1294	1275	1276	1276	1276	1277	1277	1277	1278	1278	1278	1278
1899 ...	1277	1281	1281	1281	1282	1282	1282	1282	1282	1282	1282	1283
1900 ...	1284	1284	1284	1290	1291	1290	1290	1290	1290	1291	1291	1291
1901* ...	507	508	508	509	509	509	509	510	510	510	510	510
1902 ...	511	511	511	511	511	511	512	512	512	512	512	512
1903 ...	511	511	512	512	512	512	512	512	512	512	472	478
1904 ...	479	479	479	479	479	479	479	479	479	479	479	479
1905 ...	479	479	479	479	479	479	479	479	479	479	480	479

* From the year 1901 the scale-coefficients are given for an ordinate of 1 c. m. on the photographic curve.

The value of cot μ so derived is ·41252. Its value obtained from a similar experiment of the previous year was ·41104, and hence for continuity the mean of the two values (·41178) is adopted as the value of cot μ_0 for the intervening (yearly) period between the two experiments.

Having thus secured the value of cot μ_0 the monthly values of the co-efficient in terms of the division of the scale are derived from equation 52 —

$$\frac{dH}{ds} = H\, a \cot \mu_0 - \mathrm{H}\, a^2 \cot^2 \mu_0\, (s - S). \qquad (61)$$

where other notations remaining the same, $s =$ the mean *monthly* value of the scale reading.

68. The factor for converting the scale readings into an ordinate of 1 inch is 0·289 and into 1 c.m. is 0·734 as referred already and the scale co-efficients so derived and used in the reductions every month have all been collected in table (12). The scale co-efficients upto 1900 are for an ordinate of 1 inch and from 1901 to 1905 for 1 c.m.

69. It may be noted here that experiment (3) was added to the observational series after the year 1887, the scale co-efficients of the previous years being directly derived from the results of experiment (1) and (2) only. The operations then consisted in correcting the deflections of magnet N_3 by a factor $\left(1 - \frac{\cdot 02269}{r^2}\right)$ which indicated the correction due to the dissimilarity in the distribution of magnetism between the magnet No. 3 and the magnetograph magnet. If the distribution was similar it is obvious that the ratios $\frac{\mathrm{d}'}{\mathrm{d}}$ of the deflections of magnet N_3 to those of the force magnet would be for all distances a constant quantity, and independent of the distances of deflections. If the magnets however are dissimilar then we have clearly to deal with the quotient $\frac{\mathrm{d}'}{\mathrm{d}} \frac{\left(1 + \frac{p'}{r^2}\right)}{\left(1 + \frac{p''}{r^2}\right)}$ which may be put equal to some constant D; p' and p'' being the distribution constants in each case.

We have hence approximately—

$$D = \frac{\mathrm{d}'}{\mathrm{d}} \left(1 - \frac{p'' - p'}{r^2}\right) = \frac{\mathrm{d}'}{\mathrm{d}} \left(1 - \frac{p}{r^2}\right) \qquad (62)$$

where p is the *differential* effect of dissimilar distribution. This value of p was initially derived from a large series of deflection experiments and found to be ·02269 which has been used as a factor for correcting d′—the deflections of magnet N_3.

70. Having thus corrected the deflection values d′, the first value of cot μ was derived from the equation—

$$\frac{1}{d\mu} \frac{dH}{H} = \frac{a' \Sigma \mathrm{d}'}{a \Sigma \mathrm{d}} \qquad (63)$$

where a' is the value in circular measure (corrected for torsion) of the scale division of the Magnetometer used for deflections of magnet N_3; and a is similarly the value of the scale attached to the reading telescope of the magnetograph. The operations hereafter are the same as before leading up to the final value of cot μ from which the value of the scale co-efficient is derived.

71. It may be remarked here that the refinement aimed at in the several operations for the evaluation of p and J, may not, from the point of the actual requirements of the scale co-efficient which does not necessitate an accuracy greater than $\frac{1}{200}$ of the whole, be deemed essentially necessary. For it can be seen that with either of the methods adopted before or after 1887 the values of cot μ do not differ sufficiently to affect the co-efficient to the above limit; and as a matter of interest it may be also noticed that even the exclusion of the consideration of the distribution constant and J from the reductions does not affect the value of the co-efficients obtained to any seriously appreciable extent. And yet as a matter of check and control on the working of the instruments as also on the observational work, the process has been systematically adopted in order to make it impossible for any extraneous errors to vitiate the results without being at once detected.

3. *The temperature co-efficient.*

72. It is obviously advantageous in all works of precision to secure if possible against the applications of any kind of corrections. We know that the indications of a magnet vary with temperature. It is hence necessary in the first instance to have the variation of temperature to which the magnet is subject made as small as possible; and secondly to secure a magnet with a small co-efficient. The first is secured by installing the magnetograph in a room of special construction where the variation of temperature may be practically made as small as possible. It is difficult always to command a magnet with a small co-efficient but it is not impossible, and efforts to secure such a magnet are well worth the trouble.

73. It becomes necessary next to consider ways and means by which the small variations of temperature can be correctly determined. Assuming that a single day's variation of force should be accurate to 1γ so that the mean daily variation for the month may be depended upon to about $\cdot 2\gamma$, it is clear that the scale of the thermometer should be open enough to allow of the variation of temperature to be read off to the necessary degree of accuracy so that with the value of the temperature co-efficient the result may be correct to 1γ. Supposing, as a case in point, the temperature co-effieient to be 10γ for 1° F. a thermometer when it is of the usual type the length of the scale of which is about $\cdot 1$ inch for one degree, it is obvious, can hardly answer the requirements. Another source of error has also to be guarded against. The thermometer may not indicate the change actual of the temperature of the magnet. There is not much uncertainty about this in the small enclosures of the magnetographs located in underground rooms; but in overground rooms with large variations of temperature and with large enclosures (as in the Grubb's Magnetometer, see Chapter III), this is markedly serious; and even in the magnetograph enclosures under attenuated pressure as the thermometers and the magnet are some distance apart, with dissimilar powers of absorption and radiation, there is undoubtedly a small lag (*vide* paragraph 117) in their indications. In such cases then all depends upon the magnitude of the temperature co-efficient. These considerations will be referred to again in Chapters III and VI, Part I.

74. There are three methods by which the temperature co-efficient of the magnet of a force magnetograph can be derived and one or the other has been used wherever convenient.

The *first* method is that of heating and cooling the magnet bar by itself, when detached from its fittings in the magnetograph and placed in a suitable receptacle filled with water the temperature of which is raised or lowered. This causes the moment of the magnet to fall or rise respectively; and noting the angle of deflection produced on a declination magnetometer needle, the co-efficient is computed. The equation of equilibrium when the magnet is used as a deflector (by the method of sines) is—

$$Cm = H \sin \mu \tag{64}$$

where C is some constant depending upon the distance between the magnets; and μ is the angle of deflection.

When the temperature t changes to t', a change of δm occurs in the moment m of the magnet, and $\delta\mu$ in the angle μ of deflection. Correcting $\delta\mu$ for natural change in declination and differentiating we have—

$$C\delta m = H \cos \mu\delta\mu \tag{65}$$

and dividing (65) by (64) we have—

$$\frac{\delta m}{m} = \cot \mu\delta\mu = -k\ (t - t') \tag{66}$$

where k is the co-efficient sought. When corrections due to changes of force which occur during the experiment are appreciably large, they are allowed for and the expression $\cot \mu\delta\mu$ in the equation is written $\cot \mu\delta\mu + \frac{\delta H}{H}$; and as allowance also should be made for the pulley and wires which support the magnet in the bifilar suspension in the theory of equilibrium of which the force varies directly as the diameter of the pulley and inversely as the length of the wires, if e and e' are the co-efficients of linear expansion of brass and platinum respectively, the expression on the right becomes $-\{k + (2e - e')\}\ (t - t')$ and hence the complete equation will be of the form—

$$\frac{\delta m}{m} = \cot \mu\delta\mu + \frac{\delta \mathrm{H}}{\mathrm{H}} = -\{k + (2e - e')\}\,(t - t') \tag{67}$$

The *second* method depends upon the average change in the daily temperature and the simultaneous change in the scale reading of the instrument from which $\frac{\Sigma\Delta s}{\Sigma\Delta t}$ could be easily computed, and the co-efficient $\frac{d\mathrm{H}}{ds}\,\frac{\Sigma\Delta s}{\Sigma\Delta t}$ derived.

In the *third* method—that of heating and cooling the magnetograph room the simultaneous readings of the thermometer and scale during the experimental heating and cooling, are noted and the co-efficient derived as in method (2).

75. Each method has its advantages and disadvantages. Method (1) enables a correct value of the co-efficient of the magnet to be secured by direct experiment. But it is doubtful if the different conditions in which the magnet with its appendages, is actually used in the magnetograph, would allow the value of the co-efficient to remain absolutely unaffected. Method (2) is convenient and simple and has the advantage not possible in the other two methods of having the value of the co-efficient determined in the very conditions which obtain when the magnet is working in the instrument and under which its record is secured. The correct determination of the co-efficient by this method however depends upon circumstances. The daily change of temperature should be fairly definite and appreciably large and no uncertainty should prevail in the daily instrumental change such as may be likely to vitiate the scale readings. In the magnetograph room at Colaba the average daily change of temperature is so small as to be inappreciable. This precludes the adoption of this method. It is of course possible by taking the *monthly* changes of temperature and comparing them with the *monthly* changes of scale reading, provided the instrumental changes are correctly eliminated to secure the temperature co-efficient. But the uncertainty in the process of elimination of instrumental changes even though small is too great to ensure the derivation of the value of the co-efficient correctly. The use of the method extended to the monthly values however has been made, as will be seen presently, not so much with the view to secure the co-efficient by this method, as with the object of showing how far the reliability and accuracy of the computed instrumental change can be depended upon. This operation and its result having been specially indicated in another section which treats of the creep of the zero of the instrument, have been given elsewhere

76. Method (3) which has been invariably adopted at Colaba though suffering from the objection already referred to, in common with method (1), is on the whole fairly reliable. The only precaution necessary is to ensure that the thermometer records the actual variations of the temperature of the magnet.

77. The magnetograph room at Colaba has been heated and cooled periodically for this purpose and a summary of the results of the experiments conducted from time to time is given below :—

February 1879	temperature co-efficient	$\frac{\delta H}{\delta s}\,\frac{\Sigma\Delta s}{\Sigma\Delta t}$	$= \cdot 00121 \times -\cdot 024 = -\cdot 00029$	C. G. S.
January 1880	,,	,,	$= \cdot 00122 \times -\cdot 030 = -\cdot 000037$	,,
February 1880	,,	,,	$= \cdot 00122 \times -\cdot 036 = -\cdot 000044$	,,
January 1881	,,	,,	$= \cdot 00123 \times -\cdot 023 = -\cdot 000028$	,,
February 1881	,,	,,	$= \cdot 00123 \times -\cdot 019 = -\cdot 000023$	
			Mean $= -\cdot 000032$	C. G. S.

The mean co-efficient $-3\cdot 2\gamma$ for 1° F derived from these experiments was adopted and has been used throughout in the reductions.

Similar experiments were repeated in January and February 1886, in January 1895, and in January 1907.

January and February 1886,	Temp. co-efficient	$\frac{\delta H}{\delta s}\,\frac{\Sigma\Delta s}{\Sigma\Delta t}$	$= \cdot 000362 \times -\cdot 0865 = -\cdot 000031$	C. G. S
January 1895	,,	,,	$= \cdot 000368 \times -\cdot 0960 = -\cdot 000035$	,,
January 1907	,,	,,	$= \cdot 000352 \times -\cdot 1108 = -\cdot 000039$	,,

The mean result of all experiments work out as $-\cdot 000033$ C. G. S. which shows that the adopted co-efficient $-3\cdot 2\gamma$ for 1° F. can be accepted as fairly reliable.

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograph.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force Magnetograph.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean monthly value of Zero (as observed).	Mean monthly value of Zero corrected to 90° F.	Mean monthly value of Zero calculated by formula.	Difference Column 10—Column 11.	Differences in Column 12 corrected for mean annual excess.	Differences in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
								1872.							
			inch.	°	inch.	°									
January ...	·372216	17·0	0·4381	88·40	0·3943	88·32	·372022	·370299	·370353	...	...	...	...	...	...
February ...	·372290	...	...	...	...	88·42	...	...	...	...	...	...	...	...	...
March ...	·372636	...	...	...	...	90·86	...	...	...	...	...	...	...	...	...
April ...	·372926	14·7	4·6814	92·07	4·5824	92·27	·372522	·353560	·353487	...	...	...	...	...	...
May ...	·372811	13·2	4·3259	93·90	4·2246	94·24	·372401	·354844	·354708	...	...	...	...	...	...
June ...	·372756	15·5	3·8194	95·07	3·7686	95·11	·372545	·356796	·356632	...	...	...	...	...	...
July ...	·372603	17·0	3·4142	92·14	3·3694	92·24	·372418	·358270	·358198	...	...	...	...	...	...
August ...	·372613	17·5	3·1237	90·30	3·0300	90·33	·372219	·359445	·359434	...	...	...	...	...	...
September ...	·372590	14·5	2·8472	90·10	2·7912	89·99	·372349	·360548	·360548	...	...	...	...	...	...
October ...	·372336	16·6	2·5228	90·02	2·5053	89·92	·372259	·361627	·361630	...	...	...	...	...	...
November ...	·372410	17·0	2·3476	89·92	2·3175	89·86	·372280	·362424	·362428	...	...	...	...	...	...
December ...	·372530	14·5	2·1605	90·15	2·1175	90·01	·372343	·363316	·363316	...	...	...	...	...	...
Mean ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
								1873.							
			inch.	°	inch.	°									
January ...	·372322	15·6	1·9456	87·68	1·8847	87·86	·372068	·364009	·364077	...	...	...	...	...	...
February ...	·372603	15·7	1·8386	87·75	1·7566	87·99	·372260	·364738	·364802	...	...	...	...	...	...
March ...	·372691	15·5	1·6557	88·92	1·5657	89·21	·372314	·365594	·365619	...	...	...	...	...	...
April ...	·372811	16·0	1·4349	91·78	1·3775	92·00	·372571	·366646	·366582	...	...	...	...	...	...
May ...	·372825	17·5	1·1820	93·95	1·1529	93·93	·372699	·367728	·367602	...	...	...	...	...	...
June ...	·372894	14·5	0·9532	94·65	0·8728	94·41	·372538	·368761	·368620	...	...	...	...	...	...
July ...	·372963	16·0	0·7114	91·50	0·6503	91·39	·372694	·369873	·369829	...	...	...	...	...	...
August ...	·372769	16·5	0·4817	90·22	0·4658	90·11	·372696	·370671	·370667	...	...	...	...	...	...
September ...	·372682	13·5	0·3449	89·52	0·2960	89·42	·372466	·371177	·371196	...	...	...	...	...	...
October ...	·372820	18·5	4·6034	89·67	4·5698	89·56	·372655	·353864	·353878	...	...	...	...	...	...
November ...	·372742	15·5	4·4891	89·15	4·4403	89·14	·372541	·354247	·354275	...	...	...	...	...	...
December ...	·372779	17·0	4·3326	87·36	4·3091	87·41	·372684	·354905	·354988	...	...	...	...	...	...
Mean ...	·372742	16·0	...	90·18	...	90·20	·372515	...	...	...	...	...	...	...	...
								1874.							
			inch.	°	inch.	°									
January ...	·372880	17·5	4·1873	85·15	4·1634	84·91	·372773	·355563	·355726	...	...	...	...	...	...
February ...	·372792	14·5	4·1045	84·25	4·0476	84·17	·372553	·355796	·355983	...	...	...	...	...	...
March ...	·372889	14·5	4·0633	84·77	3·9701	84·84	·372505	·356053	·356218	...	...	...	...	...	...
April ...	·372912	11·5	3·9000	86·27	3·8470	86·68	·372705	·356740	·356846	...	...	...	...	...	...
May ...	·373004	13·0	3·8161	89·50	3·7487	90·02	·372741	·357169	·357168	...	...	...	...	...	...
June ...	·373000	13·5	3·6412	91·90	3·5922	91·87	·372795	·357844	·357784	...	...	...	...	...	...
July ...	·373152	15·0	3·5074	90·34	3·4334	90·40	·372845	·358528	·358515	...	...	...	...	...	...
August ...	·373240	15·7	3·3535	89·02	3·2929	89·07	·372989	·359238	·359268	...	...	...	...	...	...
September ...	·373097	16·0	3·2057	89·18	3·1606	89·06	·372904	·359680	·359710	...	...	...	...	...	...
October ...	·373069	17·5	3·0216	88·82	3·0166	88·75	·373046	·360403	·360443	...	...	...	...	...	...
November ...	·373046	14·5	2·9746	87·90	2·9317	87·83	·372864	·360563	·360632	...	...	...	...	...	...
December ...	·373087	16·0	2·8735	87·04	2·8445	87·09	·372967	·361017	·361110	...	...	...	...	...	...
Mean ...	·373140	14·9	3·5541	87·84	3·5041	87·89	·372807	·358216	·358284	...	...	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograph.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force Magnetograph.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean monthly value of Zero (as observed).	Mean monthly value of Zero corrected to 90° F.	Mean monthly value of Zero calculated by formula.	Difference Column 10—Column 11.	Differences in Column 12 corrected for mean annual excess.	Differences in Column 13 corrected for annual variation of Zero.	Smoothed means of zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1875.															
			inch.	°	inch.	°									
January ...	·373055	16·5	2·7925	84·95	2·7607	84·86	·372918	·361312	·361476	...	...	...	...	...	...
February ...	·373083	13·5	2·7351	83·32	2·6586	83·59	·372770	·361577	·361782	...	...	...	...	...	...
March ...	·373157	17·0	2·5862	...	2·5464	...	·372989	·362251	...	...	...	...	...	...	...
April ...	·373207	17·5	2·4809	...	2·4737	...	·373177	·£62740	...	...	...	...	...	...	...
May ...	·373235	15·5	2·3604	...	2·3458	...	·373173	·363260	...	...	...	...	...	...	...
June ...	·373313	16·0	2·2313	...	2·2063	...	·373207	·363870	...	...	...	...	...	...	...
July ...	·373263	17·5	2·0520	...	2·0487	...	·373249	·364560	...	...	...	...	...	...	...
August ...	·373267	14·5	1·9611	...	1·9262	...	·373119	·364938	...	...	...	...	...	...	...
September ...	·373240	15·0	1·8216	...	1·7759	...	·373046	·365490	...	...	...	...	...	...	...
October ...	·373373	16·5	1·6843	...	1·6790	...	·373350	·366197	...	...	...	...	...	...	...
November ...	·373355	13·5	1·5781	...	1·5780	...	·373355	·366625	...	...	...	...	...	...	...
December ...	·373235	15·0	1·5026	...	1·4858	...	·373163	·366819	...	...	...	...	...	...	...
Mean ...	·373232	15·7	2·1488	...	2·1238	...	·373126	·364137	...	...	...	...	...	...	...
1876.															
	·		inch.		inch.										
January ...	·373226	15·5	1·4377	...	1·4019	...	·373073	·367081	...	...	...	...	...	...	...
February ...	·373212	12·2	1·3301	...	1·3047	...	·373103	·367531	...	...	...	...	...	...	...
March ...	·373410	15·0	1·2945	...	1·2376	...	·373166	·367867	...	...	...	...	...	...	...
April ...	·373553	15·5	1·2152	...	1·1621	...	·373325	·368344	...	...	...	...	...	...	...
May ...	·373562	17·0	1·0863	...	1·0608	...	·373453	·368901	...	...	...	...	...	...	...
June ...	·373530	17·5	0·9719	...	0·9504	...	·373438	·369354	...	...	...	...	...	...	...
July ...	·373609	15·5	0·8907	...	0·8383	...	·373384	·369778	...	...	...	...	...	...	...
August ...	·373618	16·0	0·7685	...	0·7271	...	·373440	·370308	...	...	...	...	...	...	...
September ...	·373493	16·5	0·6219	...	0·6149	...	·373463	·370811	...	...	...	...	...	...	...
October ...	·373507	14·7	0·5341	...	0·5172	...	·373434	·371200	...	...	...	...	...	...	...
November ...	·373553	15·0	0·4669	...	0·4322	...	·373403	·371535	...	...	...	...	...	...	...
December ...	·373396	16·6	0·3609	...	0·3429	...	·373318	·371834	...	...	...	...	...	...	...
Mean ...	·373472	15·6	0·9149	...	0·8825	...	·373333	·369545	...	...	...	...	...	...	...
1877.															
			inch.	°	inch.	°									
January ...	·373489	17·0	0·2912	...	0·2682	...	·373389	·372227	...	...	...	...	...	...	...
February ...	·373553	17·5	4·6479	...	...	...	...	...	...	...	...	...	...	...	...
March ...	·373585	17·5	4·5919	89·15	4·5615	89·08	·373459	·354812	·354841	...	...	...	...	...	...
April ...	·373558	14·5	4·5084	90·50	4·4860	90·71	·373473	·355116	·355093	...	...	...	...	...	...
May ...	·373516	16·0	4·4081	92·84	4·3691	92·86	·373357	·355448	·355356	...	...	...	...	...	...
June ...	·373401	16·5	4·2929	95·15	4·2695	94·96	·373299	·355777	·355618	...	...	...	...	...	...
July ...	·373562	14·5	4·2132	94·45	4·1730	94·60	·373402	·356259	·356112	...	...	...	...	...	...
August ...	·373493	15·0	4·0816	94·02	4·0656	93·95	·373425	·356699	·356573	...	...	...	...	...	...
September ...	·373410	15·5	3·9632	93·27	3·9591	93·25	·373392	·357084	·356980	...	...	...	...	...	...
October ...	·373655	17·0	3·9079	93·00	3·8615	93·16	·373469	·357544	·357443	...	...	...	...	...	...
November ...	·373604	17·5	3·7754	92·10	3·7586	92·23	·373539	·358020	·357949	...	...	...	...	...	...
December ...	·373604	15·5	3·7267	91·02	3·6940	91·11	·373472	·358205	·358169	...	...	...	...	...	...
Mean ...	·373536	16·2	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograph.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force Magnetograph.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean Monthly value of Zero (as observed).	Mean monthly value of Zero corrected to 90° F.	Mean monthly value of Zero calculated by formula.	Differences Column 10—Column 11.	Differences in Column 12 corrected for mean annual excess.	Differences in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1878.															
			inch.	°	inch.	°									
January ...	·373659	16·0	3·6555	88·92	3·6241	88·74	·373523	·358534	·358574	...	...	...	...	...	...
February ...	·373493	16·5	3·5618	88·17	3·5594	88·21	·373484	·358752	·358809	...	...	...	...	...	...
March ...	·373756	16·5	3·5464	89·35	3·5114	89·34	·373611	·359067	·359088	...	...	...	...	...	...
April ...	·373636	17·0	3·4587	90·97	3·4316	91·02	·373526	·359299	·359266	...	...	...	...	...	...
May ...	·373498	15·0	3·3719	92·86	3·3452	92·93	·373389	·359506	·359412	...	...	...	...	...	...
June ...	·373466	15·5	3·2428	94·85	3·2482	94·79	·373486	·359990	·359837	...	...	...	...	...	...
July ...	·373834	17·0	3·2310	92·78	3·2069	92·74	·373726	·360392	·360304	...	...	...	...	...	...
August ...	·373738	17·5	3·1300	91·62	3·1330	91·50	·373746	·360710	·360662	...	...	...	...	...	...
September ...	·373765	14·5	3·0734	91·67	3·0484	91·70	·373662	·360965	·360911	...	...	...	...	...	...
October ...	·373701	16·2	2·9921	91·38	2·9750	91·56	·373636	·361233	·361183	...	...	...	...	...	...
November ...	·373775	16·5	2·9323	90·90	2·9068	90·95	·373671	·361544	·361514	...	...	...	...	...	...
December ...	·373825	14·5	2·8644	89·30	2·8286	89·23	·373673	·361861	·361836	...	...	...	...	...	...
Mean ...	·373679	16·1	3·2550	91·06	3·2349	91·06	·373594	·360154	·360116	...	...	...	...	...	...
1879.															
			inch.	°	inch.	°									
January ...	·373678	15·2	2·7961	87·48	2·7891	87·51	·373650	·361997	·362077	...	...	...	...	...	...
February ...	·373779	15·2	2·7507	87·47	2·7423	87·62	·373749	·362283	·362359	...	...	...	...	...	...
March ...	·373890	15·5	2·7150	87·82	2·6768	88·06	·373738	·362538	·362600	...	...	...	...	...	...
April ...	·373991	16·0	2·6707	89·76	2·6323	89·92	·373835	·362816	·362819	...	...	...	...	...	...
May ...	·373784	17·5	2·5857	91·82	2·5709	91·86	·373723	·362953	·362893	...	...	...	...	...	...
June ...	·373784	14·5	2·5089	92·50	2·5145	92·57	·373809	·363268	·363186	...	...	...	...	...	...
July ...	·373940	16·0	2·4811	92·16	2·4633	92·13	·373864	·363530	·363462	...	...	...	...	...	...
August ...	·373885	16·5	2·4238	91·15	2·4061	91·16	·373811	·363710	·363673	...	...	...	...	...	...
September ...	·373784	13·5	2·3632	90·60	2·3232	90·52	·373613	·363851	·363835	...	...	...	...	...	...
October ...	·373876	15·0	2·3196	90·20	2·2788	90·19	·373704	·364124	·364118	...	...	...	...	...	...
November ...	·373641	15·5	2·2460	89·02	2·2361	89·06	·373600	·364193	·364223	...	...	...	...	...	...
December ...	·373770	17·0	2·2258	86·86	2·1826	86·78	·373585	·364398	·364501	...	...	...	...	...	...
Mean ...	·373817	15·6	2·5072	89·74	2·4847	89·78	·373723	·363305	·363312	...	...	...	...	...	...
1880.															
			inch.	°	inch.	°									
January ...	·373973	17·5	2·1886	84·75	2·1397	84·70	·373765	·364753	·364923	...	...	...	...	...	...
February ...	·374023	14·5	2·1221	84·05	2·0774	84·01	·373834	·365080	·365272	...	...	...	...	...	...
March ...	·373927	17·0	2·0810	85·60	2·0152	85·53	·373647	·365147	·365290	...	...	...	...	...	...
April ...	·374189	17·5	2·0387	88·60	1·9773	88·47	·373926	·365584	·365633	...	...	...	...	...	...
May ...	·373867	15·5	1·9454	90·30	1·9132	90·21	·373728	·365649	·365642	...	...	...	...	...	...
June ...	·373765	16·0	1·9120	91·64	1·8948	91·67	·373693	·365689	·365636	...	...	...	...	...	...
July ...	·373871	17·5	1·8967	89·72	1·8625	89·85	·373730	·365859	·365864	...	...	...	...	...	...
August ...	·373844	14·5	1·8588	89·62	1·7423	89·50	·373347	·365974	·365990	...	...	...	...	...	...
September ...	·373424	15·2	1·7170	88·36	1·7306	88·60	·373490	·366167	·366212	...	...	...	...	...	...
October ...	·373627	16·7	1·7366	88·45	1·6905	88·54	·373435	·366277	·366324	...	...	...	...	...	...
November ...	·373475	13·7	1·6483	88·05	1·6434	88·04	·373454	·366491	·366554	...	...	...	...	...	...
December ...	·373618	15·0	1·6273	86·80	1·6157	86·79	·373569	·366720	·366823	...	...	...	...	...	...
Mean ...	·373800	15·9	1·8977	87·99	1·8585	87·99	·373635	·365782	·365847	...	...	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed.)	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograms.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force Magnetograms.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean monthly value of Zero (as observed).	Mean monthly value of Zero corrected to 90° F.	Mean monthly value of Zero calculated by Formula.	Difference, Column 10—Column 11.	Difference in Column 12 corrected for mean annual excess.	Difference in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
								1881.							
			in.	°	in.	°									
January ...	·373738	15·7	1·6178	86·10	1·5854	86·12	·373602	·366880	·367004	...	...	...	...	...	...
February ...	·373692	12·5	1·5461	86·00	1·5169	86·00	·373568	·367130	·367258	...	...	...	...	...	...
March ...	·373779	16·2	1·5706	87·16	1·5186	87·09	·373556	·367111	·367204	...	...	...	...	...	...
April ...	·373724	16·5	1·5485	88·30	1·4879	88·21	·373464	·367146	·367203	...	...	...	...	...	...
May ...	·373825	14·5	1·4982	90·27	1·4520	90·55	·373638	·367471	·367453	...	...	...	...	...	...
June ...	·373834	15·0	1·4559	91·30	1·4099	91·28	·373638	·367646	·367605	...	...	...	...	...	...
July ...	·373899	16·5	1·4205	89·90	1·3728	90·08	·373702	·367865	·367862	...	...	...	...	...	...
August ...	·373876	17·0	1·3941	89·90	1·3447	89·93	·373667	·367948	·367950	...	...	...	...	...	...
September ...	·373678	17·5	1·2906	90·57	1·2531	90·73	·373523	·368187	·368164	...	...	...	...	...	...
October ...	·373770	15·5	1·2774	89·62	1·2354	89·75	·373595	·368333	·368341	...	...	...	...	...	...
November ...	·373475	16·0	1·1687	89·32	1·1746	89·26	·373498	·368492	·368516	...	...	...	...	...	...
December ...	·373604	17·5	1·1820	87·65	1·1540	87·74	·373488	·368567	·368639	...	...	...	...	...	...
Means ...	·373741	15·9	1·4142	88·84	1·3754	88·89	·373578	·367731	·367767	...	...	...	...	...	...
								1882.							
			in.	°	in.	°									
January ...	·373641	14·5	1·1727	86·80	1·1302	86·73	·373458	·368648	·368753	...	...	...	...	...	...
February ...	·373687	11·5	1·1469	86·25	1·0931	86·15	·373455	·368801	·368924	...	...	...	...	...	...
March ...	·373793	15·0	1·1246	86·98	1·0754	87·02	·373584	·369004	·369099	...	...	...	...	...	...
April ...	·373535	15·5	1·0283	88·97	0·9626	89·13	·373260	·369155	·369183	...	...	...	...	...	...
May ...	·373539	17·2	0·9960	91·06	0·9377	91·07	·373290	·369291	·369257	...	...	...	...	...	...
June ...	·373558	17·5	0·9376	91·52	0·9135	91·51	·373455	·369558	·369510	...	...	...	...	...	...
July ...	·373673	15·5	3·9078	90·35	3·7263	90·48	·373489	·369625	·369610	...	...	...	...	...	...
August ...	·373627	16·0	3·7080	89·76	3·5091	89·82	·373423	·369781	·369787	...	...	...	...	...	...
September ...	·373595	16·7	3·5744	89·52	3·5400	89·59	·373561	·369886	·369899	...	...	...	...	...	...
October ...	·373526	14·7	3·2454	89·62	3·1484	89·69	·373427	·370156	·370166	...	...	...	...	...	...
November ...	·373406	15·0	3·1070	88·82	2·8380	88·79	·373125	·370173	·370212	...	...	...	...	...	...
December ...	·373452	16·5	3·0927	87·95	2·9291	88·02	·373284	·370238	·370301	...	...	...	...	...	...
Means ...	·373586	15·5	...	88·97	...	89·00	·373401	...	...	...	...	...	...	...	...
								1883.							
			in.	°	in.	°									
January ...	·373655	17·0	3·0853	87·44	2·9451	87·64	·373515	·370455	·370531	·370657	−·000126	−·000156	−·000185	...	...
February ...	·373673	17·5	2·9940	86·10	2·8257	86·22	·373502	·370563	·370684	·370798	− 114	− 144	− 163	...	...
March ...	·373516	17·7	2·7575	86·45	2·7129	86·63	·373476	·370655	·370763	·370938	− 175	− 205	− 188	...	...
April ...	·373539	14·5	2·4900	89·20	2·5955	89·31	·373653	·370954	·370976	·371077	− 101	− 131	− 102	...	...
May ...	·373890	16·0	2·5844	92·40	2·4660	92·33	·373765	·371198	·371123	·371215	− 92	− 122	− 93	...	...
June ...	·373954	16·5	2·4752	92·65	2·3215	92·72	·373796	·371379	·371292	·371352	− 60	− 90	− 59	...	...
July ...	·373959	14·5	2·4278	90·80	2·1650	90·79	·373685	·371431	·371406	·371488	− 82	− 112	− 81	·371526	−·000120
August ...	·374042	15·0	2·2743	89·98	2·1002	90·01	·373862	·371674	·371674	·371622	+ 52	+ 22	+ 36	·371686	− 12
September ...	·373982	15·7	1·9475	88·97	1·8436	89·07	·373877	·371956	·371986	·371756	+ 230	+ 200	+ 195	·371840	+ 146
October ...	·374102	13·5	1·9714	88·92	1·7961	88·85	·373917	·372045	·372082	·371889	+ 193	+ 163	+ 142	·372000	+ 82
November ...	·374222	14·2	1·8244	87·70	1·6511	87·68	·374040	·372318	·372392	·372020	+ 372	+ 342	+ 301	·372161	+ 231
December ...	·374125	15·5	1·7941	85·02	1·6602	84·97	·373983	·372251	·372412	·372152	+ 260	+ 230	+ 190	·372320	+ 92
Means ...	·373888	15·6	2·3855	88·80	2·2569	88·85	·373756	·371407	·371443	·371414	+·000030	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed.)	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograms.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force Magnetograms.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean monthly value of Zero (as observed).	Mean monthly value of Zero corrected to 90° F.	Mean monthly value of Zero calculated by formula.	Difference, Column 10—Column 11.	Difference in Column 12 corrected for mean annual excess.	Difference in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
					1884.										
			in.	°	in.	°									
January ...	·374199	16·0	1·8017	83·30	1·6704	83·41	·374066	·372320	·372531	·372281	+ ·000250	+ ·000070	+ ·000041	·372477	+ ·000054
February ...	·374125	16·5	1·7470	83·35	1·5795	83·15	·373944	·372293	·372512	·372411	+ 101	− 79	− 98	·372626	− 114
March ...	·374374	15·7	1·8111	85·00	1·4366	84·93	·373980	·372477	·372639	·372540	+ 99	− 81	− 64	·372756	− 117
April ...	·374614	16·0	1·6972	87·30	1·2988	87·37	·374199	·372840	·372924	·372668	+ 256	+ 76	+ 105	·372876	+ 48
May ...	·374503	17·5	1·3894	90·30	1·1952	90·24	·374298	·373047	·373039	·372795	+ 244	+ 64	+ 93	·372988	+ 51
June ...	·374604	14·5	1·2904	91·92	1·0032	91·79	·374299	·373249	·373192	·372921	+ 271	+ 91	+ 122	·373099	+ 93
July ...	·374498	16·0	1·1223	91·14	0·8458	90·99	·374203	·373317	·373285	·373046	+ 239	+ 59	+ 90	·373212	+ 73
August ...	·374545	17·0	1·1312	89·75	0·8525	89·82	·374255	·373362	·373368	·373170	+ 198	+ 18	+ 32	·373321	+ 47
September ...	·374323	13·5	0·8933	89·15	0·7299	89·03	·374148	·373383	·373414	·373293	+ 121	− 59	− 64	·373429	− 15
October ...	·374217	15·0	0·7102	88·46	0·5716	88·44	·374071	·373471	·373521	·373415	+ 106	− 74	− 95	·373528	− 7
November ...	·374217	15·5	0·6032	87·45	0·4737	87·44	·374081	·373584	·373666	·373535	+ 131	− 49	− 90	·373620	+ 46
December ...	·374272	17·0	0·5533	86·65	0·4532	86·52	·374163	·373688	·373799	·373656	+ 143	− 37	− 77	·373712	+ 87
Means ...	·374374	15·8	1·2292	87·81	1·0092	87·76	·374142	·373086	·373157	·372978	+ 180	...	...	...	...
					1885.										
			in.	°	in.	°									
January ...	·374277	17·5	3·8442	86·90	3·7160	86·71	·374111	·369466	·369571	·369501	+ ·000070	+ ·000165	+ ·000136	·369523	+ ·000048
February ...	·374259	14·5	3·8904	85·82	3·6905	85·94	·374013	·369400	·369530	·369621	− 91	+ 4	− 15	·369610	− 80
March ...	·374369	14·5	3·8475	86·85	3·6152	87·05	·374085	·369566	·369660	·369740	− 80	+ 15	+ 32	·369707	− 47
April ...	·374203	15·0	3·6050	88·96	3·5230	89·07	·374104	·369697	·369727	·369858	− 131	− 36	− 7	·369811	− 84
May ...	·374208	16·5	3·4036	91·45	3·3127	91·43	·374093	·369945	·369899	·369976	− 77	+ 18	+ 47	·369912	− 13
June ...	·374365	13·5	3·4327	92·95	3·2371	93·01	·374122	·370069	·369973	·370093	− 120	− 25	− 94	·370006	− 33
July ...	·374337	15·0	3·3793	92·38	3·2335	92·35	·374153	·370105	·370030	·370209	− 179	− 84	− 53	·370098	− 68
August ...	·374268	15·7	3·2671	90·57	3·0892	90·64	·374047	·370176	·370156	·370324	− 168	− 73	− 59	·370203	− 47
September ...	·374125	16·0	2·9648	89·86	2·9525	89·80	·374108	·370406	·370412	·370437	− 25	+ 70	+ 65	·370321	+ 91
October ...	·374332	17·5	3·0809	90·10	2·9405	90·06	·374155	·370468	·370466	·370550	− 84	+ 11	− 10	·370443	+ 23
November ...	·374328	14·7	2·9785	90·25	2·8493	90·26	·374166	·370593	·370585	·370663	− 78	+ 17	− 24	·370559	+ 26
December ...	·374194	16·0	2·8886	89·28	2·8383	89·22	·374129	·370567	·370592	·370775	− 183	− 88	− 128	·370671	− 79
Means ...	·374272	15·5	3·3819	89·61	3·2498	89·63	·374107	·370038	·370050	·370146	− ·000095	...	...	...	...
					1886.										
			in.	°	in.	°									
January ...	·374125	16·5	2·7754	87·87	2·6652	88·04	·373992	·370653	·370716	·370885	− ·000169	− ·000018	− ·000047	·370787	− ·000071
February ...	·374272	13·5	2·7367	87·15	2·6180	87·39	·374131	·370840	·370924	·370996	− 72	+ 79	+ 60	·370903	+ 21
March ...	·374305	17·0	2·5851	88·40	2·5122	88·35	·374211	·371041	·371094	·371107	− 13	+ 138	+ 155	·371010	+ 84
April ...	·374199	17·5	2·3634	90·15	2·3313	89·98	·374153	·371211	·371212	·371217	− 5	+ 146	+ 175	·371108	+ 104
May ...	·374213	15·5	2·3177	92·67	2·2238	92·69	·374095	·371286	·371200	·371326	− 126	+ 25	+ 54	·371200	0
June ...	·374245	16·0	2·2097	92·92	2·1848	92·93	·374214	·371455	·371361	·371435	− 74	+ 77	+ 108	·371288	+ 73
July ...	·374143	17·5	2·1519	90·20	2·1166	90·33	·374102	·371429	·371418	·371543	− 125	+ 26	+ 57	·371386	+ 32
August ...	·374300	14·5	2·1751	89·50	2·0430	89·51	·374133	·371551	·371567	·371650	− 83	+ 68	+ 82	·371493	+ 74
September ...	·374166	15·2	2·0836	89·00	1·9952	89·04	·374055	·371533	·371564	·371756	− 192	− 41	− 46	·371589	− 25
October ...	·374106	16·7	1·9558	89·25	1·8607	89·34	·373989	·371637	·371658	·371862	− 204	− 53	− 74	·371670	− 12
November ...	·373964	13·5	1·8743	89·35	1·8000	89·34	·373870	·371593	·371614	·371967	− 353	− 202	− 243	·371758	− 144
December ...	·373798	15·0	1·7117	88·64	1·7304	88·67	·373823	·371634	·371677	·372071	− 394	− 243	− 283	·371849	− 172
Means ...	·374153	15·7	2·2450	89·59	2·1734	89·63	·374064	·371322	·371334	·371485	− 151	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograms.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force Magnetograms.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean monthly value of Zero (as observed).	Mean monthly value of Zero corrected to 90° F.	Mean monthly value of Zero calculated by formula.	Difference, Column 10—Column 11.	Difference in Column 12 corrected for mean annual excess.	Difference in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							1887.								
			in.	°	in.	°									
January ...	·374106	15·5	1·7476	87·75	1·7085	87·72	·374056	·371895	·371968	·372174	−·000206	+·000009	−·000020	·371935	+·000033
February ...	·374249	12·2	1·6699	86·87	1·6430	86·95	·374218	·372140	·372238	·372277	− 39	+ 176	+ 157	·372024	+ 214
March ...	·374157	15·8	1·6835	88·00	1·6043	88·09	·374060	·372031	·372092	372379	− 287	− 72	− 55	·372121	− 29
April ...	·374143	16·5	1·5643	90·05	1·4611	90·00	·374010	·372160	·372160	·372481	− 321	− 106	− 77	·372226	− 66
May ...	·374130	14·5	1·3366	92·07	1·3374	92·25	·374137	·372444	·372372	·372582	− 210	+ 5	+ 34	·372338	+ 34
June ...	·374249	15·0	1·4214	92·44	1·2930	92·34	·374083	·372445	·372370	·372683	− 313	− 98	− 67	·372456	− 86
July ...	·374254	16·7	1·3975	89·97	1·2759	89·94	·374099	·372482	·372484	·372784	− 300	− 85	− 54	·372565	− 81
August ...	·374171	17·2	1·2356	89·22	1·1645	89·28	·374083	·372608	·372631	·372884	− 253	− 38	− 24	·372660	− 29
September ...	·374213	17·5	1·1267	88·77	1·0521	88·75	·374117	·372783	·372823	·372983	− 160	+ 55	+ 50	·372757	+ 66
October ...	·374337	15·7	1·1543	88·70	1·0125	88·67	·374156	·372872	·372915	·373082	− 167	+ 48	+ 27	·372864	+ 51
November ...	·374300	16·0	1·0305	88·42	0·9616	88·53	·374217	·372998	·373045	·373180	− 135	+ 80	+ 39	·372967	+ 78
December ...	·374162	17·5	0·9087	87·60	0·8893	87·61	·374137	·373009	·373085	·373278	− 193	+ 22	− 18	·373068	+ 17
Means ...	·374206	15·8	1·3564	89·15	1·2836	89·18	·374114	·372489	·372515	·372731	− 215	...	...	...	...
							1888.								
			in.	°	in.	°									
January ...	·374291	13·3	0·9521	87·60	0·7856	87·51	·374077	·373080	·373160	·373374	−·000214	+·000009	−·000020	·373170	−·000010
February ...	·374448	15·0	0·9472	87·44	0·7865	87·42	·374243	·373245	·373328	·373470	− 142	+ 81	+ 62	·373267	+ 61
March ...	·374545	17·7	0·9587	89·22	0·7219	89·20	·374243	·373326	·373352	·373566	− 214	+ 9	+ 26	·373360	− 8
April ...	·374323	14·5	0·6507	91·42	0·5944	91·48	·374253	·373498	·373451	·373661	− 210	+ 13	+ 42	·373454	− 3
May ...	·374328	16·0	0·5347	93·20	0·4435	93·32	·374216	·373652	·373546	·373756	− 210	+ 13	+ 42	·373541	+ 5
June ...	·374406	16·5	3·8648	93·90	3·7570	93·96	·374273	·369554	·369427	·369658	− 231	− 8	+ 23	·369434	− 7
July ...	·374374	14·5	3·8131	92·47	3·7324	92·35	·374269	·369577	·369502	·369752	− 250	− 27	+ 4	·369524	− 22
August ...	·374351	15·2	3·7909	91·00	3·6600	91·01	·374186	·369585	·369553	·369846	− 293	− 70	− 56	·369608	− 55
September ...	·374374	15·5	3·6574	90·82	3·5603	90·79	·374251	·369776	·369751	·369939	− 188	+ 35	+ 30	·369692	+ 59
October ...	·374443	17·0	3·6201	91·02	3·4784	91·13	·374269	·369893	·369857	·370031	− 174	+ 49	+ 28	·369778	+ 79
November ...	·374153	17·5	3·4192	91·50	3·3820	91·64	·374110	·369855	·369803	·370123	− 320	− 97	− 138	·369863	− 60
December ...	·374346	15·5	3·4444	90·85	3·3660	90·78	·374245	·370012	·369987	·370215	− 228	− 5	− 45	·369948	+ 39
Means ...	·374365	15·7	...	90·87	...	90·88	·374219	...	...	...	− 223	...	...	...	...
							1889.								
			in.	°	in.	°									
January ...	·374300	16·0	3·3997	89·64	3·3516	89·63	·374239	·370019	·370031	·370304	−·000273	−·000073	−·000102	·370040	−·000009
February ...	·374415	16·5	3·4442	89·17	3·3089	89·23	·374247	·370081	·370106	·370395	− 289	− 89	− 107	·370141	− 35
March ...	·374309	16·5	3·2523	90·30	3·1664	90·23	·374199	·370213	·370206	·370485	− 279	− 79	− 62	·370241	− 35
April ...	·374452	13·5	3·2892	91·35	3·1376	91·58	·374268	·370318	·370267	·370575	− 308	− 108	− 79	·370338	− 71
May ...	·374319	15·0	3·0403	93·06	3·0054	93·13	·374277	·370490	·370390	·370664	− 274	− 74	− 45	·370442	− 52
June ...	·374434	15·5	3·0812	93·65	2·9300	93·68	·374244	·370549	·370431	·370753	− 322	− 122	− 91	·370545	− 114
July ...	·374415	17·0	2·9006	92·02	2·8568	91·95	·374358	·370756	·370694	·370841	− 147	+ 53	+ 84	·370645	+ 49
August ...	·374415	17·5	2·8409	91·17	2·7830	91·19	·374343	·370834	·370796	·370929	− 133	+ 67	+ 81	·370745	+ 51
September ...	·374300	14·5	2·6696	90·77	2·6792	90·93	·374317	·370936	·370906	·371017	− 111	+ 89	+ 84	·370842	+ 64
October ...	·374443	15·8	2·6792	91·14	2·6141	91·12	·374360	·371061	·371025	·371104	− 79	+ 121	+ 100	·370937	+ 88
November ...	·374369	16·5	2·5701	90·10	2·5137	90·03	·374296	·371124	·371123	·371191	− 68	+ 132	+ 91	·371030	+ 93
December ...	·374429	14·5	2·6205	88·87	2·5196	88·65	·374295	·371115	·371158	·371277	− 119	+ 81	+ 41	·371123	+ 35
Means ...	·374383	15·7	2·9823	90·94	2·9055	90·95	·374287	·370625	·370594	·370795	−·000200	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograms.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly temperature of Horizontal Force Magnetograms.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly absolute Horizontal Force.	Mean monthly values of Zero (as observed).	Mean monthly values of Zero corrected to 90° F.	Mean monthly values of Zero calculated by formula.	Difference, Column 10—Column 11.	Difference in Column 12 corrected for mean annual excess.	Difference in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1890.															
			inch.	°	inch.	°									
January ...	·374383	15·0	2·5150	88·16	2·4689	88·17	·374325	·371207	·371266	·371361	−·000095	+·000072	+·000043	·371213	+·000053
February ...	·374369	15·5	2·4990	88·40	2·4419	88·42	·374298	·371214	·371265	·371446	− 181	− 14	− 33	·371301	− 36
March ...	·374485	15·5	2·4760	89·65	2·3703	89·79	·374355	·371357	·371364	·371531	− 167	0	+ 17	·371385	− 21
April ...	·374452	16·0	2·3720	91·48	2·2858	91·44	·374342	·371444	·371398	·371616	− 218	− 51	− 22	·371460	− 62
May ...	·374471	17·5	2·2650	93·20	2·1703	93·08	·374346	·371583	·371484	·371700	− 216	− 49	− 20	·371534	− 50
June ...	·374503	14·5	2·2180	93·52	2·1372	93·36	·374395	·371674	·371566	·371783	− 217	− 50	− 19	·371610	− 44
July ...	·374591	16·0	2·2360	90·92	2·1124	90·95	·374435	·371746	·371716	·371866	− 150	+ 17	+ 48	·371689	+ 27
August ...	·374563	16·5	2·0960	89·95	2·0168	89·77	·374456	·371889	·371896	·371949	− 53	+ 114	+ 128	·371770	+ 126
September ...	·374337	13·5	1·9730	89·50	1·9177	89·42	·374264	·371821	·371840	·372032	− 192	− 25	− 30	·371849	− 9
October ...	·374429	15·0	1·9780	89·34	1·8308	89·46	·374245	·371913	·371930	·372114	− 184	− 17	− 38	·371926	+ 4
November ...	·374397	15·5	1·8620	89·50	1·7852	89·53	·374300	·372026	·372041	·372196	− 155	+ 12	− 29	·372006	+ 35
December ...	·374411	17·0	1·8200	89·82	1·7684	89·63	·374339	·372086	·372098	·372277	− 179	− 12	− 52	·372086	+ 12
Means ...	·374449	15·6	2·1925	90·29	2·1088	90·25	·374342	·371663	·371655	·371823	−·000167	...	...	...	...
1891.															
January ...	·374503	17·5	1·8020	88·67	1·7375	88·72	·374419	·372204	·372245	·372357	−·000112	+·000050	+·000021	·372182	+·000063
February ...	·374489	14·5	1·7900	87·82	1·6449	87·75	·374302	·372205	·372277	·372438	− 161	+ 1	− 18	·372255	+ 22
March ...	·374328	14·5	1·6290	88·62	1·5225	88·64	·374193	·372252	·372296	·372518	− 222	− 60	− 43	·372332	− 36
April ...	·374208	15·0	1·4180	91·10	1·3690	91·21	·374149	·372402	·372363	·372598	− 235	− 73	− 44	·372415	− 52
May ...	·374425	16·5	1·4410	93·45	1·2185	93·40	·374139	·372583	·372474	·372677	− 203	− 41	− 12	·372498	− 24
June ...	·374434	13·5	1·3740	94·87	1·2316	94·94	·374254	·372681	·372523	·372755	− 232	− 70	− 39	·372585	− 62
July ...	·374503	15·0	1·3660	93·70	1·1820	93·63	·374266	·372757	·372641	·372834	− 193	− 31	0	·372666	− 25
August ...	·374369	16·2	1·2180	92·07	1·1223	92·18	·374251	·372818	·372748	·372912	− 164	− 2	+ 12	·372741	+ 7
September ...	·374249	16·0	1·0530	91·16	0·9764	91·15	·374151	·372903	·372866	·372990	− 124	+ 38	+ 33	·372822	+ 44
October ...	·374383	17·5	1·1550	90·17	0·9837	90·09	·374161	·372904	·372901	·373067	− 166	− 4	− 25	·372905	− 4
November ...	·374448	14·5	1·0980	89·87	0·9347	89·83	·374238	·373043	·373048	·373144	− 96	+ 66	+ 25	·372986	+ 62
December ...	·374540	16·0	1·0850	88·98	0·9073	88·93	·374311	·373151	·373185	·373221	− 36	+ 126	+ 86	·373059	+ 126
Means ...	·374407	15·6	1·3691	90·87	1·2359	90·87	·374236	·372659	·372631	·372793	−·000162	...	...	...	...
1892.															
January ...	·374134	17·0	0·8540	88·45	0·7727	88·30	·374025	·373037	·373091	·373297	−·000206	−·000097	−·000126	·373128	−·000037
February ...	·374263	13·5	0·8350	88·42	0·5790	88·50	·373939	·373198	·373246	·373372	− 126	− 17	− 36	·373200	+ 46
March ...	·374088	16·0	0·6600	89·06	0·4993	89·00	·373880	·373241	·373273	·373448	− 175	− 66	− 49	·373277	− 4
April ...	·374342	16·5	0·6770	93·07	0·5033	92·97	·374117	·373473	·373378	·373524	− 146	− 37	− 8	·373365	+ 13
May ...	·374093	13·3	0·4110	95·33	0·2633	95·47	·373908	·373571	·373396	·373599	− 203	− 94	− 65	·373458	− 62
June ...	·374130	15·0	0·4800	95·40	0·3205	95·35	·373924	·373514	·373343	·373674	− 331	− 222	− 191	·373552	− 209
July ...	·374111	17·7	3·6940	94·37	3·4785	94·41	·373839	·369435	·369294	·369549	− 255	− 146	− 115	·369444	− 150
August ...	·374245	17·0	3·7610	92·12	3·5212	92·23	·373945	·369487	·369416	·369623	− 207	− 98	− 84	·369531	− 115
September ...	·374438	17·5	3·7810	90·07	3·5631	90·06	·374162	·369651	·369649	·369697	− 48	+ 61	+ 56	·369615	+ 34
October ...	·374434	14·3	3·6320	90·03	3·4145	90·03	·374159	·369836	·369835	·369771	+ 64	+ 173	+ 152	·369693	+ 142
November ...	·374581	16·0	3·6740	89·46	3·4815	89·43	·374336	·369928	·369946	·369844	+ 102	+ 211	+ 170	·369772	+ 174
December ...	·374471	17·5	3·4560	88·60	3·3636	88·76	·374359	·370101	·370141	·369917	+ 224	+ 333	+ 293	·369856	+ 285
Means ...	·374277	15·9	...	91·20	...	91·21	·374049	...	...	...	− 109	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograms.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly temperature of Horizontal Force Magnetograms.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly absolute Horizontal Force.	Mean monthly values of Zero (as observed).	Mean monthly values of Zero corrected to 90° F.	Mean monthly values of Zero calculated by formula.	Difference, Column 10—Column 11.	Difference in Column 12 corrected for mean annual excess.	Difference in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
								1893.							
			inch.	°	inch.	°									
January ...	·374296	14·5	3·4950	87·95	3·4132	87·83	·374188	·369867	·369936	·369989	− ·000053	+ ·000077	+ ·000048	·369937	− ·000001
February ...	·374369	11·5	3·4650	86·80	3·3692	86·87	·374250	·369985	·370085	·370061	+ 24	+ 154	+ 135	·370010	+ 75
March ...	·374369	15·0	3·4550	88·26	3·3259	88·40	·374210	·369999	·370050	·370133	− 83	+ 47	+ 64	·370078	− 28
April ...	·374425	15·5	3·4050	91·10	3·2557	91·35	·374244	·370122	·370079	·370205	− 126	+ 4	+ 33	·370140	− 61
May ...	·374563	17·2	3·3620	93·94	3·1971	93·95	·374354	·370306	·370180	·370276	− 96	+ 34	+ 63	·370193	− 13
June ...	·374489	17·5	3·2950	94·22	3·1034	94·25	·374247	·370315	·370179	·370347	− 168	− 38	− 7	·370233	− 54
July ...	·374466	15·5	3·3070	92·37	3·0627	92·41	·374157	·370277	·370200	·370418	− 218	− 88	+ 57	·370276	− 76
August ...	·374309	16·0	3·1380	91·94	2·9362	91·98	·374054	·370328	·370265	·370488	− 223	− 93	− 79	·370325	− 60
September ...	·374231	16·5	2·9360	91·95	2·8949	92·01	·374181	·370504	·370440	·370558	− 118	+ 12	+ 7	·370374	+ 66
October ...	·374282	14·5	2·8970	92·02	2·8201	91·98	·374183	·370601	·370538	·370628	− 90	+ 40	+ 19	·370433	+ 105
November ...	·374314	15·0	2·9490	92·00	2·7745	91·99	·374092	·370568	·370504	·370698	− 194	− 64	− 105	·370501	+ 3
Decembsr ...	·374300	16·5	2·9270	90·80	2·8058	90·87	·374148	·370585	·370557	·370767	− 210	− 80	− 120	·370571	− 14
Means ...	·374368	15·4	3·2192	91·11	3·0799	91·16	·374192	·370288	·370250	·370381	− ·000130	...	...	...	...
								1894.							
January ...	·374157	17·0	2·8650	89·06	2·7633	89·29	·374035	·370520	·370543	·370835	− ·000292	− ·000124	− ·000153	·370640	− ·000097
February ...	·374060	17·5	2·6980	89·45	2·5697	89·28	·373892	·370621	·370644	·370904	− 260	− 92	− 111	·370711	− 67
March ...	·374383	17·5	2·9030	90·42	2·5864	90·40	·373979	·370687	·370674	·370972	− 298	− 130	− 113	·370779	− 105
April ...	·374272	14·5	2·6120	92·40	2·4952	92·53	·374127	·370951	·370870	·371040	− 170	− 2	+ 27	·370846	+ 24
May ...	·374457	16·0	2·5810	94·50	2·4640	94·44	·374306	·371169	·371027	·371108	− 81	+ 87	+ 116	·370922	+ 105
June ...	·374420	16·5	2·6550	95·00	2·3645	95·04	·374166	·371154	·370993	·371176	− 183	− 15	+ 16	·371001	− 8
July ...	·374222	14·5	2·4060	93·62	2·2100	93·31	·373962	·371146	·371040	·371243	− 203	− 35	− 4	·371077	− 37
August ...	·374162	15·0	2·3080	91·94	3·1766	91·98	·373995	·371213	·371150	·371310	− 160	+ 8	+ 22	·371152	− 2
September ...	·374097	15·5	2·2440	91·17	2·1175	91·13	·373934	·371228	·371192	·371377	− 185	− 17	− 22	·371229	− 37
October ...	·374388	17·0	2·3270	90·84	2·2159	90·87	·374247	·371415	·371387	·371444	− 57	+ 111	+ 90	·371301	+ 86
November ...	·374083	17·5	2·0330	90·05	2·0810	90·08	·374145	·371485	·371482	·371510	− 28	+ 140	+ 99	·371371	+ 111
December ...	·374443	15·5	2·3400	89·25	2·1656	89·21	·374221	·371453	·371478	·371576	− 98	+ 70	+ 30	·371439	+ 39
Means ...	·374262	16·2	2·4902	91·47	2·3508	91·46	·374084	·371087	·371040	·371208	− ·000168	...	...	...	...
								1895.							
January ...	·374217	16·0	2·2080	88·46	2·1213	88·56	·374109	·371400	·371446	·371641	− ·000195	− ·000117	− ·000146	·371504	− ·000058
February ...	·374388	16·5	2·2590	88·72	2·0120	88·65	·374071	·371502	·371545	·371706	− 161	− 83	− 102	·371569	− 24
March ...	·374332	16·5	2·1240	90·52	1·9936	90·57	·374168	·371622	·371604	·371770	− 166	− 88	− 71	·371637	− 33
April ...	·374425	13·7	2·1000	91·90	1·9272	92·11	·374211	·371748	·371680	·371835	− 155	− 77	− 48	·371712	− 32
May ...	·374526	15·0	1·9610	94·14	1·8670	94·34	·374412	·372026	·371887	·371900	− 13	+ 65	+ 94	·371790	+ 97
June ...	·374475	15·5	1·9840	95·05	1·8210	95·11	·374269	·371942	·371778	·371964	− 186	− 108	− 77	·371872	− 94
July ...	·374425	17·0	1·9500	93·68	1·7829	93·72	·374212	·371933	·371814	·372028	− 214	− 136	− 105	·371965	− 151
August ...	·374466	17·5	1·9370	91·80	1·7930	91·89	·374285	·371994	·371934	·372092	− 158	− 80	− 66	·372050	− 116
September ...	·374337	14·5	1·7790	90·90	1·7167	91·04	·374261	·372058	·372025	·372156	− 131	− 53	− 58	·372128	− 103
October ...	·374480	16·0	1·6240	91·44	1·5540	91·36	·374387	·372392	·372348	·372219	+ 129	+ 207	+ 186	·372208	+ 140
November ...	·374591	16·5	1·6790	91·17	1·5013	91·16	·374363	·372435	·372398	·372282	+ 116	+ 194	+ 153	·372282	+ 116
December ...	·374591	14·5	1·5850	90·40	1·5333	90·39	·374525	·372556	·372544	·372345	+ 199	+ 277	+ 237	·372360	+ 184
Means ...	·374438	15·8	1·9325	91·51	1·8019	91·57	·374273	·371967	·371917	·371995	− ·000078	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograms.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force magnetograms.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean monthly values of Zero (as observed).	Mean monthly values of Zero corrected to 90° F.	Mean monthly value of Zero calculated by formula.	Difference, Column 10—Column 11.	Difference in Column 12 corrected for mean annual excess.	Difference in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
								1896.							
			in.	°	in.	°									
January ...	·374729	15·0	1·6528	90·00	1·4502	89·88	·374465	·372601	·372605	·372406	+ ·000199	+ ·000093	+ ·000064	·372443	+ ·000162
February ...	·374438	15·5	1·5774	89·35	1·4377	89·41	·374260	·372411	·372430	·372468	− 38	− 144	− 163	·372527	− 97
March ...	·374789	14·5	1·7052	90·20	1·3944	90·50	·374399	·372606	·372590	·372530	+ 60	− 46	− 29	·372611	− 21
April ...	·374604	15·0	1·4701	93·26	1·3321	93·34	·374430	·372717	·372610	·372592	+ 18	− 88	− 59	·372683	− 73
May ...	·374595	16·7	1·3148	95·52	1·1405	95·52	·374371	·372903	·372726	·372654	+ 72	− 34	− 5	·372751	− 25
June ...	·374706	13·5	1·3303	95·77	1·2302	95·61	·374572	·372989	·372809	·372715	+ 94	− 12	+ 19	·372818	− 9
July ...	·374600	15·0	1·3355	92·70	1·2060	92·75	·374435	·372883	·372795	·372776	+ 19	− 87	− 56	·372879	− 84
August ...	·374600	15·5	1·2500	90·67	1·1241	90·77	·374441	·372994	·372969	·372837	+ 132	+ 26	+ 40	·372945	+ 24
September ...	·374554	16·0	1·1940	90·86	1·0519	90·85	·374371	·373013	·372986	·372898	+ 88	− 18	− 23	·373015	− 29
October ...	·374683	17·5	1·1576	91·77	1·0098	91·70	·374490	·373185	·373131	·372958	+ 173	+ 67	+ 46	·373080	+ 51
November ...	·374692	14·2	1·0867	91·72	0·9699	91·84	·374545	·373292	·373233	·373018	+ 215	+ 109	+ 68	·373145	+ 88
December ...	·374632	16·0	1·0027	90·52	0·9481	90·65	·374565	·373340	·373319	·373078	+ 241	+ 135	+ 95	·373210	+ 109
Means ...	·374635	15·4	1·3398	91·86	1·1912	91·90	·374445	·372911	·372850	·372744	+ 000106	...	...	...	...
								1897.							
January ...	·374595	16·5	1·0270	88·62	0·9347	88·76	·374480	·373272	·373312	·373138	+ ·000174	+ ·000032	+ ·000003	·373281	+ ·000031
February ...	·374747	13·5	1·1660	87·97	0·9621	88·07	·374487	·373245	·373307	·373196	+ 111	− 31	− 50	·373347	− 40
March ...	·374692	17·0	1·0460	88·94	0·9029	88·95	·374507	·373340	·373374	·373255	+ 119	− 23	− 6	·373407	− 33
April ...	·374383	17·5	0·7330	91·40	0·6987	91·37	·374338	·373435	·373391	·373314	+ 77	− 65	− 36	·373466	− 75
May ...	·374637	15·5	0·7710	94·05	0·6457	94·07	·374476	·373642	·373512	·373373	+ 139	− 3	+ 26	·373519	− 7
June ...	·374729	16·2	0·7400	95·40	0·6077	95·50	·374561	·373775	·373599	·373432	+ 167	+ 25	+ 56	·373573	+ 26
July ...	·374835	17·5	0·7780	93·87	0·6352	93·97	·374653	·373833	·373706	·373490	+ 216	+ 74	+ 105	·373628	+ 78
August ...	·374586	14·5	0·6730	92·27	0·5912	92·16	·374476	·373711	·373642	·373548	+ 94	− 48	− 34	·373687	− 45
September ...	·374743	15·0	0·7140	91·76	0·5619	91·79	·374547	·373820	·373763	·373606	+ 157	+ 15	+ 10	·373749	+ 14
October ...	·374586	16·7	0·5900	91·25	0·5112	91·34	·374474	·373813	·373770	·373664	+ 106	− 36	− 57	·373804	− 34
November ...	·374535	13·5	0·5000	90·37	0·4594	90·32	·374480	·373887	·373877	·373721	+ 156	+ 14	− 27	·373854	+ 23
December ...	·374443	15·0	0·3890	89·08	0·3394	89·09	·374379	·373939	·373968	·373778	+ 190	+ 48	+ 8	·373901	+ 67
Means ...	·374626	15·7	0·7606	91·25	0·6542	91·28	·374488	·373643	·373602	·373460	+ ·000142	...	...	...	...
								1898.							
January ...	·374466	15·7	3·4480	88·05	3·4128	88·13	·374423	·370074	·370134	·369979	+ ·000155	+ ·000065	+ ·000036	·370086	+ ·000048
February ...	·374646	12·5	3·5162	88·60	3·3915	88·64	·374488	·370164	·370208	·370035	+ 173	+ 83	+ 64	·370132	+ 76
March ...	·374213	16·2	3·1326	89·52	3·2372	89·63	·374350	·370219	·370231	·370092	+ 139	+ 49	+ 66	·370185	+ 46
April ...	·374397	16·5	3·2760	92·35	3·1971	92·17	·374290	·370211	·370142	·370148	− 6	− 96	− 67	·370237	− 95
May ...	·374503	14·5	3·2393	94·27	3·1244	94·43	·374361	·370374	·370232	·370204	+ 28	− 62	− 33	·370289	− 57
June ...	·374545	15·0	3·2231	94·30	3·1106	94·38	·374404	·370432	·370292	·370260	+ 32	− 58	− 27	·370345	− 53
July ...	·374498	16·5	3·2301	92·67	3·1208	92·81	·374362	·370377	·370287	·370316	− 29	− 119	− 88	·370408	− 121
August ...	·374411	17·0	3·0625	91·54	3·0388	91·71	·374386	·370505	·370450	·370371	+ 79	− 11	+ 3	·370463	− 13
September ...	·374282	17·5	[illegible]	90·95	2·7976	91·05	·374119	·370545	·370510	·370426	+ 84	− 6	− 11	·370510	0
October ...	·374466	15·5	3·0202	91·45	2·8862	91·56	·374299	·370610	·370560	·370481	+ 79	− 11	− 32	·370564	− 4
November ...	·374429	16·0	[illegible]	91·66	2·8741	91·63	·374346	·370673	·370621	·370536	+ 85	− 5	− 46	·370629	− 8
December ...	·374531	17·5	2·8611	90·67	2·8875	90·93	·374573	·370883	·370853	·370591	+ 262	+ 172	+ 132	·370693	+ 160
Means ...	·374449	15·9	3·1562	91·34	3·0899	91·42	·374367	·370420	·370377	·370287	+ ·000090	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograms.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force Magnetograms.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean monthly values of Zero (as observed.)	Mean monthly values of Zero corrected to 90° F.	Mean monthly value of Zero calculated by formula.	Difference Column 10—Column 11.	Difference in Column 12 corrected for mean annual excess.	Difference in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							1899.								
			in.	°	in.	°									
January ...	·374568	14·5	2·9378	88·07	2·8941	88·14	·374514	·370818	·370878	·370646	+·000232	+·000120	+·000091	·370755	+·000123
February ...	·374379	11·5	2·8502	88·10	2·7932	88·24	·374310	·370732	·370788	·370700	+ 88	− 24	− 43	·370813	− 25
March ...	·374332	15·0	2·7846	89·50	2·7529	89·60	·374294	·370768	·370781	·370754	+ 27	− 85	− 68	·370865	− 84
April ...	·374466	15·7	2·7339	92·27	2·6788	92·26	·374395	·370963	·370891	·370808	+ 83	− 29	0	·370917	− 26
May ...	·374581	17·2	2·6504	94·28	2·5480	94·27	·374450	·371183	·371046	·370862	+ 184	+ 72	+ 101	·370973	+ 73
June ...	·374540	17·5	2·6287	94·55	2·5589	94·69	·374455	·371174	·371024	·370916	+ 108	− 4	+ 27	·371028	− 4
July ...	·374448	15·5	2·5837	92·92	2·5155	93·02	·374364	·371139	·371042	·370969	+ 73	− 39	− 8	·371076	− 34
August ...	·374503	16·0	2·6107	92·66	2·5292	92·72	·374401	·371159	·371072	·371022	+ 50	− 62	− 48	·371125	− 53
September ...	·374314	16·5	2·4247	92·30	2·4411	92·42	·374339	·371210	·371133	·371075	+ 58	− 54	− 59	·371182	− 49
October ...	·374480	14·5	2·4884	92·75	2·3965	92·96	·374369	·371297	·371202	·371128	+ 74	− 38	− 59	·371242	− 40
November ...	·374572	15·0	2·4666	92·68	2·3895	92·64	·374472	·371409	·371325	·371181	+ 144	+ 32	− 9	·371289	+ 36
December ...	·374572	16·5	2·3887	91·65	2·3419	91·64	·374512	·371507	·371455	·371234	+ 221	+ 109	+ 69	·371331	+ 124
Means ...	·374480	15·4	2·6290	91·81	2·5700	91·88	·374406	·371113	·371053	·370941	+·000112	...	...	...	...
							1900.								
			in.	°	in.	°									
January ...	·374563	17·0	2·4452	89·34	2·3163	89·61	·374406	·371432	·371444	·371286	+·000158	+·000068	+·000039	·371376	+·000068
February ...	·374438	17·5	2·4097	88·65	2·3364	88·82	·374349	·371349	·371387	·371338	+ 49	− 41	− 60	·371425	− 38
March ...	·374512	17·5	2·3108	89·95	2·2080	90·14	·374386	·371551	·371547	·371389	+ 158	+ 68	+ 85	·371480	+ 67
April ...	·374595	14·5	2·2973	91·85	2·1959	92·15	·374474	·371641	·371572	·371441	+ 131	+ 41	+ 70	·371538	+ 34
May ...	·374369	16·0	2·1359	93·84	2·0032	94·01	·374203	·371617	·371489	·371493	− 4	− 94	− 65	·371594	− 105
June ...	·374614	16·5	2·2283	94·77	2·0976	94·81	·374446	·371740	·371586	·371544	+ 42	− 48	− 17	·371640	− 54
July ...	·374517	14·5	2·1885	93·50	2·1037	93·55	·374410	·371696	·371582	·371595	− 13	− 103	− 72	·371683	− 101
August ...	·374526	15·2	2·1604	91·68	2·0813	91·77	·374427	·371742	·371685	·371646	+ 39	− 51	− 37	·371732	− 47
September ...	·374655	15·5	2·1469	91·15	2·0430	91·21	·374523	·371888	·371849	·371697	+ 152	+ 62	+ 57	·371779	+ 70
October ...	·374568	17·4	2·0521	91·20	1·9748	91·14	·374466	·371917	·371881	·371748	+ 133	+ 43	+ 22	·371825	+ 56
November ...	·374646	17·5	2·0344	90·92	1·9557	91·02	·374547	·372022	·371989	·371798	+ 191	+ 101	+ 60	·371878	+ 111
December ...	·374462	15·5	1·9767	90·55	1·9329	90·64	·374408	·371913	·371893	·371848	+ 45	− 45	− 85	·371937	− 44
Means ...	·374539	16·2	2·1988	91·45	2·1040	91·57	·374420	·371709	·371659	·371569	+ 90	...	...	...	...
							1901.								
			c.m.	°	c.m.	°									
January ...	·374475	16·0	4·8880	88·86	4·8470	88·93	·374456	·371999	·372033	·371898	+·000135	+·000057	+·000028	·371995	+·000038
February ...	·374457	16·5	5·0280	87·47	4·8270	87·63	·374360	·371908	·371984	·371948	+ 36	− 42	− 61	·372050	− 66
March ...	·374494	16·7	4·7900	89·60	4·5570	89·67	·374378	·372063	·372074	·371998	+ 76	− 2	+ 15	·372100	− 26
April ...	·374531	13·5	4·5530	92·20	4·3610	92·52	·374443	·372224	·372143	·372048	+ 95	+ 17	+ 46	·372141	+ 2
May ...	·374581	15·0	4·4420	94·30	4·1310	94·41	·374427	·372324	·372183	·372097	+ 86	+ 8	+ 37	·372182	+ 1
June ...	·374591	15·7	4·2090	94·82	4·0120	94·79	·374490	·372448	·372295	·372146	+ 149	+ 71	+ 102	·372226	+ 69
July ...	·374526	17·2	4·3000	92·56	4·0550	92·68	·374405	·372341	·372255	·372195	+ 60	− 18	+ 13	·372268	− 13
August ...	·374531	17·5	4·2150	91·07	3·9870	91·12	·374417	·372384	·372348	·372244	+ 104	+ 26	+ 40	·372314	+ 34
September ...	·374369	14·5	3·8670	90·72	3·8360	90·88	·374358	·372402	·372374	·372293	+ 81	+ 3	− 2	·372362	+ 12
October ...	·374314	16·0	3·7820	91·28	3·7290	91·39	·374291	·372389	·372345	·372342	+ 3	− 75	− 96	·372407	− 62
November ...	·374448	16·7	3·7400	91·05	3·6560	91·32	·374414	·372549	·372507	·372391	+ 116	+ 38	− 3	·372449	+ 58
December ...	·374332	14·5	3·7270	90·02	3·6220	90·09	·374280	·372433	·372430	·372439	− 9	− 87	− 127	·372490	− 60
Means ...	·374471	15·8	4·2950	91·16	4·1350	91·29	·374393	·372289	·372248	·372170	+ 78	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograms.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force Magnetograms.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean monthly value of Zero (as observed.	Mean monthly value of Zero corrected to 90° F.	Mean monthly value of Zero calculated by formula.	Difference Column 10—Column 11.	Difference in Column 12 corrected for mean annual excess.	Difference in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 13 corresponding to series in Column 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							1902.								
			c.m.	°	c.m.	°									
January ...	·374392	15·4	3·7330	89·36	3·4960	89·44	·374274	·372488	·372506	·372487	+·000019	−·000026	−·000055	·372534	−·000028
February ...	·374457	15·5	3·6880	88·92	3·4780	89·06	·374354	·372577	·372607	·372535	+ 72	+ 27	+ 8	·372581	+ 26
March ...	·374452	15·7	3·5590	90·67	3·3610	90·68	·374351	·372634	·372612	·372583	+ 29	− 16	+ 1	·372621	− 9
April ...	·374485	16·4	3·3530	92·88	2·9690	92·94	·374291	·372774	·372680	·372631	+ 49	+ 4	+ 33	·372664	+ 16
May ...	·374411	17·5	3·0810	95·17	2·8050	95·14	·374269	·372836	·372672	·372679	− 7	− 52	− 23	·372714	− 42
June ...	·374498	14·5	2·9950	95·65	2·6970	95·76	·374350	·372972	·372788	·372726	+ 62	+ 17	+ 48	·372766	+ 22
July ...	·374429	16·0	2·8090	94·60	2·6010	94·74	·374327	·372995	·372843	·372773	+ 70	+ 25	+ 56	·372822	+ 21
August ...	·374369	16·7	2·6900	93·82	2·5050	93·88	·374276	·372993	·372869	·372820	+ 49	+ 4	+ 18	·372877	− 8
September ...	·374300	13·7	2·7430	92·57	2·4680	92·61	·374160	·372896	·372812	·372867	− 55	− 100	− 105	·372929	− 117
October ...	·374360	15·2	2·6060	92·38	2·3290	92·52	·374222	·373030	·372949	·372914	+ 35	− 10	− 31	·372977	− 28
November ...	·374388	15·5	2·3770	92·20	2·1570	92·33	·374279	·373175	·373100	·372961	+ 139	+ 94	+ 53	·373025	+ 75
December ...	·374314	17·0	2·3440	90·90	2·1930	91·05	·374242	·373119	·373085	·373007	+ 78	+ 33	− 7	·373078	+ 7
Means ...	·374405	15·8	2·9980	92·43	2·7550	92·51	·374283	·372874	·372794	·372749	+·000045	...	...	...	...
							1903.								
			c.m.	°	c.m.	°									
January ...	·374305	17·7	2·2610	89·11	2·1760	89·20	·374265	·373153	·373179	·373053	+·000126	−·000024	−·000053	·373136	+·000043
February ...	·374360	14·7	2·2830	87·77	2·1420	87·76	·374288	·373193	·373265	·373099	+ 166	+ 16	− 3	·373191	+ 74
March ...	·374415	14·5	2·4370	88·85	2·0390	88·89	·374212	·373168	·373204	·373145	+ 59	− 91	− 74	·373246	− 42
April ...	·374309	15·4	2·0260	90·77	1·6030	90·80	·374093	·373272	·373246	·373191	+ 55	− 95	− 66	·373305	− 59
May ...	·374254	16·5	1·7540	93·29	1·4790	93·32	·374114	·373357	·373251	·373237	+ 14	− 136	− 107	·373366	− 115
June ...	·374369	13·5	1·4970	93·51	1·2940	93·67	·374270	·373607	·373490	·373283	+ 207	+ 57	+ 88	·373426	+ 64
July ...	·374388	15·0	1·4970	92·77	1·2430	92·72	·374256	·373620	·373533	·373328	+ 205	+ 55	+ 86	·373488	+ 45
August ...	·374185	15·7	1·2990	90·97	1·1060	91·01	·374087	·373521	·373489	·373373	+ 116	− 34	− 20	·373545	− 56
September ...	·374042	16·0	0·9840	90·76	0·9650	90·82	·374034	·373540	·373514	·373418	+ 96	− 54	− 59	·373590	− 76
October ...	·374153	17·5	0·9030	90·76	0·6090	90·71	·374000	·373688	·373665	·373463	+ 202	+ 52	+ 31	·373630	+ 35
November ...	·374050	18·0	0·4220	89·57	0·1280	89·82	·373919	·373853	·373859	·373508	+ 351	+ 201	+ 160	·373673	+ 186
December ...	·373904	16·0	0·4540	88·71	0·3770	88·67	·373865	·373910	·373753	·373553	+ 200	+ 50	+ 10	·373711	+ 42
Means ...	·374228	15·9	1·4850	90·57	1·2630	90·62	·374117	·373490	·373454	·373304	+·000150	...	...	...	...
							1904.								
			c.m.	°	c.m.	°									
January ...	·374296	16·5	6·7530	87·51	6·3690	87·57	·374114	·371063	·371141	·370749	+·000392	+·000350	+·000321	·370888	+·000253
February ...	·374111	13·5	6·6430	88·29	6·4680	88·36	·374029	·370931	·370983	·370793	+ 190	+ 148	+ 129	·370916	+ 67
March ...	·374222	16·0	7·0460	89·24	6·5610	89·14	·373987	·370844	·370872	·370837	+ 35	− 7	+ 10	·370951	− 79
April ...	·373987	16·5	6·4890	91·20	6·0780	91·18	·373789	·370878	·370840	·370881	− 41	− 83	− 54	·370980	− 140
May ...	·374157	14·5	6·4300	93·02	5·8560	93·18	·373887	·371082	·370980	·370925	+ 55	+ 13	+ 42	·370996	− 16
June ...	·374102	15·0	6·2830	93·58	5·8570	93·51	·373896	·371090	·370978	·370969	+ 9	− 33	− 2	·371017	− 39
July ...	·374249	16·5	6·7160	91·95	5·9870	92·06	·373904	·371036	·370970	·371013	− 43	− 85	− 54	·371038	− 68
August ...	·374079	17·0	6·2390	91·69	5·9280	91·66	·373929	·371089	·371036	·371057	− 21	− 63	− 49	·371060	− 24
September ...	·374139	17·5	6·2540	91·24	5·7690	91·29	·373909	·371146	·371105	·371100	+ 5	− 37	− 42	·371098	+ 7
October ...	·373991	15·5	5·9820	92·12	5·4960	92·04	·373755	·371122	·371057	·371143	− 86	− 128	− 149	·371139	− 82
November ...	·373899	16·0	5·5930	91·96	5·4250	91·88	·373816	·371217	·371157	·371186	− 29	− 71	− 112	·371175	− 18
December ...	·374028	17·5	5·7470	90·21	5·5670	90·21	·373942	·371275	·371268	·371229	+ 39	− 3	− 43	·371214	+ 54
Means ...	·374105	16·0	6·3479	91·00	5·9467	91·01	·373913	·371064	·371032	·370990	+·000042	...	...	...	...

TABLE 13.—*Reductions of monthly and annual Means of Absolute Horizontal Force.*

Month.	Horizontal Force (observed).	Mean date of observation.	Corresponding ordinate of Horizontal Force Magnetograms.	Corresponding temperature of Horizontal Force enclosure.	Mean monthly ordinate of Horizontal Force Magnetograms.	Mean monthly temperature of Horizontal Force enclosure.	Mean monthly Absolute Horizontal Force.	Mean monthly value of Zero (as observed).	Mean monthly value of Zero corrected to 90° F.	Mean monthly value of Zero calculated by formula.	Difference Column 10—Column 11.	Differences in Column 12 corrected for mean annual excess.	Difference in Column 13 corrected for annual variation of Zero.	Smoothed means of Zero in Column 10.	Column 10—Column 15 corresponding to series in Colnmn 14.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							1905.								
			c.m.	°	c.m.	°									
January ...	·373977	14·5	5·6810	88·92	5·3590	88·73	·373817	·371250	·371291	·371272	+·000019	−·000002	−·000031	·371258	+·000033
February ...	·374019	11·5	5·7550	86·89	5·2660	86·85	·373784	·371262	·371363	·371315	+ 48	+ 27	+ 8	·371303	+ 60
March ...	·374130	15·0	5·8500	87·94	5·2620	87·99	·373850	·371330	·371394	·371358	+ 36	+ 15	+ 32	·371350	+ 44
April ...	·373973	15·5	5·5640	90·26	5·0760	90·23	·373738	·371307	·371300	·371401	− 101	− 122	− 93	·371397	− 97
May ...	·374083	17·0	5·4170	93·34	4·9400	93·35	·373855	·371489	·371382	·371442	− 60	− 81	− 52	·371446	− 64
June ...	·374102	17·5	5·0870	94·99	4·6290	94·88	·373879	·371662	·371506	·371484	+ 22	+ 1	+ 32	·371499	+ 7
July ...	·374102	15·5	5·1670	93·60	4·7010	93·55	·373877	·371625	·371511	·371526	− 15	− 36	− 5	...	...
August ...	·373908	16·4	4·6980	92·43	4·5020	92·51	·373817	·371661	·371581	·371568	+ 13	− 8	+ 6	...	...
September ...	·373793	16·7	4·2500	92·61	4·2650	92·55	·373798	·371755	·371673	·371610	+ 63	+ 42	+ 37	...	...
October ...	·374023	14·5	4·7930	93·35	4·3010	93·44	·373790	·371730	·371620	·371652	− 32	− 53	− 74	...	...
November ...	·373973	15·0	4·3160	93·60	3·8090	93·64	·373731	·371903	·371787	·371693	+ 94	+ 73	+ 32	...	...
December ...	·373848	16·5	3·9710	91·50	4·1530	91·51	·373935	·371946	·371898	·371734	+ 164	+ 143	+ 103	...	...
Means ...	·373994	15·5	5·0460	91·62	4·6890	91·60	·373823	·371577	·371525	·371505	+·000021	...	...	...	...

Whenever an adjustment of the instrument has been made in the middle of the year the annual means for the year have not been derived.

TABLE 14.—*Showing corrections applicable to the monthly mean values of Absolute Horizontal Force due to difference between the mean date of the Month and the mean date of observations.*

Unity = 0·1γ = ·000001 C. G. S.

Years.	Month.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1872 ...	−75	...	...	+13	+101	−21	−61	+81	+19	−41	−72	+35	..
1873 ...	−3	−56	0	−30	−59	+14	−14	−27	+39	−75	−12	−34	−21
1874 ...	−44	−10	+20	+66	+45	+25	+8	−3	−15	−30	+7	−7	+5
1875 ...	−15	+7	−22	−37	0	−15	−30	+15	0	−15	+22	+7	−7
1876 ...	0	+32	+7	−7	−21	−35	0	−7	−21	+11	0	−15	−5
1877 ...	−18	...	−24	+6	−6	−18	+12	+6	−6	−18	−30	0	...
1878 ...	−5	−24	−10	−19	+5	−5	−14	−19	+5	−7	−14	+10	−8
1879 ...	+2	−9	0	−8	−16	+4	−4	−8	+12	+4	−4	−12	−3
1880 ...	−12	0	−9	−15	0	−6	−12	+6	−1	−7	+8	+3	−4
1881 ...	−1	+8	−4	−8	+5	0	−5	−8	−13	0	−5	−10	−3
1882 ...	+5	+12	+2	−2	−8	−12	0	−2	−8	+4	0	−5	−1
1883 ...	−7	−17	−11	+2	−2	−7	+5	+2	−3	+10	+4	0	−2
1884 ...	−2	−8	−1	−4	−8	+2	−2	−6	+6	+2	−2	−6	−2
1885 ...	−7	−2	+3	0	−3	+5	+2	−1	−3	−7	+1	−2	−1
1886 ...	−3	+2	−5	−8	0	−3	−7	+3	−1	−4	+5	+2	−2
1887 ...	0	+6	−1	−5	+3	0	−4	−5	−8	−1	−3	−6	−2
1888 ...	+7	−2	−7	+2	−2	−5	+3	+1	−2	−5	−8	0	−1
1889 ...	−1	−7	−3	+4	+1	−1	−4	−6	+1	−1	−4	+3	−1
1890 ...	+1	−4	0	−3	−6	+1	−1	−3	+4	+1	−1	−4	−1
1891 ...	−5	−1	+3	0	−3	+4	+1	−2	−3	−5	+1	−1	−1
1892 ...	−4	+2	−1	−4	+5	0	−5	−4	−6	+3	−2	−5	−2
1893 ...	+2	+5	+1	−1	−4	−5	0	−1	−3	+2	0	−2	0
1894 ...	−3	−8	−5	+1	−1	−3	+2	+1	−1	−3	−6	0	−2
1895 ...	−1	−6	−2	+3	+1	−1	−4	−5	+1	−1	−4	+2	−1
1896 ...	+1	−2	+2	0	−3	+3	+1	0	−2	−5	+2	−1	0
1897 ...	−2	+1	−3	−5	0	−2	−4	+2	0	−2	+3	+1	−1
1898 ...	0	+3	−1	−3	+2	0	−2	−3	−4	0	−2	−4	−1
1899 ...	+2	+4	+1	−1	−3	−4	0	−1	−3	+2	0	−2	0
1900 ...	−2	−6	−3	+1	−1	−2	+2	0	−1	−3	−4	0	−2
1901 ...	−1	−4	−2	+2	+1	−1	−3	−3	+1	−1	−3	+2	−1
1902 ...	0	−3	0	−2	−3	+1	−1	−2	+2	+1	−1	−3	−1
1903 ...	−3	−1	+1	−1	−1	+2	+1	0	−1	−3	−4	−1	−1
1904 ...	−1	+1	−1	−2	+1	0	−1	−2	−3	0	−1	−3	−1
1905 ...	+1	+3	+1	−1	−2	−3	0	−1	−2	+1	0	−1	0

The corrections have been derived from smoothed instrumental changes.

4. *Use of the differential Instrument.*

78. Having obtained the values of the scale co-efficient of the instrument and of the temperature co-efficient of the magnet, it is now possible to make use of the instrument in the first instance, to secure the absolute values of force corresponding to the mean of the month and the year. In table 13 are collected the data in full detail from the year 1872 to 1905, the various operations involved being set forth step by step. Col. 2 contains the monthly mean value of the absolute force observed with the Kew unifilar. Col. 3 gives the mean date of the observations for the month. A minute correction to the final result of the month is necessary as the mean of the dates in this column does not exactly coincide with the exact middle date of the month. This though invariably inappreciable is sometimes significant and has been computed and given in table 14. Cols. 4 and 5 contain respectively the ordinate of the magnetograms and the temperature of the magnetograph enclosure corresponding to the exact time of the absolute observations. Cols. 6 and 7 give the mean ordinate and mean temperature respectively for the month. In Col. 8 appear the absolute values for the month derived from corrections obtained from the previous columns.*

79. The values of the zero of the instrument similarly derived are given in Col. 9 which in Col. 10 are all corrected for and reduced to a common temperature of 90° F. Col. 11 contains the theoretical values of the instrumental zero as computed from a suitable formula, the details of the derivation of which are given in the next section. Col. 12 gives the difference between the observed and computed values of the instrumental zero. Differences in Col. 12 corrected for the mean annual excess appear in Col. 13, and in Col. 14 these are further corrected for the annual variation of the instrumental zero. In Col. 15 is given another series of the values of the zero derived by smoothing the values given in Col. 10 by taking the running means of 12-monthly means, and reducing them finally to the mean of the month. Col. 16 gives the difference between the Cols. 10 and 15. Corrections indicated by figures in Col. 3 have been computed and given in table 14 but have not been applied. Cols. 1 to 8 refer to the use of the differential instrument for the purposes of the absolute determinations, while Cols. 9 to 16 give data which, while fully indicating the behaviour of such an instrument, may also, if these indications have been correctly interpreted, otherwise prove useful for the purpose to be presently referred to.

80. The mean monthly values of absolute force given in Col. 8, it should be noted, are not free from errors. They involve (*a*) observational errors, (*b*) instrumental (magnetograph) errors due to the shift of the zero, probably also (*c*) difference, if any, between the magnetic secular change at the two places, the electrometer tower 50 feet above ground where absolute observations are made and the underground room where the magnetograph has been located; and (*d*) any instrumental error of the absolute magnetometer which may depend upon and vary with some meteorological conditions. In the result of a large number of years the errors of the average month due to cause (*a*) and any small irregular movements due to other causes may by the law of probability become small enough to be inappreciable. This will leave the regular errors (*c*) and (*d*) alone to be dealt with, provided it is assumed in regard to (*b*) that the mean annual secular (instrumental) change proceeds at a uniform rate from month to month, and hence it is possible to eliminate it fully by the application of the correction $-\frac{2n-13}{24}s$ where s is the secular change and n the month of the year.

81. All these have been severally examined in the next section.

The examination of the zero series of a variation instrument is usually very rarely undertaken. It must hence be stated at the outset that the discussions about the data of this differential instrument and others which follow, whatever be the result and conclusions arrived at, refer solely to the behaviour of the particular instruments and to other collateral phenomena, and do not in any way affect the results of the absolute observations the results of which are given in the first eight columns in table 13. They do however throw some useful light on the probable errors involved in the final results and enable the degree of reliability of the working of the variation instruments to be ascertained fairly correctly.

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* The temperature figures from March 1875 to February 1877 are not available as the ivory scale of the thermometer in the enclosure had cracked and the thermometer had fallen down. The temperature readings hence were not resumed till the enclosure was next opened for adjustment in February 1877. The absence of corrections precludes the zero series from being correctly determined for that interval. For the mean absolute force however it will be seen that the correction necessary for its reduction to the mean of the month is dependent upon a very small difference of temperature which is always less than 0°·2 And as the temperature co-efficient is 3·2γ for 1° the uncertainty would amount to about ½γ.

TABLE 15.—*Mean monthly and yearly values of Horizontal Force Magnetograph Zero and Annual Inequality.*

Unity = 1γ = ·000001 C. G. S.

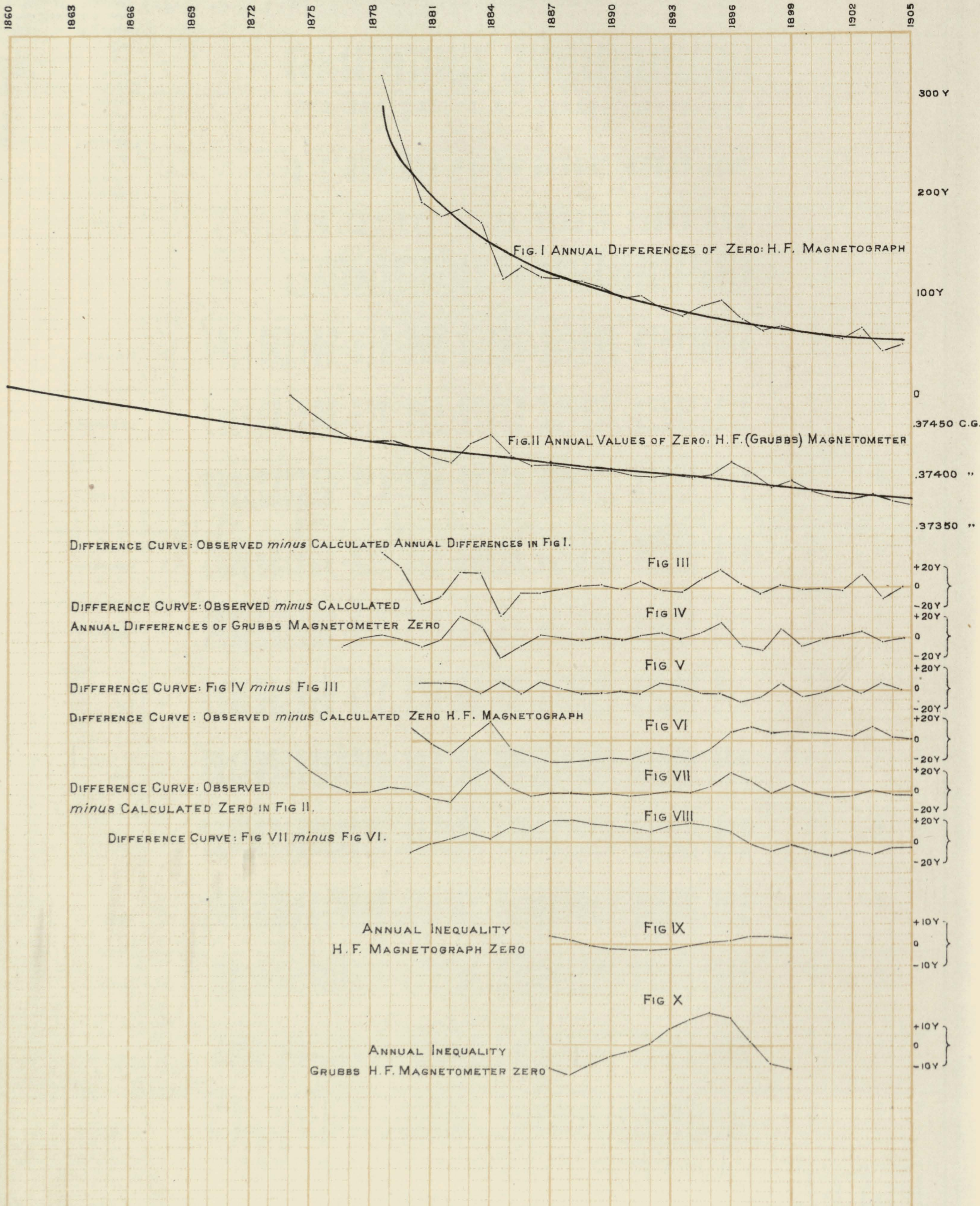
Years.	MONTHS. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Consecutive differences of Annual means.	Differences in column 15 calculated by Formula $\Delta Z = a + \beta t^{-1}$.	Departures of observed from calculated differences or column 15—column 16.	Calculated Zero of Horizontal Force Magnetograph from calculated differences.	Departures of observed from calculated Zero or column 14—column 18.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1872 ...	370353	...	...	353487	354708	356632	358198	359434	360548	361630	362428	363316	...				...	...
1873 ...	364077	364802	365619	365582	367602	368620	369829	370667	371196	353878	354275	354988	...	...	...	...	...	...
1874 ...	355726	355983	356218	356846	357168	357784	358515	359268	359710	360443	360632	361110	...	...	...	...	...	...
1875 ...	361476	361782	362251	362740	363260	363870	364560	364938	365490	366197	366625	366819	...	...	...	...	...	...
1876 ...	367081	367531	367867	368344	368901	369354	369778	370308	370811	371200	371535	371834	...	...	...	...	...	...
1877 ...	372227	...	354841	355093	355356	355618	356112	356573	356980	357443	357949	358169	...	...	...	...	...	...
1878 ...	358574	358809	359088	359266	359412	359837	360304	360662	360911	361183	361514	361836	360116	...	...	...	360561	-445
1879 ...	362077	362359	362600	362819	362893	363186	363462	363673	363835	364118	364223	364501	363312	3196	2847	+349	363418	-106
1880 ...	364923	365272	365290	365633	365642	365636	365864	365990	366212	366324	366554	366823	365847	2535	2319	+216	365737	+110
1881 ...	367004	367258	367204	367203	367453	367605	367862	367950	368164	368341	368516	368639	367767	1920	2074	-154	367811	...
	368753	368924	369099	369183	369257	369510	...	...	...	...	...	...	369546	...	...	...	369684	-44
1882 ...	368778	368949	369124	369208	369282	369535	369610	369787	369899	370166	370212	370301	369571	1779	1873	-94	369709	-138
1883 ...	370531	370684	370763	370976	371123	371292	371406	371674	371986	372082	372331	372412	371438	1867	1705	+162	371414	+24
1884 ...	372531	372512	372639	372924	373039	373192	373285	373368	373414	373521	373666	373799	373157	1719	1564	+155	372978	...
	...	...	...	...	...	...	...	...	...	...	...	...	374325	...	...	...	374421	+179
1885 ...	369571	369530	369660	369727	369899	369973	370030	370156	370412	370466	370585	370592	370050	1168	1443	-275	370146	-96
1886 ...	370716	370924	371094	371212	371200	371361	371418	371567	371564	371658	371614	371677	371334	1284	1339	-55	371485	-151
1887 ...	371968	372238	372092	372160	372372	372370	372484	372631	372823	372915	373045	373085	372515	1181	1246	-65	372731	...
	373160	373328	373352	373451	373546	...	...	...	...	...	...	...	373672	...	...	...	373895	-216
1888 ...	368968	369136	369160	369259	369354	369427	369502	369553	369751	369857	369803	369987	369480	1157	1164	-7	369703	-223
1889 ...	370031	370106	370206	370267	370390	370431	370694	370796	370906	371025	371123	371158	370594	1114	1092	+22	370795	...
	...	...	...	...	...	...	...	...	371840	371930	372041	372098	...	...	...	...	...	-201
1890 ...	371266	371265	371364	371398	371484	371566	371716	371896	371820	371910	372021	372078	371648	1054	1028	+26	371823	-175
1891 ...	372245	372277	372296	372363	372474	372523	372641	372748	372866	372901	373048	373185	372611	963	970	-7	372793	...
	373091	373246	373273	373378	373396	373343	...	...	...	...	...	...	373581	...	...	...	373710	-182
1892 ...	368891	369046	369073	369178	369196	369143	369294	369416	369649	369835	369946	370141	369381	970	917	+53	369510	-129
1893 ...	369936	370085	370050	370079	370180	370179	370200	370265	370440	370538	370504	370557	370230	849	871	-22	370381	-151
1894 ...	370543	370644	370674	370870	371027	370993	371040	371150	371192	371387	371482	371478	371020	790	827	-37	371208	-188
1895 ...	371446	371545	371604	371680	371887	371778	371814	371934	372025	372348	372398	372544	371897	877	787	· 90	371995	-98
1896 ...	372605	372430	372590	372610	372726	372809	372795	372969	372986	373131	373233	373319	372830	933	749	+184	372744	+86
1897 ...	373312	373307	373374	373391	373497	373599	373706	373642	373763	373770	373877	373968	373581	751	716	+35	373460	...
	373990	...	...	...	...	...	...	...	...	...	...	...	374213	...	...	...	374143	+121
1898 ...	370134	370208	370231	370142	370232	370292	370287	370450	370510	370560	370621	370853	370357	632	683	-51	370287	+70
1899 ...	370878	370788	370781	370891	371046	371024	371042	371072	371133	371202	371325	371455	371033	676	654	+22	370941	+92
1900 ...	371444	371387	371547	371572	371489	371586	371582	371685	371849	371881	371989	371893	371639	606	628	-22	371569	+70
1901 ...	372033	371984	372074	372143	372183	372305	372255	372348	372374	372345	372507	372430	372228	589	601	-12	372170	+58
1902 ...	372506	372607	372612	372680	372672	372788	372843	372869	372812	372949	373100	373085	372774	546	579	-33	372749	...
	...	...	...	...	...	...	...	...	...	...	369702	370904	373434	...	...	...	373304	+25
1903 ...	373179	373265	373204	373246	373251	373490	373533	373489	373514	373665	373859	373753	370585	660	555	+105	370455	+130
1904 ...	371141	370983	370872	370840	370980	370978	370970	371036	371105	371057	371157	371268	371012	427	535	-108	370990	+22
1905 ...	371291	371363	371394	371300	371382	371506	371511	371581	371673	371620	371787	371898	371505	493	515	-22	371505	0
Inequality 1878—1905.	-505	-418	-357	-272	-175	-80	+18	+132	+248	+361	+478	+574	...	...	...	...	...	...
Corrections due to instrumental change ...	+534	+437	+340	+243	+146	+49	-49	-146	-243	-340	-437	-534	...	...	...	...	...	...
Corrected Inequality .	+29	+19	-17	-29	-29	-31	-31	-14	+5	+21	+41	+40	...	...	...	...	...	...

The monthly means from 1891 to 1905 are not corrected for a change of 2γ due to the introduction in the magnetograph room of V. F. No. 2 magnet. But the yearly means have been corrected for this change.

Colaba Observatory

Curves showing the behaviour of the Grubb's H. F. Magnetometer & H. F. Magnelograph as indicating the secular and annual variations of Absolute Horizontal Force

Plate 2.



Figs I and II { Thick Curve = Theoretical Curve. Thin Curve = Observed Curve.

Govt. Photozinco Office Poona. 1909.

5. The Magnetograph as a recorder of secular change.

82. It is usual always to treat instruments of this type strictly as differential instruments. And the reason is obvious. When the instrument is young with its magnet newly magnetised to saturation, what with large losses in the moment of the magnet and the fatigue of the wires of the bifilar suspension, the creep of the zero for several years is not only rapid but irregular. In magnetographs of the most recent construction the magnets are very small and are specially 'aged' to remove the excess of magnetisation, which minimises the effects of the first defect; while the quartz fibre suspension effectively meets the second objection. In the older type of instruments owing to these drawbacks it is difficult for the first few years at least to expect the instrumental indications to preserve their zero unaltered for more than a day, and even this is mainly a matter of presumption. It is only after the lapse of several years that the creep becomes steady and sufficiently reduced in magnitude to make it possible, if the data refer to a large number of years, to formulate some law for this instrumental creep.

The creep of the Zero.

83. As the rapid shift of the zero takes the curve off the photographic paper in a very short time, fresh adjustments become necessary periodically to bring the curve back on to the recording paper. This introduces an additional disturbing factor fatal to correct registration by the instrument, of the minute secular changes which are so important for the purposes of investigation.

84. The Colaba Magnetograph was started in 1870. It had to be readjusted or its record interrupted for some reason or other on the following occasions:—May 1871, February 1872, October 1873, February 1877, July 1882, January 1885, June 1888, July 1892, February 1898, and November 1903. It will be seen that the instrument was practically disturbed by these adjustments every six years in the later years of its life, and much oftener when it was young.

85. In table 15 are collected the mean monthly values in force of the datum or zero line as derived from the absolute values. All are corrected to an uniform temperature of 90° F. Wherever double figures are given, an adjustment is indicated, the upper figure corresponding to the zero of the former adjustment, and the lower figures to that of the latter. It must be noted that the zeros are comparable during the year, but the values from year to year are comparable only during the period of one adjustment to which they are common. Though the series is given from 1872 to 1905, unfortunately no temperature corrections are available, as already referred to, from March 1875 to February 1877. This precludes the use of the series prior to 1878 for this purpose and hence the period 1878-1905 only has been made use of in the following discussion.

86. Proceeding to the consideration of the mean annual values, the treatment adopted is as follows:—In column 14 are given the annual means of the zero, double figures being given for the years of adjustment. As the curve of the zero itself rises very rapidly it is difficult to be charted on a suitable scale, and as it is also otherwise inconvenient to deal with, in column 15 are collected the differences of the annual means of two consecutive years which are treated with the formula $\Delta z = \alpha + \beta t^{-1}$ which appeared to suit best the condition of the series for the period considered, where α and β are some constants and t is the number of years reckoned from some convenient year. The theoretical differences so derived are given in column 16, the next column 17 giving the departures of the observed from the theoretical differences.

87. The theoretical differences in column 16 are then taken, and with the initial value of the zero of the year 1905 the series of the annual values of the zero is built up for the period. This is given in column 18, while in column 19 appear the differences of the annual means of the observed zero series from the theoretical zeros.

88. The series in columns 15 and 16 are charted for ready reference in Plate 2, figure 1, in thin and thick lines respectively, as are also the departures in columns 17 and 19 as figures 3 and 6.

89. Assuming that the theoretical zero curves (of either differences or actual zeros) fairly set forth with correctness the conditions obtaining in the instrument, the departures of the observed from the theoretical presumably indicate the irregularities of the instrument, and figures 3 and 6 show how far the instrument fails to conform to the assumed law in the former case in regard to the differences of zeros and in the latter to the actual zeros.

90. Side by side, however, have been charted figures 4 and 7, the resulting curves obtained by a similar treatment of the zero curve of another instrument of an altogether different type—Grubb's H. F. magnetometer, a full description of which is given in Chapter III. The series charted as figures 4 and 7 appear in table 77, columns 19 and 16 respectively.

91. A glance at the two sets of curves shows that while not agreeing in the main in the minor fluctuations, their general run is strikingly parallel. The points of disagreement, the graphs of which are represented by figures 5 and 8, will be presently referred to; but considering the parallelism

first, it is difficult to conceive how two instruments, so widely different in make and type, can behave so regularly in their irregularities from year to year over 25 years, the period under examination. The conclusion is unavoidable, therefore, that a considerable portion at least of these irregularities cannot be of instrumental origin, but that both these instruments have been subject to some disturbance having a common origin, which acts either on the electrometer tower disturbing the absolute determinations but not affecting the two variation instruments nearer the ground, or on the variation instruments alone, the influence being rendered inappreciable at the height of the tower. The cause may be magnetic or non-magnetic in origin. If the former, it is conceivable that the strong local factor at Colaba renders the *induced* effects of the disturbance of the 11-year period on the secular march of the absolute force, referred to in Part II, Chapter I, slightly unequal at unequal distances from the ground.

92. If the latter, it may possibly be due to some unrecognised source of error in the absolute determinations themselves, due to some instrumental defect, though what that possibly may be it is not easy to guess. Defective temperature correction or any faulty constants in the absolute instrument can, it has been ascertained, hardly explain these annual irregularities, amounting to such a large amount as 20γ.

93. On the other hand, the general run and peculiarity of the curves, the peaks in 1884 and 1896 and a possible one in 1874 occurring after an interval of about 12 years, if not accepted as accidental, may be suspected as indicating the differential effect of some general magnetic disturbance operating with a slight inequality upon the absolute instrument at the tower and on the variation instruments located nearer the ground.

94. Coming now to the points of disagreement between the two variation instruments a further examination of figures 5 and 8 shows that the departures are pretty irregular such as may be expected from (1) irregular changes of the zero or from (2) uncompensated effects of temperature on the variation instruments if the thermometer failed to measure accurately the actual changes in the temperature of the magnet. The irregularity in the shift of the zero is always most marked after every fresh adjustment of these instruments, but the larger departures do by no means correspond to the epochs of these adjustments of the magnetograph; and Grubb's magnetometer was not disturbed at all after 1873. Hence the probability of the discrepancies being due to irregularities in the zero of either instrument appears to be small. Examining the departures in connection with uncompensated temperature effects, the indications of Grubb's instrument in this respect, as will be seen later (*vide* Chapter III), give undoubted evidence of being vitiated. On the other hand, the small temperature coefficient of the magnetograph and the small range itself of the temperature in the magnetograph room and lesser range still in the enclosure, make the possibility of such uncompensated temperature errors markedly remote* in the magnetograph. Hence for the major portion at least of these irregularities the Grubb's instrument appears to be clearly responsible.

Annual variation of magnetograph zero.

95. Referring now to the march of the mean monthly values of the zero of the magnetograph, it is obvious that if there is no instrumental creep, if the temperature errors have been fully compensated and there is no difference in the magnetic secular change from month to month at the two places, the values of the zero should be all equal and must lie on a straight horizontal line. A minute but well-defined annual variation, it will be seen, is however, indicated. The mean monthly values of the zero (average of the period 1878-1905) given in table 15 are corrected for the instrumental (secular) change equal to $116{\cdot}6\gamma$ in the usual way by the application of the formula referred to in paragraph 80. It will be noted that this correction ($\pm 53{\cdot}4\gamma$) graded from January to December is very large, compared to the minute residual variation which falls to be explained. The mean monthly values of the zero can also be derived by an indirect and less reliable process by taking the crude monthly means of the zero wholly *uncorrected* for temperature and deriving the annual inequality by assuming that the inequality is the result of the combination of two variations only—one caused by the temperature series shown in the last row of figures at the bottom of table 16 with an unknown coefficient of temperature to be sought and the other by the secular (instrumental) series where s is the other unknown constant. In this assumption the operation of any other possible cause is, of course, excluded. From these data, by the method of least squares, the following result has been obtained: $s = 122{\cdot}7\gamma$; $t_\circ = -1{\cdot}98\gamma$.

96. This method of procedure, which attempts to determine both the temperature coefficient and the progressive change on the supposition that the inequality is due to the operation of two factors only, is obviously objectionable; its only utility, however, is that it enables one to see how far at least the large value of the secular (instrumental) creep is approximately reliable the observed value (annual instrumental creep) of which is about $116{\cdot}6\gamma$ while the calculated value indicates $122{\cdot}7\gamma$. The temperature coefficient also works out at $-1{\cdot}98\gamma$ instead of the correct value $-3{\cdot}2\gamma$; and as also the residual inequality after the elimination of the variations due to the

* Results of experiment conducted in one of the magnetograph enclosures (*vide* para. 117) where the conditions of the magnets and thermometers in all enclosures are almost identically alike, show that these effects are inappreciably small in the diurnal and annual march.

TABLE 16.—*Monthly Mean Readings of Thermometer in the Horizontal Force Magnetograph Enclosure.*

Years.	Month.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
	°	°	°	°	°	°	°	°	°	°	°	°	°
1873 ...	87·86	87·99	89·21	92·00	93·93	94·41	91·39	90·11	89·42	89·56	89·14	87·41	90·20
1874 ...	84·91	84·17	84·84	86·68	90·02	91·87	90·40	89·07	89·06	88·75	87·83	87·09	87·89
1875 ...	84·85	83·59	...	...	...	...	...	...	...	...	...	...	...
1876 ...	...	...	...	...	...	...	...	...	...	...	...	...	...
1877 ...	...	...	89·08	90·71	92·86	94·96	94·60	93·95	93·25	93·16	92·23	91·11	...
1878 ...	88·74	88·21	89·34	91·02	92·93	94·79	92·74	91·50	91·70	91·56	90·95	89·23	91·06
1879 ...	87·51	87·62	88·06	89·92	91·85	92·57	92·13	91·16	90·52	90·19	89·06	86·78	89·78
1880 ...	84·70	84·01	85·53	88·47	90·21	91·67	89·85	89·50	88·60	88·54	88·04	86·79	87·99
1881 ...	86·12	86·00	87·09	88·21	90·55	91·28	90·08	89·93	90·73	89·75	89·26	87·74	88·89
1882 ...	86·73	86·15	87·02	89·13	91·07	91·51	90·48	89·82	89·59	89·69	88·79	88·02	89·00
1883 ...	87·64	86·22	86·63	89·31	92·33	92·72	90·79	90·01	89·07	88·85	87·68	84·97	88·85
1884 ...	83·41	83·15	84·93	87·37	90·24	91·79	90·99	89·82	89·03	88·44	87·44	86·52	87·76
1885 ...	86·71	85·94	87·05	89·07	91·43	93·01	92·35	90·64	89·80	90·06	90·26	89·22	89·63
1886 ...	88·04	87·39	88·35	89·98	92·69	92·93	90·33	89·51	89·04	89·34	89·34	88·67	89·63
1887 ...	87·72	86·95	88·09	90·00	92·25	92·34	89·94	89·28	88·75	88·67	88·53	87·61	89·18
1888 ...	87·51	87·42	89·20	91·48	93·32	93·96	92·35	91·01	90·79	91·13	91·64	90·78	90·88
1889 ...	89·63	89·23	90·23	91·58	93·13	93·68	91·95	91·19	90·93	91·12	90·03	88·65	90·95
1890 ...	88·17	88·42	89·79	91·44	93·08	93·36	90·95	89·77	89·42	89·46	89·53	89·63	90·25
1891 ...	88·72	87·75	88·64	91·21	93·40	94·94	93·63	92·18	91·15	90·09	89·83	88·93	90·87
1892 ...	88·30	88·50	89·00	92·97	95·47	95·35	94·41	92·23	90·06	90·03	89·43	88·76	91·21
1893 ...	87·83	86·87	88·40	91·35	93·95	94·25	92·41	91·98	92·01	91·98	91·99	90·87	91·16
1894 ...	89·29	89·28	90·40	92·53	94·44	95·04	93·31	91·98	91·13	90·87	90·08	89·21	91·46
1895 ...	88·56	88·65	90·57	92·11	94·34	95·11	93·72	91·89	91·04	91·36	91·16	90·39	91·57
1896 ...	89·88	89·41	90·50	93·34	95·52	95·61	92·75	90·77	90·85	91·70	91·84	90·65	91·90
1897 ...	88·76	88·07	88·95	91·37	94·07	95·50	93·97	92·16	91·79	91·34	90·32	89·09	91·28
1898 ...	88·13	88·64	89·63	92·17	94·43	94·38	92·81	91·71	91·05	91·56	91·63	90·93	91·42
1899 ...	88·14	88·24	89·60	92·26	94·27	94·69	93·02	92·72	92·42	92·96	92·64	91·64	91·88
1900 ...	89·61	88·82	90·14	92·15	94·01	94·81	93·55	91·77	91·21	91·14	91·02	90·64	91·57
1901 ...	88·93	87·63	89·67	92·52	94·41	94·79	92·68	91·12	90·88	91·39	91·32	90·09	91·29
1902 ...	89·44	89·06	90·68	92·94	95·14	95·76	94·74	93·88	92·61	92·52	92·33	91·05	92·51
1903 ...	89·20	87·76	88·89	90·80	93·32	93·67	92·72	91·01	90·82	90·71	89·82	88·67	90·62
1904 ...	87·57	88·36	89·14	91·18	93·18	93·51	92·05	91·66	91·29	92·04	91·88	90·21	91·01
1905 ...	88·73	86·85	87·99	90·23	93·35	94·88	93·55	92·51	92·55	93·44	93·64	91·51	91·60
Inequality, 1878-1905 ...	−2·55	−3·02	−1·84	+0·39	+2·62	+3·31	+1·75	+0·63	+0·13	+0·17	0·20	−1·35	

two adopted factors, is nearly as large as before, the existence of some other disturbing cause besides the two factors admitted in the mathematical analysis, becomes strongly plausible.

97. At first sight one is inclined to ascribe the annual variation of zero to a possible over-correction of temperature of the magnetograph. The examination however of the temperature curve given in table 16 fails to explain the large maximum in November and to a lesser degree the minimum in July.

And as the determination of the temperature coefficient has so far given most consistent and reliable results from time to time in the eight independent experiments referred to in paragraph 77, it is difficult to ascribe the variation of zero to a faulty temperature coefficient.

98. There are still two more possible causes to examine. As already referred to, the thermometer in the enclosure may not correctly measure the actual march of temperature of the magnet. This has been duly investigated by an experiment conducted in one of the magnetograph enclosures (*vide* paragraph 117) and the results show that the difference, if any, may be relied upon to be inappreciably small.

99. The other cause which also has been examined is the possible irregular expansion of the photographic paper and the condition of the film at the time the ordinates are tabulated. The procedure at Colaba is as follows. Papers are put on the cylinder every alternate day, two days curve being secured on one magnetogram. These are immediately developed, fixed, and finally washed and left in running water for 12 hours. They are then hung up and allowed to dry. Usually, though not quite always, the turn of the paper when it is taken for the purposes of tabulation, comes about a fortnight later. Thus the condition of the paper will depend mainly upon the season at which it is taken to the tabulator and upon the treatment it initially received at the time it passes through the various photographic processes. The factors which may be expected to affect the paper film are moisture and temperature. It is hence obvious that as the photographic process and the work of tabulation are spread more or less uniformly over all the months of the year, the ordinates measured from month to month if affected by such influence may acquire an annual variation dependent upon the combined effects of moisture and temperature.

100. The usual daily routine work includes eye readings of the magnetograph taken at 6, 10, 14, 16 and 22 hours every day. Tabulations taken at these exact instants of observations are entered in a special form along with the scale readings (eye observations). It is obvious that as both the ordinates and the scale readings are simultaneously taken a constant relation must exist between them provided no change occurs in the telescope and scale by which the eye readings are secured, and in the paper from which the ordinates are measured. The check constants obtained are derived thus. The tabulation ordinate is converted into scale reading by the factors 3·46 and 1·363 respectively for an ordinate of 1 inch or 1 c.m. The value of the scale reading is then subtracted (added in case of Declination) from the observed eye reading. These constants from month to month are shown in table below :—

TABLE 17.—*Scale Readings of H. F. Magnetograph corresponding to the Datum Line.*

Year.	Months.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1883 ...	19·71	19·70	19·71	19·72	19·71	19·70	19·69	19·68	19·68	19·69	19·68	19·65
1884 ...	19·66	19·65	19·66	19·66	19·67	19·67	19·66	19·67	19·66	19·65	19·65	19·63
1885 ...	22·70	22·69	22·71	22·71	22·70	22·71	22·71	22·72	22·70	22·70	22·68	22·68
1886 ...	22·69	22·67	22·67	22·67	22·67	22·65	22·65	22·66	22·66	22·66	22·66	22·65
1887 ...	22·67	22·66	22·67	22·67	22·67	22·65	22·64	22·64	22·64	22·65	22·65	22·58
1888 ...	22·57	22·58	22·56	22·57	22·58	22·67	22·66	22·70	22·75	22·77	22·75	22·74
1889 ...	22·74	22·73	22·72	22·72	22·69	22·67	22·67	22·68	22·68	22·67	22·68	22·68
1890 ...	22·67	22·68	22·66	22·68	22·68	22·66	22·66	22·66	22·68	22·70	22·70	22·70
1891 ...	22·70	22·68	22·70	22·70	22·70	22·69	22·69	22·68	22·67	22·68	22·68	22·63
1892 ...	22·63	22·63	22·64	22·65	22·66	22·67	22·73	22·68	22·76	22·78	22·77	22·75
1893 ...	22·75	22·75	22·71	22·72	22·72	22·69	22·69	22·71	22·72	22·75	22·74	22·70
1894 ...	22·69	22·71	22·72	22·74	22·73	22·67	22·68	22·68	22·67	22·66	22·65	22·66
1895 ...	22·65	22·65	22·67	22·69	22·70	22·64	22·64	22·63	22·65	22·66	22·66	22·65
1896 ...	22·64	22·65	22·65	22·66	22·66	22·63	22·61	22·61	22·62	22·64	22·63	22·61
1897 ...	22·62	22·61	22·62	22·61	22·62	22·62	22·62	22·62	22·62	22·62	22·62	22·61
1898 ...	22·60	22·69	22·68	22·70	22·74	22·66	22·62	22·62	22·60	22·66	22·66	22·67
1899 ...	22·65	22·65	22·66	22·67	22·68	22·65	22·67	22·67	22·67	22·69	22·69	22·68
1900 ...	22·68	22·67	22·67	22·68	22·68	22·67	22·68	22·64	22·62	22·64	22·63	22·63
1901 ...	22·62	22·62	22·64	22·64	22·63	22·62	22·61	22·63	22·63	22·65	22·63	22·61
1902 ...	22·59	22·59	22·59	22·59	22·60	22·60	22·60	22·59	22·59	22·59	22·60	22·58
1903 ...	22·60	22·59	22·61	22·62	22·62	22·63	22·62	22·61	22·62	22·61	22·82	22·79
1904 ...	22·81	22·79	22·79	22·79	22·80	22·78	22·75	22·75	22·77	22·80	22·83	22·82
1905 ...	22·82	22·81	22·82	22·82	22·85	22·83	22·82	22·82	22·83	22·85	22·84	22·84
Aunual variation ...	0	0	0	+ ·01	+ ·01	0	− ·01	0	0	0	0	− ·01

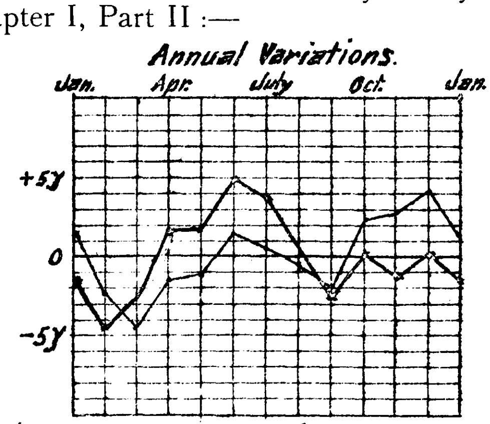
101. The zero mirror of the magnetograph is once for all fixed and there is no possibility of its being disturbed inside the enclosure. The telescope and the scale are firmly fixed, but from their exposed situation they are likely to be disturbed by an accidental knock. Any sudden dislocation of the constant hence would at once reveal that the conditions between the two series have been disturbed, possibly by the disturbance of the telescope or scale, if not caused by a readjustment of the instrument. These dislocations whenever markedly apparent have been duly investigated and allowed for.

102. If now an annual variation is disclosed in the above monthly constants it would presumably indicate that the operation of some regular disturbing cause affecting either the paper or the telescope and the scale or both is existent. As there is no possibility of the latter being affected by such regular influences, we are driven to the inference that the development and other photographic processes and the subsequent operation of tabulations of the magnetograms made from month to month under different conditions of temperature and moisture, are the cause of this variation. A glance at the last row of figures in table 17 shows that such a variation is indicated, but whatever its cause may be, its effect is very small, being within $\pm$ 0·4γ.

103. For the purpose of the present enquiry however it is sufficient for us to see that this effect on the paper is at any rate very small and that it fails to explain the comparatively large annual variation of the H. F. magnetograph zero, though undoubtedly it forms a part of the variation and contributes to it to the small extent noted above.

104. The cause of this may however lie in a non-magnetic source of variation in the results of absolute determinations. Such a contingency though improbable is not impossible. For the methods usually employed in the Absolute Observation experiments for recording the temperature changes in the magnet during the Vibration and Deflection experiments, are by no means perfect. The thermometer which is placed in the Vibration box and that placed on the Deflection Bar during the Deflection experiments, though near enough the magnet, may not in either case give the true temperature changes of the magnet. From the experimental results derived from the temperature observations specially conducted to investigate this question in Grubb's Magnetometer enclosure (*vide* Chapter III), we see that such differences are by no means unlikely or impossible. If the results of these experiments can be depended upon as applicable to a certain extent to the small enclosure of the Kew magnetometer, the magnet during the winter or dry months may stand at a lower temperature than that indicated by the thermometer in the enclosure and during summer or moist months at a higher temperature. The errors in the experiments of vibration and deflection are to a certain extent complementary, still the residual result may give a minute fictitious inequality to the absolute determinations. Presumably these effects are not appreciably large; but some uncertainty must remain which cannot be avoided in the conditions which obtain at present in the construction of the magnetometers.

105. If any of the causes examined above are regarded as insufficient to explain the variation of the magnetograph zero, no alternative is possible but to suppose that the minute but definitely marked variation of the magnetograph may be due to some difference in the magnetic secular growth from month to month at the two places above and below the ground, as we have some reason to believe that such difference does exist between the secular march of force from year to year at the two places as will be seen from Chapter III, Part I, and Chapter I, Part II :—



Thick curve:- Annual Variation of Absolute Force.
Thin curve :- " " " " by Magnetograph.

106. If so it may be interesting to see how the annual variation of force recorded by the magnetograph compares with the similar phenomenon recorded at the electrometer tower where absolute determinations* are made. The figures above which give the annual magnetic inequalities of force as derived from absolute determinations and that given by the magnetograph (combining the absolute variation with the variation of zero) indicate that the latter exhibits a slightly smoother phenomenon with a

* The annual variation is referred to and discussed in Part II, Chapter I.

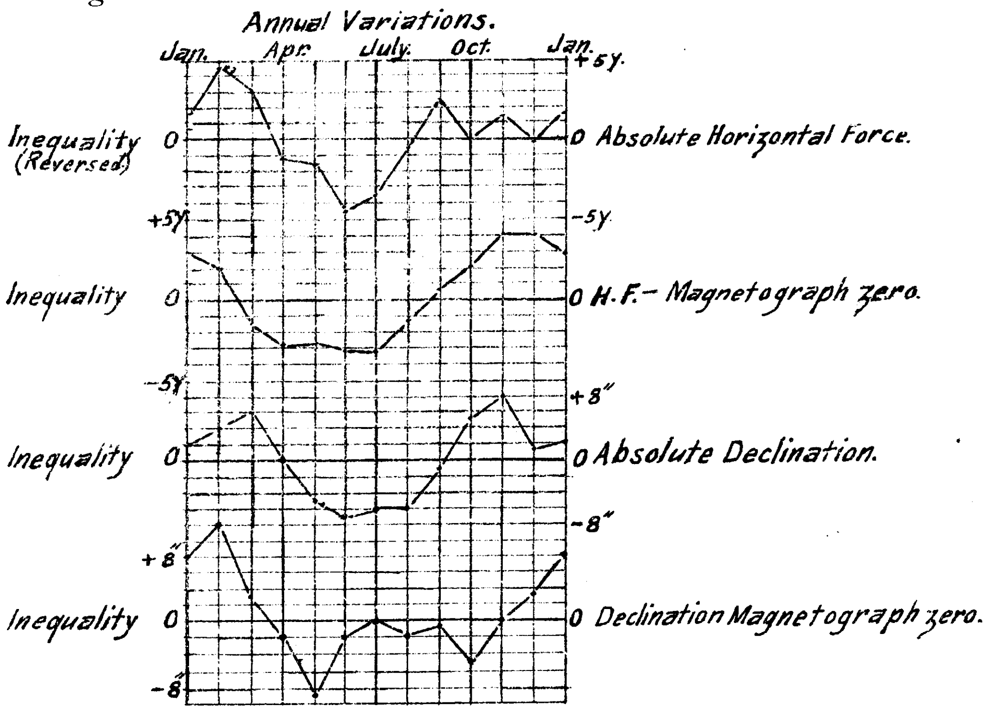
somewhat more regular semiannual pulse, the minima falling exactly about the equinoxial months and the maxima about the solstices and it will be seen later, (*vide* Chapter X, Part II), that a similar semiannual pulse is also indicated by disturbance curves. The annual inequalities from which the above curves are charted are given in table below :—

TABLE 18.

Unity = 1γ = ·00001 C. G. S.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
From absolute determination.	−1·5	−4·3	−2·9	+1·3	+1·8	+4·8	+3·5	+0·8	−2·6	+0·1	−1·3	+0·1
From the Magnetograph.	+1·4	−2·4	−4·6	−1·6	−1·1	+1·7	+0·4	−0·6	−2·1	+2·2	+2·8	+4·1

107. In this connection the curves of the annual variation of absolute horizontal force (reversed), declination, and the variations of the zeros of the two variation instruments, are charted together below, and it may be noticed that the general sweep of the curves in each element is markedly similar, and as the declination curves obviously preclude, so far as is known, any temperature effect the parallelism is suggestive of a common magnetic influence.



108. In any case, whatever be the real cause, whether instrumental or magnetic, these variations of the zero must be allowed for, as they presumably would not affect the march of the magnetic phenomena generally at the tower where the absolute determinations are made which must be regarded as our standard observations. Referring back hence to table 13 the process adopted for reduction is as follows. Figures in column 11 (monthly means of the zeros) have been derived from the calculated annual mean zeros by interpolation so as to secure a continuous series. In column 12 appear the differences of the observed and calculated zeros which are corrected first in column 13 for the mean annual excess shown in column 19 of table 15, and then in column 14 they appear further corrected for the annual inequality of the magnetograph zero discussed above.

109. These final or residual errors can be derived by a simpler method. From the observed series in column 10, is derived a continuous series by a simple smoothing operation, the mean of every 12 consecutive monthly values being taken and placed as the value at the epoch of the 1st day of the seventh month in the series and combining thereafter two consecutive means so derived for the epoch of the middle of the month. The series so derived appears in column 15, from which obviously the annual variation is eliminated by the smoothing operation. In column 16 are shown the differences between column 10 and column 15. Either of the series in column 16 or column 14 may now be supposed to give the residual errors which are partly the result of probable errors of observations of the absolute determinations and partly of the irregularity of the magnetograph instrument in not exactly conforming to the assumed law of the uniform creep of the zero. The probable error of the monthly mean derived from either of the columns 14 or 16, (±5·3γ or ±5·0γ) when compared with the probable error of the monthly mean of the absolute determination (±2·6γ) referred to in Chapter I, shows a small difference as obviously they

must on account of the different treatment adopted, the magnetograph zero having been relied upon in the latter case just for the period of one month, while in the former by the adoption of a hypothetical law it is depended upon for a much greater period. The difference hence in the two may be taken to measure roughly the irregularity of the variation instrument (inclusive of the irregularities, if any, in the monthly growth of magnetic force at the two places).

110. The use of the instrument for the derivation of the diurnal inequalities falls next for discussion.

6. Magnetograph as Recorder of diurnal variations.

111. The drum of the instrument is fed every alternate day with photographic paper and thus two days' curves are secured on one magnetogram. The time at which the papers are changed, as also when the slit is altered to receive the second day's curve on the paper, is always between 9 a.m. and 10 a.m. Thus the curve on the paper is continuous from 10 a.m. of one day to 10 a.m. of the succeeding day. As described elsewhere the papers are removed from the cylinder every alternate day and developed, washed, dried and are ready as a rule for the tabulator about a fortnight later.

112. The tabulations are made every hour by the measurement of the ordinate between the zero line and the curve. These measurements are made by specially constructed tabulators the verniers of which read to ·001 inch. No smoothing operation of the curves is resorted to. At Colaba the traces are not so much disturbed as in the higher latitudes and hence no trouble has been experienced in tabulating the result so as to necessitate smoothing operations. Only on very rare occasions at times of great disturbances as the day is not omitted altogether, does the tabulation require attention when a smoothing operation here and there is allowed. The ordinates are tabulated and duly checked and entered in forms, from 10 a. m. to 10 a. m. (*vide* form E attached). The practice at Colaba as at other observatories to change lamps, slits and paper between 9 a. m. and 10 a. m., gives an unbroken continuity to the diurnal curve only between 10 a. m. of one day and 10 a. m. of the following day. It is doubtful hence if it is of any advantage to arrange the ordinates in the forms otherwise than from 10 a. m. to 10 a. m. If they are arranged from 0^h to 24^h the unbroken continuity which one naturally expects to secure in the diurnal curve cannot be preserved. This would, it is true, be immaterial if the instrument can be relied upon to remain undisturbed, without introducing any dislocation (that is a change in the curve due to other than magnetic causes) of the curve between 9 a. m. to 10 a. m. This peculiarity is noticed in the vertical force instruments which show a dislocation of the curve on the slightest provocation. A gentle knock, or any slight concussion produced by an accidental fall of a glass chimney or any small article, such as a note book, on the floor of the magnetograph room, is sufficient to cause such dislocations of the curve They occur sometimes even without any assignable cause. If these are detectable in the curve, and if the curve is available, these can be, as they have to be, corrected. But during the shifting time when either the slit is changed or the paper is renewed no curve is available, and if during that operation, as is usually the case, the dislocation occurs it would be an unknown quantity and if the ordinates are arranged from 0^h to 24^h a portion of the day's curve from 0^h to 9^h will differ from the other portion of the curve from 10^h to 24^h by the unknown constant equal to the dislocation and to that extent vitiate the diurnal inequality. In the other case it will appear in the aperiodic change. The practice hence at Colaba has been always to arrange the hours from 10 a.m. to 10 a.m., and perform all necessary calculations, reductions, etc., on this form so filled up, leading up to the final result. As after the elimination of the aperiodic change the inequality is a cyclic phenomenon, in the analysis for securing Fourier coefficients, the epoch of the maximum which is considered from 10 a. m. in the analysis can be easily reduced eventually so as to reckon from midnight.

113. That the adoption of hours from 10 a. m. to 10 a. m. of the next day is open to some objection cannot be denied. The diurnal inequality so derived for each month clearly omits the first nine hours of every month and includes in their stead the nine corresponding hours of the following month. The error involved by this subtitution is 1/30th of the difference between the ordinates of the same hours and affects the hours from 0^h to 9^h only, the rest of the hours obviously remaining unchanged. Usually it has been noted that this difference is negligible at Colaba, and only when the 1st day of the month happens to be a greatly disturbed day that these differences become appreciable but they are of such order and character as may affect any variation of a month obtained by the rejection or inclusion of a single disturbed day, from the 30 or 31 days of the month.

114. The other point on which it is also open to criticism, is that the mean epoch of the month, of which the diurnal inequality is assumed to be typical will not be coincident with but differ from the actual mean of the month by about 9 hours. The correction due to this shift is so small that it can be safely held to be negligible.

115. The diurnal variation of the tabulated ordinates for every month as shown at the bottom of the form E is then reduced to force variation by the scale coefficient for the month indicated in table 12, and the results so derived from 1872 to 1905 are collected in tables 19 to 52.

Before however the correction due to the aperiodic change is applied, the ordinates of the inequality require first to be considered for corrections due to temperature changes.

FORM

Government Observatory, Bombay, Month of August 1904,

Tabulated by.	Checked by.	Colaba Civil Hour.	10	11	12	13	14	15	16	17	18	19	20	21
		Date.												
5th August 1904 K. B. P.	15th August 1904, A.	1	6·715	6·760	6·737	6·645	6·410	6·267	6·170	6·012	5·875	5·840	5·847	5·830
K. B. P. ...	A.	2	6·315	6·925	6·980	6·915	6·667	6·200	6·085	5·740	5·580	5·515	5·535	5·595
7th August 1909, K. B. P.	16th August 1904 A.	3	6·290	6·400	6·410	6·605	6·392	6·200	5·905	5·700	5·465	5·482	4·862	4·660
9th August 1904. K. B. P.	A.	4	5·880	6·055	5·880	5·715	5·262	5·385	5·200	4·990	4·732	4·680	4·735	4·790
16th August 1904 K. B. P.	A.	5	5·852	5·875	6·025	6·087	6·087	5·940	5·780	5·632	5·555	5·587	5·550	5·557
16th August 1909 K. B. P.	A.	6	6·490	6·595	6·790	6·540	6·270	6·017	5·795	5·700	5·720	5·727	5·690	5·717
17th August 1904 K. B. P.	27th August 1904 A.	7	6·770	6·970	7·100	7·055	6·647	6·280	5·980	5·767	5·647	5·600	5·660	5·657
K. B. P. ...	A.	8	6·710	6·810	6·767	6·600	6·412	6·082	5·820	5·770	5·760	5·742	5·732	5·710
K. B. P. ...	A.	9	6·632	6·730	6·710	6·642	6·420	6·167	5·977	5·835	5·780	5·830	5·805	5·825
K. B. P. ...	A.	10	6·840	6·880	6·840	6·705	6·445	6·170	5·995	6·000	6·030	6·005	5·925	5·900
K. B. P. ...	A.	11	6·430	6·647	6·700	6·567	6·287	6·115	6·047	5·960	5·870	5·840	5·812	5·810
K. B. P. ...	A.	12	7·000	7·000	6·947	6·715	6·395	6·137	5·970	5·747	5·830	5·830	5·860	5·860
K. B. P. ...	30th August 1904 A.	13	6·730	6·762	6·840	6·640	6·380	6·145	6·005	5·875	5·782	5·680	5·575	5·585
K. B. P. ...	A.	14	6·630	6·555	6·445	6·310	6·150	6·030	5·890	5·800	5·770	5·747	5·742	5·767
K. B. P. ...	A.	15	6·445	6·550	6·730	6·660	6·530	6·500	6·342	6·185	6·042	6·000	5·827	5·670
K. B. P. ...	A.	16	6·382	6·655	6·605	6·520	6·250	6·015	5·790	5·590	5·640	5·630	5·555	5·550
K. B. P. ...	1st September 1904 A.	17	6·110	6·267	6·290	6·265	6·100	5·925	5·772	5·655	5·570	5·412	5·440	5·455
K. B. P. ...	A.	18	6·435	6·405	6·422	6·295	6·175	6·205	6·080	5·905	5·755	5·620	5·640	5·650
K. B. P. ...	A.	19	5·987	6·105	6·160	6·090	5·920	5·827	5·782	5·742	5·780	5·730	5·667	5·605
K. B. P. ...	A.	20	6·475	6·610	6·675	6·610	6·435	6·347	6·275	6·170	6·040	5·932	5·920	5·970
K. B. K. ...	A.	21	6·840	6·910	6·720	6·592	6·367	6·247	6·180	6·027	5·945	5·680	5·737	5·745
K. B. P. ...	A.	22	6·337	6·180	6·037	6·037	5·920	5·810	5·847	5·735	5·637	5·622	5·567	5·615
1st September 1904, K. B.	A.	23	5·750	5·925	6·075	6·110	6·037	5·940	5·807	5·747	5·735	5·705	5·647	5·640
K. B. ...	A.	24	6·007	6·110	6·122	6·137	6·097	6·072	5·995	5·947	5·815	5·732	5·720	5·692
K. B. ...	2nd Septembar 1904 A.	25	6·257	6·330	6·302	6·190	6·007	5·915	5·880	5·915	5·912	5·845	5·810	5·762
K. B. ...	A.	26	6·750	6·925	6·920	6·730	6·487	6·320	6·132	5·945	5·877	5·782	5·745	5·752
K. B. ...	A.	27	6·340	6·405	6·372	6·390	6·400	6·400	6·187	6·140	6·040	5·990	5·985	5·960
K. B. ...	A.	28	6·762	6·870	6·795	6·545	6·310	6·132	5·970	5·992	6·000	5·930	5·865	5·880
5th September 1904, K. B.	15th September 1904 A.	29	6·757	6·965	6·950	6·735	6·465	6·225	5·950	5·847	5·847	5·847	5·755	5·617
K. B. ...	A.	30	6·340	6·190	5·925	5·635	5·560	5·580	5·687	5·700	5·865	5·875	5·515	5·030
7th September 1904 K. B.	A.	31	5·620	5·910	6.170	6·075	5·900	5·750	5·637	5·675	5·612	5·512	5·430	5·447
		Sum ...	198·878	202·276	202·441	199·357	193·184	188·345	183·932	180·445	178·508	176·949	175·155	174·303
		Mean .	6·415	6·525	6·530	6·431	6·232	6·076	5·933	5·821	5·758	5·708	5·650	5·623
		Variation.	+ ·487	+ ·597	+ ·602	+ ·503	+ ·304	+ ·148	+ ·005	− ·107	− ·170	− ·220	− ·278	− ·305
Scale co-efficient = ·00479 M. M. G. S.	Variation in M. M. G. S. unit.	M. ...	+00233	+00286	+00288	+00241	+00146	+00071	+00002	−00051	−00081	−00105	−00133	−00146

Hourly sums and meams taken by M. 7th September 1904.
Do. do. checked by A. 22nd September 1904.
Variations taken by K. 22nd September 1904.
Do. checked by A.

E.

Hourly Abstract of tabulation of H. F. Magnetograms.

Date.	22	23	0	1	2	3	4	5	6	7	8	9	Sum.	Mean.	
1	5.867	5.870	5.845	5.870	5.875	5.955	5.985	5.987	6.185	6.087	6.000	6.560	147.194	6.133	
2	5.652	5.690	5.630	5.640	5.620	5.620	5.632	5.642	5.687	5.850	6.027	6.177	142.919	5.955	
3	5.437	5.260	5.380	5.305	5.280	5.700	5.825	5.522	5.837	5.232	5.337	5.710	136.196	5.675	
4	4.700	4.820	5.390	5.147	5.000	5.120	5.347	5.230	5.260	5.205	5.425	5.660	125.608	5.234	
5	5.575	5.605	5.555	5.550	5.585	5.600	5.617	5.640	5.700	5.805	5.975	6.280	138.014	5.751	
6	5.692	5.780	5.750	5.690	5.775	5.735	5.737	5.747	5.825	5.932	6.170	6.520	143.404	5.975	
7	5.647	5.647	5.662	5.665	5.662	5.710	5.690	5.680	5.770	5.845	6.110	6.420	144.641	6.027	
8	5.675	5.705	5.727	5.715	5.745	5.697	5.770	5.762	5.830	5.945	6.170	6.435	144.091	6.004	
9	5.845	5.920	5.980	6.010	6.170	5.985	5.960	5.887	5.915	6.087	6.280	6.590	146.982	6.124	
10	5.890	5.815	5.855	5.775	5.840	5.790	5.730	5.790	5.885	5.940	6.047	6.190	146.282	6.095	
11	5.800	5.805	5.877	5.880	5.870	5.845	5.832	5.865	5.880	6.000	6.310	6.705	145.754	6.073	
12	5.880	5.990	5.967	5.925	5.975	5.960	5.957	5.975	6.012	6.065	6.225	6.520	147.742	6.156	
13	5.647	5.642	5.810	5.815	5.797	5.832	5.792	5.817	5.740	5.647	5.737	6.305	143.580	5.983	
14	5.737	5.747	5.775	5.800	5.807	5.807	5.882	5.915	5.947	6.000	6.167	6.415	143.835	5.993	
15	5.832	5.800	5.865	6.020	5.945	5.967	5.910	6.000	6.127	6.130	6.005	6.147	147.229	6.135	
16	5.600	5.647	5.625	5.645	5.650	5.595	5.620	5.710	5.655	5.685	5.795	6.027	140.436	5.852	
17	5.577	5.647	5.647	5.710	5.710	5.710	6.425	6.257	6.115	6.005	6.077	6.125	141.266	5.886	
18	5.627	5.600	5.690	5.730	5.660	5.700	5.632	5.600	5.705	5.625	5.630	5.800	140.586	5.858	
19	5.700	5.715	5.727	5.742	5.770	5.777	5.760	5.795	5.815	5.845	5.960	6.190	140.191	5.841	
20	5.937	6.025	6.070	6.160	6.080	6.020	6.032	6.050	6.012	5.887	6.057	6.440	148.229	6.176	
21	5.655	5.972	5.757	5.642	5.815	5.840	5.780	5.710	5.717	5.740	5.777	6.200	144.595	6.025	
22	5.700	5.815	5.680	5.925	5.725	5.625	5.670	5.680	5.555	5.435	5.472	5.625	138.251	5.760	
23	5.580	5.580	5.660	5.632	5.640	5.725	5.660	5.670	5.637	5.560	5.622	5.812	137.896	5.746	
24	5.670	5.652	5.712	5.747	5.800	5.775	5.742	5.740	5.710	5.710	5.840	6.080	140.624	5.859	
25	5.762	5.780	5.760	5.745	5.750	5.800	5.782	5.782	5.777	5.785	5.967	6.315	142.130	5.922	
26	5.737	5.740	5.740	5.782	5.855	5.830	5.832	5.842	5.862	5.957	6.067	6.205	145.814	6.076	
27	5.932	5.887	5.932	5.947	5.910	5.912	5.960	5.955	5.910	5.837	6.020	6.425	146.236	6.093	
28	5.882	5.915	5.940	5.917	5.920	5.940	5.980	5.977	6.035	6.207	6.127	6.460	147.351	6.140	
29	5.625	5.655	5.732	5.925	5.930	6.020	6.105	6.115	5.875	5.650	5.900	5.982	145.474	6.061	
30	4.790	4.842	5.035	5.140	5.295	5.392	5.470	5.497	5.497	5.345	5.477	5.435	132.117	5.505	
31	5.497	5.567	5.560	5.585	5.550	5.557	5.517	5.570	5.577	5.600	5.775	6.000	136.093	5.671	
	175.147	176.135	177.335	177.781	178.006	178.541	179.633	179.409	180.054	179.643	183.548	191.755	4410.760	183.784	
	5.650	5.682	5.720	5.735	5.742	5.759	5.795	5.787	5.808	5.795	5.921	6.186	142.282	5.928	+10
	−.278	−.246	−.208	−.193	−.186	−.169	−.133	−.141	−.120	−.133	−.007	+.258	+2.904 −2.894	5.798	
	−00133	−00118	−00100	−00092	−00089	−00081	−00064	−00068	−00057	−00064	−00003	+00124			

Daily sums and means taken by K. B.
Do. do. checked by M.

TABLES 19 & 20.—*Horizontal Force Magnetograph—showing the mean diurnal inequalities for each month of the years 1872 and 1873 and for the whole year.*

Unity = ·1γ = ·000001 C. G. S.

1872. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−157	−344	−190	**−257**	−216	−167	−172	−152	−203	−93	−136	−188	−190
1 19	−131	−315	−182	−232	−204	−134	−193	−173	−169	−68	−102	−166	−172
2 19	−122	−272	−178	−215	−212	−159	−172	−164	−152	−42	−115	−119	−160
3 19	−114	−176	−145	−203	−183	−163	**−202**	**−186**	−127	−13	−111	−128	−146
4 19	−96	−138	−136	−203	−187	−171	−189	−160	−135	+25	−94	−94	−131
5 19	−87	97	−107	−190	−175	−176	−160	−156	−135	−55	−85	−77	−125
6 19	−35	−55	−112	−161	−116	−117	−84	−135	−135	−64	−30	−47	−91
7 19	+35	+30	−45	−91	+12	−13	+42	−46	−127	−30	+60	+13	−13
8 19	+100	+201	+112	+124	+179	+125	+202	+67	+8	+110	+170	+94	+124
9 19	+197	+315	+293	+356	+357	+230	+370	+202	+216	+238	+285	+205	+272
10 19	+319	+459	+487	+567	+524	+414	**+466**	+405	+397	+416	+413	+354	+435
11 19	**+380**	**+492**	**+545**	**+596**	**+528**	**+443**	+441	**+451**	**+457**	**+441**	**+430**	**+375**	**+465**
12 19	+358	+452	+483	+501	+449	+405	+407	+417	+435	+348	+344	+333	+411
13 19	+258	+328	+351	+377	+328	+322	+294	+341	+364	+170	+221	+243	+300
14 19	+144	+179	+206	+199	+187	+184	+189	+211	+237	−4	+106	+145	+165
15 19	+57	+88	+66	+74	+50	+63	+59	+80	+110	−89	+9	+81	+54
16 19	−39	+34	−17	−33	−42	−54	−55	−25	+25	−110	−85	−9	−34
17 19	−74	+12	−116	−74	−96	−113	−139	−93	−34	−149	−123	−64	−89
18 19	−87	−41	−161	−108	−150	−138	−185	−110	−97	−161	−123	−68	−119
19 19	−122	−43	−202	−141	−166	−130	−185	−135	−169	−174	−174	−111	−146
20 19	−162	−85	−223	−194	−212	−150	−197	−160	−169	−191	**−225**	−158	−177
21 19	**−210**	−199	−223	−186	**−237**	−163	−181	−177	−182	**−208**	−225	**−192**	−199
22 19	−210	−390	−227	−228	−233	−180	−151	−152	**−203**	−149	−191	−183	−208
23 19	−175	**−435**	**−235**	−244	−233	**−192**	−164	−148	−203	−127	−170	−192	**−210**
Range ...	590	927	780	853	765	635	668	637	660	649	655	567	675
Average progressive change per day.	−52	−50	−48	−46	−55	−59	−51	−39	−36	−33	−27	−30	−44

1873. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−120	−137	−219	−219	−138	−121	−108	−122	−113	−115	−111	−103	−135
1 19	−103	−167	−206	−202	−134	−108	−117	−113	−109	−82	−95	−87	−127
2 19	−103	−171	−189	−189	−142	−113	−130	−117	−87	−70	−103	−83	−125
3 19	−81	−150	−185	−159	−121	−78	−126	−122	−78	−66	−91	−78	−111
4 19	−86	−158	−133	−163	−121	−39	−126	−113	−74	−53	−74	−66	−100
5 19	−77	−141	−129	−172	−112	−56	−121	−96	−61	−49	−49	−54	−93
6 19	−60	−116	−120	−159	−78	−9	−87	−74	−65	−33	−4	−25	−69
7 19	−13	−60	−47	−69	−22	+43	−4	−48	−61	+8	+70	+37	−14
8 19	+68	+81	+99	+52	+112	+104	+82	+87	+22	+119	+140	+99	+89
9 19	+154	+257	+270	+262	+246	+182	+208	+226	+170	+222	+210	+169	+215
10 19	+295	+420	+468	+525	+345	+281	+312	+335	+314	+304	+288	+239	+344
11 19	**+359**	**+488**	**+524**	**+538**	**+371**	**+290**	**+343**	**+365**	**+357**	**+333**	**+293**	**+243**	**+575**
12 19	+325	+441	+468	+443	+293	+290	+330	+352	+348	+271	+247	+219	+336
13 19	+218	+334	+326	+323	+216	+242	+282	+283	+274	+169	+148	+144	+247
14 19	+120	+193	+172	+194	+129	+143	+174	+178	+157	+82	+54	+74	+139
15 19	+34	+51	+52	+86	+52	+9	+48	+52	+48	−21	−4	+17	+35
16 19	−13	−64	−34	+26	−52	−56	−22	−43	−26	−74	−45	−12	−35
17 19	−81	−111	−47	−60	−95	−160	−117	−109	−96	−107	−111	−58	−96
18 19	−90	−133	−99	−99	−129	**−186**	−134	−130	−122	−115	−91	−62	−116
19 19	−120	−141	−146	−155	−121	−160	−143	−165	−144	−140	−128	−95	−138
20 19	**−192**	−167	−189	−185	−108	−130	−147	−161	−166	−156	**−136**	−103	−153
21 19	−175	**−214**	−227	−206	−129	−134	**−152**	**−174**	−174	**−164**	−136	−124	**−167**
22 19	−162	−210	−215	**−237**	**−142**	−130	−117	−152	**−179**	−148	−124	−140	−163
23 19	−128	−176	**−232**	−224	−134	−125	−104	−156	−135	−127	−119	**−144**	−150
Range ...	551	702	756	775	513	476	495	539	536	497	429	387	542
Average progressive change per day.	−25	−23	−27	−29	−36	−36	−29	−25	−22	−20	−18	−19	−26

TABLES 21 & 22.—*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1874 and 1875 and for the whole year.*

Unity = 0·1γ = ·000001 C. G. S.

1874.

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−116	−215	−149	−133	−137	−117	−125	−125	−109	−38	−105	−59	−119
1 19	−79	−166	−124	−129	−125	−133	−100	−104	−100	−67	−84	−84	−108
2 19	−112	−149	−133	−112	−108	−125	−108	−88	−79	−80	−71	−101	−105
3 19	−91	−108	−124	−120	−116	−121	−92	−71	−67	−46	−67	−88	−93
4 19	−74	−91	−112	−91	−104	−117	−83	−75	−59	−59	−67	−80	−84
5 19	−54	−87	−112	−79	−104	−100	−88	−71	−46	−59	−50	−63	−76
6 19	−25	−54	−83	−75	−66	−62	−58	−58	−75	−59	−34	−38	−57
7 19	+17	+4	−29	−4	+4	0	−13	−38	−92	−29	+29	+21	−11
8 19	+99	+120	+99	+120	+91	+79	+29	+42	−25	+59	+117	+88	+76
9 19	+190	+244	+265	+286	+216	+191	+129	+171	+130	+155	+193	+172	+195
10 19	+277	+344	+406	+403	+336	+296	+275	+276	+259	+239	**+290**	+231	+303
11 19	**+314**	**+373**	**+435**	**+415**	**+353**	**+333**	+342	**+326**	**+318**	**+289**	+281	**+248**	**+336**
12 19	+256	+315	+356	+357	+307	+312	**+346**	+322	+289	+239	+210	+210	+293
13 19	+161	+224	+228	+232	+233	+233	+284	+246	+197	+130	+122	+155	+204
14 19	+87	+112	+87	+124	+133	+154	+175	+150	+109	+34	+76	+84	+110
15 19	+25	+29	−33	+37	+29	+42	+58	+33	+29	−25	0	+21	+20
16 19	−37	−21	−70	−46	−37	−33	−42	−50	−21	−54	−29	−46	−40
17 19	−79	−54	−87	−108	−75	−79	−96	−84	−50	−71	−88	−97	−81
18 19	−95	−46	−99	−174	−116	−121	−121	−100	−54	−88	−105	−97	−101
19 19	−103	−70	−120	**−203**	−141	**−133**	−133	−125	−75	−92	**−147**	−84	−119
20 19	−124	−137	−124	−174	−154	−125	**−154**	−150	−121	−109	−126	−92	−132
21 19	**−145**	−186	**−166**	−178	**−158**	−125	−138	−146	**−142**	**−126**	−126	−113	**−145**
22 19	−136	−207	−162	−191	−141	−117	−117	**−159**	−126	−109	−126	**−122**	−143
23 19	−116	**−219**	−145	−158	−150	−108	−117	−134	−113	−71	−122	−109	−130
Range ...	459	592	601	618	511	466	500	485	460	415	437	370	481
Average progressive change per day.	−17	−13	−14	−15	−17	−22	−20	−18	−19	−16	−12	−12	−16

1875.

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	**−105**	−105	−131	**−160**	**−127**	−106	−102	−98	−64	−72	−81	**−90**	−103
1 19	−84	−84	−122	−152	−106	−93	−98	−93	−38	−72	−85	−73	−92
2 19	−97	−76	−110	−127	−106	−93	−93	−93	−43	−72	−77	−81	−89
3 19	−71	−72	−89	−114	−93	−97	−85	−89	−17	−72	−73	−73	−79
4 19	−63	−67	−72	−105	−89	−97	−76	−85	−21	−68	−64	−68	−73
5 19	−42	−59	−59	−89	−76	−89	−59	−85	−9	−55	−47	−51	−60
6 19	−17	−51	−51	−80	−51	−47	−25	−64	−30	−43	−26	−21	−42
7 19	+17	−34	−4	−46	−8	+17	+17	−38	−47	−4	+38	+26	−5
8 19	+84	+46	+122	+84	+89	+93	+76	+42	−4	+89	+119	+102	+78
9 19	+135	+160	+266	+262	+186	+199	+136	+149	+119	+196	+200	+137	+179
10 19	+193	+265	+358	+397	+292	**+305**	+229	+234	+204	+251	**+269**	+196	+266
11 19	**+227**	**+337**	**+392**	**+418**	**+304**	+305	**+263**	**+272**	**+217**	**+277**	+264	**+201**	**+290**
12 19	+189	+303	+333	+333	+266	+271	+254	+255	+208	+226	+196	+167	+250
13 19	+139	+227	+207	+236	+190	+207	+204	+200	+149	+132	+102	+111	+175
14 19	+80	+114	+84	+114	+101	+123	+127	+119	+68	+43	+34	+47	+88
15 19	+17	+29	−17	+21	+25	+17	+21	+42	−4	−34	−21	−4	+8
16 19	−29	−55	−93	−46	−38	−68	−42	−25	−55	−81	−73	−38	−54
17 19	−63	−109	−122	−110	−93	−106	−85	−59	−81	−94	−85	−64	−89
18 19	−67	**−147**	−114	−127	−101	**−131**	−106	−89	−94	−89	−90	−56	−101
19 19	−88	−135	−135	−139	−114	−123	−115	−98	−94	−94	−94	−51	−107
20 19	−92	−147	−148	−143	−114	−118	−119	−102	−102	**−98**	−107	−85	−115
21 19	−97	−143	**−156**	−160	−123	−114	**−123**	−98	**−115**	−89	−102	−85	**−117**
22 19	−92	−143	−148	−148	−123	−114	−123	−81	−94	−98	**−111**	−85	−113
23 19	−101	−109	−148	−152	−118	−106	−110	**−106**	−72	−68	−85	−81	−105
Range ...	332	484	548	578	431	436	386	378	332	375	380	291	407
Average progressive change per day.	−13	−15	−13	−14	−19	−21	−19	−19	−17	−14	−13	−12	−16

TABLES 23 & 24.—*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1876 and 1877 and for the whole year.*

Unity = 0·1γ = ·000001 C. G. S.

1876. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−111	−98	−133	−111	−103	−77	−90	−73	−65	−69	−86	−87	−92
1 19	−94	−94	−137	−120	−90	−73	−99	−78	−56	−52	−73	−56	−85
2 19	−81	−77	−120	−116	−99	−73	−99	−78	−35	−52	−69	−52	−79
3 19	−77	−64	−103	−107	−90	−77	−95	−60	−47	−60	−65	−61	−75
4 19	−64	−64	−98	−103	−86	−69	−99	−73	−47	−52	−52	−56	−72
5 19	−56	−51	−86	−99	−77	−77	−95	−78	−43	−43	−43	−43	−66
6 19	−26	−39	−81	−90	−56	−39	−60	−73	−52	−35	−13	−17	−48
7 19	+13	0	−39	−51	+9	+17	+9	−26	−65	−13	+43	+35	−6
8 19	+64	+77	+81	+56	+120	+73	+86	+47	−26	+48	+121	+91	+70
9 19	+137	+175	+214	+206	+215	+142	+189	+146	+91	+121	+199	+151	+165
10 19	+231	+261	+334	+317	**+292**	+232	+267	+220	+181	+220	**+272**	+212	+253
11 19	**+269**	**+282**	**+364**	**+339**	+292	**+249**	**+305**	**+246**	**+207**	**+272**	+268	**+216**	**+276**
12 19	+227	+244	+317	+291	+240	+241	+267	+237	+190	+238	+225	+177	+241
13 19	+150	+128	+210	+214	+172	+189	+206	+198	+142	+134	+134	+108	+165
14 19	+90	+56	+111	+124	+82	+120	+125	+121	+86	+52	+52	+48	+89
15 19	+30	−9	+17	+56	0	+30	+30	+30	+17	−13	−30	−4	+13
16 19	−13	−73	−34	−9	−60	−34	−47	−30	−22	−39	−91	−39	−41
17 19	−56	−77	−69	−60	−90	−90	−86	−69	−43	−60	−108	−87	−75
18 19	−73	−81	−103	−94	**−116**	**−120**	−112	−103	−60	−73	−112	−95	−95
19 19	−85	−90	−124	−120	−116	−107	**−125**	**−108**	−65	−99	−112	−95	−104
20 19	−107	−98	−133	**−141**	−116	−112	−125	−108	**−82**	−112	**−117**	**−100**	−113
21 19	**−137**	−107	**−154**	−141	−112	−112	−112	−103	−78	**−117**	−117	−100	**−116**
22 19	−124	**−111**	−154	−124	−116	−103	−103	−99	−69	−104	−104	−87	−108
23 19	−120	−107	−128	−111	−107	−95	−103	−78	−69	−78	−86	−78	−97
Range ...	406	393	518	480	408	369	430	354	289	389	389	316	392
Average progressive change per day.	−12	−12	−10	−12	−15	−16	−16	−15	−15	−13	−12	−12	−13

1877. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−91	−89	−94	−86	−82	−70	−86	−82	−66	−91	−91	−79	−84
1 19	−87	−68	−69	−82	−78	−66	−99	−86	−70	−87	−70	−70	−78
2 19	−91	−75	−61	−74	−78	−53	−94	−78	−62	−74	−62	−66	−72
3 19	−74	−59	−61	−74	−57	−45	−82	−82	−54	−66	−45	−50	−62
4 19	−52	−51	−57	−78	−49	−57	−78	−78	−49	−70	−50	−41	−59
5 19	−48	−45	−53	−90	−66	−57	−74	−66	−41	−58	−21	−37	−55
6 19	−26	−40	−61	−86	−66	−21	−53	−49	−62	−58	−8	−12	−45
7 19	+13	−7	−25	−41	−20	+53	−8	−29	−66	−21	+41	+21	−7
8 19	+78	+44	+53	+49	+61	+123	+66	+53	0	+66	+111	+74	+65
9 19	+152	+127	+159	+184	+156	+185	+140	+140	+111	+177	+161	+132	+152
10 19	+221	+204	+278	+303	+242	+234	+238	+202	+202	+256	**+211**	+194	+232
11 19	**+251**	**+242**	**+327**	**+340**	**+287**	**+242**	**+279**	**+247**	**+235**	**+301**	+211	**+207**	**+264**
12 19	+212	+225	+266	+274	+246	+209	+267	+239	+210	+264	+157	+169	+228
13 19	+117	+156	+180	+160	+184	+156	+201	+189	+157	+153	+74	+91	+151
14 19	+39	+89	+74	+78	+98	+70	+99	+111	+95	+54	+17	+41	+72
15 19	−9	+29	−20	+8	+12	−8	+8	+29	+33	−12	−29	+12	+4
16 19	−30	−31	−61	−29	−41	−70	−66	−45	−25	−49	−66	−17	−44
17 19	−52	−61	−74	−53	−86	−98	−99	−82	−49	−87	−87	−45	−73
18 19	−69	−74	−78	−90	**−123**	**−135**	**−103**	−103	−66	−111	−87	−62	−92
19 19	−69	−103	−90	−123	−107	−123	−94	−95	−82	−103	−95	−87	−98
20 19	−74	−106	−119	**−131**	−119	−119	−90	−95	−82	−103	−62	**−99**	−100
21 19	−87	**−112**	**−123**	−127	−98	−115	−82	**−107**	**−95**	−115	−74	−95	**−102**
22 19	**−104**	−102	−123	−131	−111	−103	−86	−99	−82	**−120**	−83	−70	−101
23 19	−95	−93	−110	−98	−102	−82	−94	−74	−82	−99	**−99**	−87	−93
Range ...	355	354	450	471	410	377	382	354	330	421	310	306	366
Average progressive change per day.	−12	−12	−12	−13	−15	−13	−14	−14	−14	−14	−11	−9	−13

TABLES 25 & 26 —*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1878 and 1879 and for the whole year.*

Unity = 0·1γ = ·000001 C. G. S.

1878. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 74	− 87	− 112	− 120	− **108**	− 100	− 79	− 79	− 71	− 79	− 83	− 67	− 88
1 19	− 66	− 75	− 108	− 129	− 100	− 79	− 79	− 79	− 62	− 75	− 75	− 75	− 83
2 19	− 62	− 79	− 99	− 120	− 87	− 87	− 75	− 75	− 42	− 75	− 83	− 67	− 78
3 19	− 54	− 70	− 99	− 91	− 87	− 87	− 75	− 75	− 33	− 67	− 70	− 54	− 72
4 19	− 41	− 66	− 83	− 83	− 83	− 96	− 71	− 71	− 29	− 63	− 63	− 38	− 66
5 19	− 17	− 58	− 83	− 91	− 66	− 83	− 75	− 71	− 25	− 63	− 58	− 33	− 60
6 19	0	− 46	− 70	− 70	− 50	− 46	− 67	− 62	− 46	− 58	− 29	− 21	− 47
7 19	+ 21	0	− 12	− 12	+ 17	+ 25	− 29	− 50	− 50	− 8	+ 42	+ 17	− 3
8 19	+ 58	+ 66	+ 104	+ 100	+ 91	+ 112	+ 29	0	+ 8	+ 83	+ 129	+ 63	+ 70
9 19	+ 108	+ 153	+ 228	+ 232	+ 170	+ 195	+ 125	+ 92	+ 100	+ 183	+ 209	+ 129	+ 160
10 19	+ 153	+ 186	+ 294	+ **315**	+ 241	+ 266	+ 208	+ 179	+ 187	+ 225	+ 267	+ 184	+ 225
11 19	+ **157**	+ **228**	+ **331**	+ 315	+ **278**	+ **283**	+ **249**	+ 229	+ **229**	+ **254**	+ **280**	+ **205**	+ **253**
12 19	+ 116	+ 211	+ 282	+ 269	+ 237	+ 249	+ 241	+ **254**	+ 221	+ 200	+ 213	+ 171	+ 222
13 19	+ 74	+ 157	+ 182	+ 195	+ 166	+ 175	+ 204	+ 216	+ 162	+ 129	+ 104	+ 104	+ 156
14 19	+ 37	+ 87	+ 79	+ 95	+ 79	+ 83	+ 121	+ 146	+ 75	+ 46	+ 25	+ 46	+ 77
15 19	+ 21	+ 33	− 4	+ 21	+ 8	+ 4	+ 25	+ 71	− 4	0	− 21	+ 4	+ 13
16 19	0	− 12	− 41	− 46	− 46	− 71	− 46	− 4	− 50	− 25	− 50	− 29	− 35
17 19	− 29	− 41	− 58	− 70	− 71	− 100	− 79	− 50	− 67	− 42	− 79	− 67	− 63
18 19	− 41	− 70	− 91	− 100	− 87	− 100	− 95	− 67	− 79	− 71	− 100	− 75	− 81
19 19	− 50	− 83	− 108	− 120	− 100	− 100	− **100**	− 87	− 71	− 92	− 121	− 88	− 93
20 19	− 62	− 95	− 116	− 133	− 100	− **120**	− 87	− 104	− 71	− **104**	− 125	− **100**	− 101
21 19	− 70	− **108**	− 120	− **149**	− 100	− 100	− 87	− **112**	− **87**	− 104	− **134**	− 79	− **104**
22 19	− 79	− 99	− 124	− 137	− 100	− 108	− 83	− 104	− 83	− 96	− 117	− 79	− 101
23 19	− **83**	− 99	− **128**	− 116	− 91	− 96	− 79	− 92	− 79	− 96	− 92	− 79	− 94
Range ...	240	336	459	464	386	403	349	366	316	358	414	305	357
Average progressive change per day.	− 9	− 8	− 9	− 11	− 13	− 9	− 8	− 11	− 11	− 10	− 10	− 8	− 10

1879. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 75	− 105	− 121	− 100	− 88	− 80	− 101	− 80	− 84	− 71	− 88	− 109	− 92
1 19	− 58	− 100	− 105	− 105	− 88	− 80	− 92	− 84	− 80	− 84	− 76	− 97	− 87
2 19	− 63	− 88	− 105	− 96	− 96	− 75	− 92	− 80	− 71	− 84	− 72	− 101	− 85
3 19	− 54	− 75	− 100	− 96	− 84	− 84	− 88	− 76	− 55	− 76	− 67	− 84	− 78
4 19	− 38	− 67	− 88	− 92	− 75	− 88	− 84	− 67	− 46	− 67	− 59	− 72	− 70
5 19	− 25	− 50	− 88	− 92	− 71	− 80	− 80	− 59	− 46	− 67	− 50	− 46	− 63
6 19	− 13	− 33	− 75	− 84	− 50	− 38	− 50	− 50	− 50	− 63	− 29	− 21	− 46
7 19	− 8	+ 21	− 33	− 33	− 4	+ 25	+ 13	− 21	− 59	− 17	+ 38	+ 55	− 2
8 19	+ 29	+ 100	+ 71	+ 71	+ 101	+ 96	+ 84	+ 50	− 4	+ 63	+ 135	+ 130	+ 77
9 19	+ 63	+ 180	+ 201	+ 218	+ 193	+ 189	+ 164	+ 151	+ 122	+ 168	+ 206	+ 194	+ 171
10 19	+ 113	+ 222	+ 297	+ 314	+ 268	+ 268	+ 235	+ 227	+ 227	+ 252	+ 257	+ **248**	+ 244
11 19	+ **167**	+ **242**	+ **343**	+ **327**	+ **289**	+ **272**	+ **268**	+ **243**	+ **261**	+ **290**	+ **261**	+ 244	+ **267**
12 19	+ 167	+ 230	+ 297	+ 280	+ 239	+ 247	+ 256	+ 222	+ 244	+ 244	+ 194	+ 185	+ 234
13 19	+ 109	+ 151	+ 205	+ 193	+ 189	+ 189	+ 197	+ 168	+ 189	+ 143	+ 93	+ 118	+ 162
14 19	+ 54	+ 63	+ 100	+ 92	+ 96	+ 80	+ 126	+ 88	+ 88	+ 55	+ 21	+ 46	+ 76
15 19	+ 21	0	+ 38	+ 21	+ 13	+ 13	+ 34	− 4	+ 17	− 4	− 25	+ 8	+ 11
16 19	− 4	− 46	− 38	− 33	− 54	− 59	− 34	− 59	− 29	− 42	− 55	− 25	− 40
17 19	− 21	− 59	− 79	− 63	− 92	− 96	− 80	− 63	− 50	− 59	− 63	− 38	− 64
18 19	− 29	− 75	− 100	− 96	− 117	− **122**	− 109	− 76	− 76	− 84	− 80	− 59	− 85
19 19	− 42	− 79	− 105	− 121	− 121	− 117	− **113**	− 84	− 84	− 92	− 97	− 76	− 94
20 19	− 46	− 88	− 130	− **126**	− **126**	− 117	− 109	− 88	− 97	− 105	− 105	− 105	− 103
21 19	− 71	− 100	− **138**	− 126	− 126	− 109	− 109	− **92**	− 101	− **118**	− 109	− **122**	− **110**
22 19	− **88**	− **113**	− 130	− 121	− 109	− 101	− 113	− 92	− **109**	− 109	− **114**	− 122	− 110
23 19	− 79	− 109	− 138	− 105	− 101	− 84	− 96	− 80	− 84	− 97	− 93	− 101	− 97
Range ...	255	355	481	453	415	394	381	335	370	408	375	370	377
Average progressive change per day.	− 6	− 8	− 8	− 7	− 8	− 7	− 7	− 9	− 9	− 6	− 7	− 7	− 7

TABLES 27 & 28.—*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1880 and 1881 and for the whole year.*

Unity = ·1 γ = ·000001 C. G. S.

1880. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−105	−110	−127	−127	−93	−97	−107	−107	−85	−118	−102	−93	−106
1 19	−88	−101	−110	−131	−94	−100	−101	−85	−75	−108	−93	−91	−98
2 19	−88	−101	−105	−105	−68	−106	−98	−74	−70	−99	−70	−65	−87
3 19	−84	−93	−80	−97	−70	−95	−95	−62	−53	−71	−64	−59	−77
4 19	−72	−84	−76	−93	−76	−90	−83	−33	−49	−48	−54	−46	−67
5 19	−59	−80	−67	−93	−69	−80	−71	−27	−44	−57	−36	−19	−58
6 19	−34	−55	−55	−63	−49	−39	−40	−36	−57	−63	+2	+8	−40
7 19	+13	−13	+8	−30	+3	+18	+12	−30	−46	−14	+79	+65	+5
8 19	+72	+59	+127	+89	+100	+111	+70	+43	+33	+93	+155	+128	+90
9 19	+135	+177	+266	+232	+201	+208	+149	+150	+178	+226	+230	+159	+193
10 19	+215	+244	**+342**	+342	+272	+294	+231	+236	+288	+336	**+272**	+217	+274
11 19	**+265**	**+274**	+329	**+363**	**+290**	**+313**	**+260**	**+291**	**+322**	**+382**	+268	**+228**	**+299**
12 19	+249	+257	+266	+308	+253	+279	+260	+283	+276	+332	+197	+190	+262
13 19	+173	+177	+148	+224	+173	+210	+210	+219	+184	+195	+103	+116	+178
14 19	+84	+84	+46	+127	+77	+99	+137	+128	+98	+87	+44	+59	+89
15 19	+17	+25	−4	+25	+1	−5	+43	+47	+4	−18	−23	+11	+10
16 19	−38	−17	−67	−51	−47	−77	−32	−27	−54	−68	−89	−22	−49
17 19	−55	−42	−80	−101	−90	−104	−90	−63	−99	−104	−108	−74	−84
18 19	−72	−55	−93	−118	−108	−123	**−122**	−146	−109	−128	−95	−96	−105
19 19	−93	−76	−114	−122	−109	−126	−109	−146	−123	−143	−96	−109	−114
20 19	−114	−93	−135	**−139**	−130	**−131**	−109	−142	−139	**−174**	−119	−134	−130
21 19	−118	−101	**−139**	−135	**−134**	−131	−104	**−160**	**−142**	−164	−139	−134	**−133**
22 19	**−126**	**−118**	−139	−131	−121	−120	−107	−136	−135	−146	**−144**	**−137**	−130
23 19	−114	−118	−131	−135	−112	−110	−104	−125	−103	−130	−120	−105	−117
Range ...	391	392	481	502	424	444	382	451	464	556	416	365	432
Average progressive change per day.	−7	−9	−8	−7	−6	−4	−11	−9	−4	−6	−5	−4	−7

1881. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−122	−127	−152	−113	−132	−141	−158	−129	−118	−128	−92	−107	−127
1 19	−114	−113	−140	−124	−133	−143	−153	−129	−109	−107	−85	−87	−120
2 19	−108	−102	−120	−127	−126	−147	−142	−125	−86	−103	−85	−76	−112
3 19	−87	−86	−121	−119	−121	−144	−131	−119	−82	−91	−78	−80	−105
4 19	−71	−72	−116	−127	−121	−135	−128	−105	−87	−72	−63	−76	−98
5 19	−56	−62	−108	−120	−109	−108	−117	−94	−97	−63	−63	−45	−87
6 19	−22	−40	−84	−112	−70	−57	−80	−85	−100	−75	−32	−10	−64
7 19	+11	+13	−39	−51	+20	+29	−7	−53	−101	−18	+54	+58	−7
8 19	+63	+118	+96	+79	+138	+119	+125	+47	+12	+69	+130	+135	+94
9 19	+130	+225	+259	+267	+257	+249	+257	+182	+189	+213	+246	+214	+224
10 19	+245	+283	+395	+348	+342	+357	+362	+301	+329	+316	**+333**	+271	+323
11 19	**+284**	**+329**	**+420**	**+372**	**+356**	**+393**	**+398**	**+363**	**+336**	**+373**	+323	**+282**	**+352**
12 19	+250	+295	+358	+337	+315	+360	+364	+347	+286	+312	+247	+211	+307
13 19	+183	+204	+212	+242	+229	+292	+315	+286	+201	+201	+127	+124	+218
14 19	+89	+81	+107	+123	+130	+160	+209	+163	+114	+89	+37	+58	+113
15 19	+48	−3	−3	+19	+39	+32	+73	+40	+23	−15	−28	−12	+18
16 19	+7	−59	−56	−50	−68	−67	−60	−47	−5	−58	−96	−53	−51
17 19	−35	−80	−63	−82	−111	−121	−142	−76	−3	−70	−113	−71	−81
18 19	−71	−108	−84	−102	−130	−151	**−171**	−96	−46	−75	−110	−96	−103
19 19	−82	−118	−115	−114	−141	−156	−168	−131	−118	−101	−129	−110	−124
20 19	−105	−128	−156	−137	−139	**−169**	−163	**−140**	−121	−149	**−139**	−139	−140
21 19	−134	−141	−164	**−149**	**−143**	−161	−160	−137	−132	**−170**	−130	**−142**	**−147**
22 19	**−153**	**−170**	**−175**	−141	140	−150	−168	−135	−140	−137	−127	−117	−146
23 19	−153	−145	−149	−124	−136	−143	−154	−132	**−144**	−144	−127	−126	−140
Range ...	437	499	595	521	499	562	569	503	480	543	472	424	499
Average progressive change per day.	−7	−5	−2	−5	−5	−6	−5	−8	−8	−5	−6	−3	−5

TABLES 29 & 30.—*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1882 and 1883 and for the whole year.*

Unity = ·1 γ = ·000001 C. G. S.

1882. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	Novemb r.	December.	Year.
0 19	− 96	− 114	− 169	− 113	− 136	− 160	− 146	− 136	− 111	− 98	− 108	− 100	− 124
1 19	− 86	− 108	− 146	− 87	− 115	**− 164**	− 139	− 117	− 101	− 88	− 104	− 68	− 110
2 19	− 85	− 90	− 140	− 74	− 119	− 145	− 131	− 100	− 100	− 80	− 59	− 58	− 98
3 19	− 63	− 87	− 115	− 62	− 124	− 139	− 132	− 87	− 87	− 63	− 38	− 67	− 89
4 19	− 54	− 77	− 125	− 42	− 118	− 130	− 122	− 48	− 80	− 60	− 29	− 49	− 78
5 19	− 47	− 62	− 123	− 38	− 109	− 107	− 95	− 55	− 72	− 52	− 42	− 38	− 70
6 19	− 42	− 49	− 105	− 35	− 99	− 62	− 71	− 61	− 89	− 61	+ 37	− 39	− 56
7 19	− 3	− 3	− 35	+ 32	− 34	+ 24	− 35	− 45	− 61	+ 10	+ 87	+ 27	− 3
8 19	+ 54	+ 88	+ 102	+ 183	+ 81	+ 139	+ 38	+ 16	+ 28	+ 132	+ 166	+ 116	+ 95
9 19	+ 129	+ 188	+ 276	+ 271	+ 225	+ 266	+ 142	+ 149	+ 183	+ 251	+ 253	+ 170	+ 209
10 19	+ 200	+ 250	+ 398	**+ 408**	+ 348	+ 329	+ 280	+ 227	+ 273	+ 338	**+ 344**	+ 241	+ 303
11 19	**+ 220**	**+ 317**	**+ 460**	+ 353	**+ 408**	**+ 335**	+ 338	+ 295	**+ 308**	**+ 353**	+ 343	**+ 277**	**+ 334**
12 19	+ 194	+ 273	+ 423	+ 307	+ 368	+ 287	**+ 381**	**+ 315**	+ 289	+ 291	+ 262	+ 228	+ 301
13 19	+ 146	+ 170	+ 282	+ 201	+ 275	+ 223	+ 254	+ 244	+ 239	+ 183	+ 179	+ 136	+ 211
14 19	+ 60	+ 83	+ 139	+ 61	+ 144	+ 116	+ 169	+ 163	+ 126	+ 77	+ 63	+ 43	+ 104
15 19	+ 26	+ 2	+ 12	− 40	+ 6	+ 46	+ 77	+ 75	+ 38	− 12	− 25	− 16	+ 16
16 19	− 28	− 58	− 50	− 140	− 59	− 36	0	− 21	− 34	− 80	− 175	− 69	− 62
17 19	− 49	− 69	− 86	− 142	− 100	− 54	− 53	− 54	− 59	− 103	− 190	− 86	− 87
18 19	− 57	− 79	− 114	− 184	− 126	− 107	− 92	− 96	− 85	− 116	**− 227**	− 100	− 115
19 19	− 69	− 89	− 159	− 203	− 135	− 118	− 108	− 118	− 96	− 163	− 205	− 94	− 130
20 19	− 77	− 89	− 176	**− 212**	− 145	− 127	− 134	− 138	− 124	**− 195**	− 131	− 114	− 138
21 19	− 91	− 127	− 170	− 152	− 145	− 125	− 136	− 127	− 130	− 165	− 119	− 114	− 133
22 19	− 75	− 120	**− 192**	− 156	**− 148**	− 139	− 135	**− 149**	− 125	− 168	− 154	**− 123**	**− 140**
23 19	**− 109**	**− 144**	− 186	− 131	− 140	− 157	**− 151**	− 133	**− 131**	− 130	− 129	− 102	− 137
Range ...	329	461	652	620	556	499	532	464	439	548	571	400	474
Average progressive change per day.	− 4	− 4	− 9	− 10	− 3	− 3	− 3	− 3	− 6	− 12	− 4	+ 2	− 5

1883. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 93	− 149	− 132	− 137	− 91	− 121	− 155	− 128	− 121	− 155	− 126	− 104	− 126
1 19	− 88	− 136	− 109	− 156	− 97	− 109	− 159	− 126	− 99	− 141	− 126	− 86	− 119
2 19	− 81	− 109	− 92	− 142	− 94	− 113	− 140	− 98	− 83	− 143	− 111	− 85	− 108
3 19	− 88	− 125	− 89	− 127	− 107	− 113	− 123	− 89	− 80	− 111	− 116	− 69	− 103
4 19	− 83	− 111	− 80	− 126	− 97	− 113	− 112	− 98	− 81	− 115	− 83	− 83	− 98
5 19	− 70	− 95	− 68	− 117	− 84	− 88	− 90	− 105	− 62	− 119	− 74	− 59	− 86
6 19	− 41	− 67	− 58	− 109	− 47	− 51	− 55	− 103	− 74	− 122	− 54	− 35	− 68
7 19	+ 4	− 10	+ 8	− 28	+ 8	+ 56	− 15	− 54	− 60	− 54	+ 72	+ 1	− 6
8 19	+ 69	+ 81	+ 136	+ 120	+ 106	+ 145	+ 82	+ 16	+ 31	+ 75	+ 196	+ 75	+ 94
9 19	+ 135	+ 193	+ 257	+ 287	+ 198	+ 260	+ 195	+ 158	+ 178	+ 237	+ 292	+ 153	+ 212
10 19	+ 203	+ 303	+ 347	+ 397	+ 305	**+ 353**	+ 334	+ 251	+ 275	+ 362	+ 410	+ 247	+ 316
11 19	**+ 263**	**+ 348**	**+ 389**	**+ 424**	**+ 323**	+ 351	**+ 383**	+ 323	**+ 314**	**+ 439**	**+ 433**	**+ 289**	**+ 357**
12 19	+ 250	+ 324	+ 323	+ 366	+ 270	+ 322	+ 345	**+ 351**	+ 299	+ 389	+ 351	+ 235	+ 319
13 19	+ 174	+ 232	+ 231	+ 263	+ 200	+ 251	+ 304	+ 306	+ 255	+ 266	+ 197	+ 154	+ 236
14 19	+ 95	+ 132	+ 112	+ 162	+ 112	+ 134	+ 181	+ 175	+ 137	+ 115	+ 58	+ 74	+ 124
15 19	+ 24	+ 25	− 3	+ 66	+ 16	+ 6	+ 72	+ 51	+ 32	+ 33	− 40	+ 16	+ 25
16 19	− 31	− 21	− 103	− 23	− 77	− 90	− 57	− 32	− 53	− 49	− 95	− 41	− 56
17 19	− 56	− 57	− 115	− 122	− 107	− 139	− 120	− 76	− 92	− 62	− 144	− 68	− 96
18 19	− 67	− 83	− 166	− 150	− 121	**− 166**	− 153	− 93	− 105	− 82	− 169	− 75	− 119
19 19	− 83	− 107	**− 176**	− 174	− 127	− 161	− 154	− 103	− 125	− 112	**− 199**	− 101	− 135
20 19	− 101	− 132	− 160	− 176	**− 131**	− 163	− 122	− 120	− 123	− 150	− 187	− 105	− 139
21 19	− 103	− 140	− 174	**− 192**	− 121	− 160	− 137	**− 137**	− 118	− 156	− 187	**− 116**	**− 145**
22 19	**− 119**	**− 165**	− 157	− 168	− 121	− 147	− 146	− 137	− 117	**− 178**	− 154	− 113	− 143
23 19	− 112	− 129	− 119	− 139	− 119	− 146	**− 160**	− 132	**− 127**	− 166	− 142	− 102	− 133
Range ...	382	513	565	616	454	519	543	488	441	617	632	405	502
Average progressive change per day.	− 2	− 4	− 4	− 4	− 5	− 5	− 4	− 5	− 5	− 3	− 2	0	− 4

TABLES 31 & 32.—*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1884 and 1885 and for the whole year.*

Unity = ·1γ = ·000001 C. G. S.

1884. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−101	−137	−164	−166	−152	−148	−97	−111	−103	−117	−101	−97	−124
1 19	−105	−149	−179	−174	−152	−144	−82	−107	−83	−95	−95	−77	−120
2 19	−108	−133	−173	−167	−138	−135	−79	−103	−92	−81	−87	−49	−112
3 19	−106	−118	−157	−154	−145	−121	−74	−90	−88	−51	−69	−57	−102
4 19	−76	−127	−138	−129	−150	−109	−78	−97	−73	−45	−66	−37	−94
5 19	−67	−98	−138	−132	−141	−92	−79	−96	−60	−53	−55	−14	−85
6 19	−54	−82	−121	−147	−105	−49	−62	−95	−79	−54	−21	+6	−72
7 19	−4	−20	−51	−99	−2	+50	+2	−77	−79	−12	+77	+50	−14
8 19	+73	+83	+118	+80	+142	+164	+84	+30	−6	+69	+146	+97	+90
9 19	+166	+198	+321	+308	+281	+286	+194	+149	+139	+210	+240	+139	+219
10 19	+273	+309	+455	+441	+400	+372	+288	+269	+233	+328	+340	+240	+329
11 19	**+317**	**+372**	**+514**	**+517**	**+427**	**+394**	**+304**	+311	**+298**	**+378**	**+354**	**+254**	**+370**
12 19	+275	+361	+455	+435	+382	+359	+288	**+321**	+292	+318	+284	+199	+331
13 19	+185	+243	+311	+313	+284	+264	+225	+270	+222	+193	+148	+102	+230
14 19	+83	+105	+141	+170	+144	+120	+133	+172	+122	+63	+50	+1	+109
15 19	+1	+13	+15	+67	+33	+13	+30	+67	+45	−14	−28	−55	+16
16 19	−57	−72	−90	−39	−43	−79	−52	−46	−8	−71	−90	−86	−61
17 19	−76	−58	−87	−112	−95	−128	−90	−75	−44	−94	−124	−80	−89
18 19	−84	−62	−101	−115	−132	−151	−132	−104	−67	−117	−133	−74	−106
19 19	−87	−67	−148	−178	−172	−171	−153	−117	−100	−124	−148	−77	−128
20 19	−101	−115	−185	**−183**	**−178**	**−183**	**−159**	**−127**	−115	−152	**−173**	−93	−147
21 19	−113	−131	−196	−182	−164	−181	−147	−123	**−124**	−159	−149	−99	−147
22 19	**−122**	**−157**	**−209**	−180	−166	−172	−141	−116	−121	**−181**	−168	**−101**	**−153**
23 19	−112	−157	−195	−173	−155	−157	−124	−104	−107	−139	−132	−92	−137
Range ...	439	529	723	699	605	577	463	448	422	559	527	355	523
Average progressive change per day.	−1	−4	−5	−4	−5	−6	−3	−2	−5	−4	−2	−2	−4

1885. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−104	−122	−157	−166	−129	−129	−146	−88	−80	−123	−113	−90	−121
1 19	−103	−142	−146	−154	−137	−138	−143	−74	−81	−95	−113	−71	−116
2 19	−94	−137	−110	−147	−117	−119	−123	−62	−72	−83	−98	−79	−103
3 19	−74	−122	−101	−138	−104	−117	−131	−60	−40	−63	−75	−66	−91
4 19	−48	−100	−96	−121	−87	−108	−113	−51	−27	−49	−62	−52	−76
5 19	−35	−86	−92	−101	−75	−89	−109	−43	−6	−33	−43	−37	−62
6 19	−3	−72	−95	−60	−47	−59	−71	−32	−24	−19	−2	−13	−41
7 19	+49	−47	−44	+9	+24	+31	+15	+7	−53	+7	+61	+33	+8
8 19	+109	+48	+89	+158	+141	+144	+105	+102	−1	+94	+150	+77	+101
9 19	+169	+180	+250	+342	+250	+287	+214	+224	+116	+201	+232	+125	+216
10 19	+242	+296	+364	**+460**	**+332**	**+394**	+324	+265	+256	+306	+283	+203	+310
11 19	**+245**	**+356**	**+412**	+450	+316	+390	**+365**	**+273**	**+300**	**+371**	**+311**	**+225**	**+334**
12 19	+209	+354	+363	+358	+266	+340	+351	+273	+266	+341	+260	+212	+299
13 19	+141	+257	+246	+235	+193	+261	+297	+198	+192	+221	+171	+144	+213
14 19	+50	+145	+144	+100	+114	+134	+208	+119	+91	+83	+74	+73	+111
15 19	−15	+71	+50	+6	+21	0	+75	+15	+7	−27	+8	+25	+20
16 19	−61	−8	−39	−66	−40	−105	−56	−94	−68	−82	−65	−28	−59
17 19	−68	−51	−76	−107	−79	−157	−121	**−156**	−82	−101	−117	−50	−97
18 19	−95	−72	−104	−142	−106	**−180**	−139	−151	−106	−103	−111	−76	−115
19 19	−102	−89	−130	−153	−127	−180	−152	−151	−126	−145	−134	−93	−132
20 19	−94	−138	−161	−173	**−179**	−168	**−175**	−147	**−135**	−183	−159	−114	−152
21 19	−107	−163	−179	−179	−150	−155	−170	−140	−110	−185	**−167**	**−127**	−153
22 19	**−114**	**−184**	**−199**	**−211**	−152	−141	−165	−124	−108	**−191**	−149	−110	**−154**
23 19	−96	−173	−190	−199	−128	−134	−142	−104	−106	−146	−139	−109	−139
Range ...	359	540	611	671	511	574	540	429	435	562	478	352	488
Average progressive change per day.	−2	−2	−4	−6	−6	−2	−3	−6	−3	−2	−2	−4	−3

TABLES 33 & 34.—*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1886 and 1887 and for the whole year.*

Unity=·1γ= ·000001 C. G. S.

1886. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 93	− 122	− 137	**− 153**	− 78	− 86	− 78	− 71	− 87	− 61	− 84	− 64	− 93
1 19	− 64	− 116	− 122	− 106	− 75	− 73	− 86	− 51	− 73	− 62	− 55	− 44	− 77
2 19	− 46	− 121	− 111	− 87	− 67	− 83	− 67	− 38	− 39	− 41	− 55	− 33	− 66
3 19	− 50	− 85	− 91	− 78	− 71	− 79	− 63	− 20	− 31	− 44	− 51	− 30	− 58
4 19	− 38	− 69	− 109	− 54	− 66	− 70	− 59	− 9	− 33	− 26	− 37	− 62	− 53
5 19	− 29	− 45	− 68	− 59	− 64	− 64	− 44	− 17	− 20	− 23	− 50	− 2	− 40
6 19	+ 5	− 12	− 93	− 45	− 42	− 35	− 25	− 35	− 43	− 25	− 13	+ 16	− 29
7 19	+ 57	+ 37	− 44	− 7	+ 21	+ 28	+ 10	− 38	− 71	− 8	+ 68	+ 29	+ 7
8 19	+ 105	+ 116	+ 81	+ 111	+ 116	+ 92	+ 60	− 4	− 11	+ 62	+ 153	+ 100	+ 82
9 19	+ 125	+ 182	+ 241	+ 266	+ 192	+ 177	+ 133	+ 84	+ 112	+ 154	+ 204	+ 128	+ 166
10 19	+ 198	+ 253	+ 381	+ 323	+ 277	+ 273	+ 214	+ 163	+ 185	+ 230	+ 269	+ 171	+ 245
11 19	**+ 238**	**+ 282**	**+ 439**	**+ 347**	**+ 278**	**+ 281**	**+ 229**	+ 241	**+ 235**	**+ 291**	**+ 283**	**+ 175**	**+ 276**
12 19	+ 218	+ 276	+ 393	+ 262	+ 225	+ 245	+ 221	**+ 242**	+ 229	+ 257	+ 220	+ 134	+ 243
13 19	+ 194	+ 170	+ 299	+ 180	+ 168	+ 167	+ 196	+ 211	+ 184	+ 135	+ 115	+ 78	+ 175
14 19	+ 74	+ 81	+ 142	+ 74	+ 66	+ 69	+ 135	+ 102	+ 89	+ 27	+ 41	+ 38	+ 78
15 19	− 22	+ 40	− 1	− 17	− 16	− 5	+ 37	+ 10	+ 6	− 40	− 23	− 8	− 3
16 19	− 52	− 29	− 91	− 87	− 83	− 80	− 61	− 64	− 53	− 78	− 77	− 61	− 68
17 19	− 107	− 80	− 134	− 101	**− 121**	− 111	− 109	− 96	− 62	− 73	− 109	− 64	− 97
18 19	− 111	− 110	− 166	− 117	− 111	− 102	− 108	**− 108**	− 62	− 108	− 122	− 76	− 108
19 19	**− 136**	− 112	− 151	− 142	− 104	− 110	**− 112**	− 102	− 74	**− 132**	− 125	− 74	− 114
20 19	− 111	− 111	− 171	− 136	− 113	− 119	− 104	− 99	− 83	− 103	− 116	− 99	− 114
21 19	− 118	**− 148**	− 161	− 144	− 116	**− 122**	− 111	− 101	− 84	− 117	**− 159**	**− 109**	**− 124**
22 19	− 132	− 141	**− 174**	− 120	− 109	− 106	− 110	− 102	**− 116**	− 117	− 155	− 93	− 123
23 19	− 104	− 134	− 151	− 113	− 107	− 88	− 98	− 97	− 97	− 98	− 124	− 49	− 105
Range ...	374	430	613	500	399	403	341	350	349	423	442	284	400
Average progressive change per day.	− 4	− 3	− 6	− 6	− 3	− 2	− 3	− 2	− 4	− 4	− 3	− 2	− 3

1887. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 59	− 73	− 107	− 83	− 90	− 73	− 81	− 80	− 18	− 104	− 72	− 86	− 77
1 19	− 61	− 73	− 113	− 69	− 74	− 77	− 91	− 63	− 28	− 102	− 87	− 78	− 76
2 19	− 51	− 66	− 92	− 57	− 64	− 75	− 86	− 54	− 22	− 71	− 63	− 62	− 64
3 19	− 47	− 64	− 78	− 47	− 53	− 77	− 80	− 52	− 11	− 41	− 65	− 39	− 54
4 19	− 30	− 38	− 69	− 48	− 69	− 73	− 76	− 57	0	− 29	− 60	− 31	− 48
5 19	− 10	− 21	− 59	− 46	− 54	− 68	− 69	− 51	− 22	− 23	− 40	− 13	− 40
6 19	+ 16	− 35	− 49	− 47	− 31	− 50	− 48	− 46	− 39	− 28	− 11	+ 7	− 30
7 19	+ 44	+ 10	+ 13	− 1	+ 29	+ 19	+ 29	− 6	− 55	+ 3	+ 61	+ 53	+ 17
8 19	+ 70	+ 74	+ 123	+ 96	+ 122	+ 94	+ 115	+ 95	+ 14	+ 88	+ 135	+ 113	+ 95
9 19	+ 95	+ 138	+ 233	+ 213	+ 214	+ 180	+ 192	+ 171	+ 136	+ 184	+ 204	+ 151	+ 176
10 19	+ 147	+ 213	+ 321	**+ 303**	**+ 261**	+ 229	+ 254	+ 262	+ 230	+ 235	**+ 265**	+ 193	+ 243
11 19	**+ 185**	**+ 260**	**+ 322**	+ 285	+ 253	**+ 265**	**+ 285**	**+ 263**	**+ 249**	**+ 291**	+ 261	**+ 216**	**+ 261**
12 19	+ 155	+ 244	+ 270	+ 233	+ 209	+ 231	+ 252	+ 233	+ 187	+ 255	+ 189	+ 183	+ 220
13 19	+ 100	+ 152	+ 166	+ 137	+ 141	+ 191	+ 202	+ 168	+ 122	+ 140	+ 106	+ 111	+ 145
14 19	+ 32	+ 86	+ 68	+ 52	+ 73	+ 115	+ 92	+ 83	+ 52	+ 58	+ 25	+ 29	+ 64
15 19	0	+ 14	− 29	− 23	− 10	+ 28	− 11	− 5	− 39	− 12	− 50	− 7	− 12
16 19	− 39	− 60	− 86	− 75	− 78	− 69	− 86	− 74	− 105	− 81	− 72	− 34	− 72
17 19	− 51	− 89	− 100	− 109	− 117	− 123	− 97	− 102	**− 122**	− 98	− 94	− 69	− 98
18 19	− 88	− 99	− 115	− 138	− 118	**− 143**	**− 134**	− 99	− 103	− 114	− 99	− 93	− 112
19 19	**− 94**	− 102	− 122	− 135	− 120	− 125	− 112	− 108	− 109	**− 131**	**− 124**	− 124	− 117
20 19	− 87	**− 132**	**− 128**	**− 154**	**− 123**	− 117	− 131	− 121	− 85	− 101	− 118	**− 125**	**− 118**
21 19	− 79	− 113	− 128	− 126	− 118	− 105	− 120	**− 136**	− 87	− 102	− 98	− 114	− 110
22 19	− 78	− 113	− 128	− 105	− 103	− 88	− 97	− 123	− 79	− 113	− 120	− 92	− 103
23 19	− 69	− 114	− 111	− 66	− 78	− 85	− 102	− 97	− 64	− 102	− 73	− 91	− 88
Range ...	279	392	450	463	384	408	419	399	371	422	389	341	379
Average progressive change per day.	− 2	− 2	− 4	− 6	− 3	− 1	− 3	− 5	− 3	− 2	− 3	− 4	− 3

TABLES 35 *and* 36.—*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1888 and 1889 and for the whole year.*

Unity = ·1γ = ·000001 C. S. G.

1888. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 63	− 85	− 98	− 88	− 61	− 60	− 78	− 56	− 52	− 80	− 52	− 77	− 71
1 19	− 86	− 62	− 87	− 60	− 59	− 68	− 76	− 56	− 40	− 62	− 51	− 60	− 64
2 19	− 49	− 78	− 85	− 72	− 70	− 76	− 70	− 45	− 34	− 49	− 37	− 47	− 59
3 19	− 37	− 58	− 77	− 36	− 69	− 76	− 69	− 58	− 26	− 44	− 43	− 37	− 52
4 19	− 26	− 39	− 62	− 39	− 62	− 66	− 72	− 45	− 17	− 36	− 45	− 40	− 46
5 19	− 10	− 39	− 63	− 30	− 63	− 60	− 65	− 46	− 17	− 36	− 33	− 26	− 41
6 19	+ 25	− 35	− 62	− 40	− 38	− 35	− 49	− 42	− 37	− 43	− 4	− 6	− 30
7 19	+ 56	+ 12	− 24	− 18	+ 40	+ 23	+ 24	− 10	− 53	− 20	+ 52	+ 63	+ 12
8 19	+ 116	+ 59	+ 78	+ 65	+ 109	+ 108	+ 99	+ 44	− 19	+ 34	+ 121	+ 97	+ 76
9 19	+ 164	+ 139	+ 198	+ 216	+ 193	+ 199	+ 173	+ 134	+ 85	+ 121	+ 188	+ 138	+ 162
10 19	+ 213	+ 220	+ 289	**+ 296**	**+ 252**	+ 258	+ 224	+ 186	+ 192	+ 224	**+ 236**	**+ 183**	+ 231
11 19	**+ 246**	**+ 251**	**+ 326**	+ 289	+ 244	**+ 261**	**+ 227**	**+ 218**	**+ 236**	**+ 273**	+ 236	+ 176	**+ 249**
12 19	+ 226	+ 246	+ 283	+ 214	+ 187	+ 224	+ 211	+ 199	+ 217	+ 248	+ 159	+ 149	+ 214
13 19	+ 137	+ 162	+ 183	+ 140	+ 140	+ 165	+ 165	+ 170	+ 147	+ 165	+ 69	+ 107	+ 146
14 19	+ 44	+ 65	+ 83	+ 36	+ 59	+ 72	+ 98	+ 79	+ 77	+ 67	− 10	+ 58	+ 61
15 19	− 30	+ 4	+ 3	− 8	+ 9	− 15	+ 9	+ 9	+ 8	− 6	− 49	+ 2	− 5
16 19	− 90	− 71	− 55	− 44	− 42	− 79	− 77	− 58	− 47	− 59	− 93	− 45	− 63
17 19	− 110	− 91	− 98	− 82	− 96	− 100	− 98	− 94	− 62	− 65	− 97	− 56	− 87
18 19	− 114	− 106	− 98	− 125	− 126	− 108	− 103	− 89	− 76	− 99	− 104	− 82	− 102
19 19	**− 153**	− 100	− 118	− 136	**− 140**	− 125	− 95	− 88	− 100	**− 119**	**− 107**	− 94	− 115
20 19	− 140	− 98	− 137	**− 139**	− 134	**− 135**	**− 104**	**− 106**	− 104	− 111	− 90	**− 116**	**− 118**
21 19	− 110	− 96	**− 153**	− 121	− 111	− 116	− 97	− 103	**− 113**	− 100	− 99	− 112	− 111
22 19	− 115	**− 108**	− 109	− 114	− 89	− 108	− 93	− 75	− 100	− 107	− 76	− 84	− 98
23 19	− 95	− 92	− 120	− 104	− 70	− 84	− 83	− 68	− 62	− 94	− 70	− 91	− 86
Range ...	399	359	476	435	392	396	331	324	349	392	343	299	367
Average progressive change per day.	− 2	− 1	− 4	− 6	− 4	− 3	− 2	− 3	− 4	− 4	− 2	− 1	− 3

1889. Bombay City Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 78	− 92	− 64	− 129	− 78	− 90	− 86	− 72	− 33	− 81	− 67	− 51	− 77
1 19	− 66	− 77	− 81	− 103	− 70	− 92	− 73	− 66	− 48	− 56	− 60	− 36	− 69
2 19	− 69	− 69	− 68	− 106	− 50	− 92	− 70	− 63	− 44	− 58	− 53	− 30	− 64
3 19	− 61	− 83	− 69	− 101	− 47	− 77	− 70	− 59	− 24	− 50	− 42	− 36	− 60
4 19	− 44	− 61	− 48	− 98	− 50	− 80	− 63	− 55	− 23	− 62	− 38	− 22	− 54
5 19	− 30	− 59	− 53	− 95	− 52	− 68	− 64	− 53	− 24	− 55	− 8	− 15	− 48
6 19	− 15	− 51	− 55	− 78	− 29	− 40	− 41	− 30	− 40	− 59	− 17	+ 2	− 38
7 19	+ 24	− 13	− 28	− 28	+ 21	+ 44	+ 6	+ 17	− 51	− 28	+ 42	+ 36	+ 3
8 19	+ 79	+ 43	+ 69	+ 94	+ 98	+ 117	+ 63	+ 92	− 20	+ 31	+ 107	+ 73	+ 70
9 19	+ 121	+ 118	+ 161	+ 230	+ 171	+ 217	+ 152	+ 179	+ 108	+ 128	+ 179	+ 100	+ 155
10 19	+ 160	+ 197	+ 232	+ 319	+ 229	+ 287	+ 251	+ 231	+ 192	+ 234	+ 243	+ 137	+ 226
11 19	**+ 177**	+ 252	**+ 258**	**+ 326**	**+ 231**	**+ 291**	**+ 276**	**+ 246**	**+ 218**	**+ 278**	**+ 262**	**+ 152**	**+ 247**
12 19	+ 143	**+ 253**	+ 216	+ 264	+ 189	+ 258	+ 255	+ 225	+ 201	+ 232	+ 195	+ 130	+ 213
13 19	+ 108	+ 178	+ 137	+ 174	+ 136	+ 187	+ 167	+ 181	+ 139	+ 143	+ 114	+ 72	+ 145
14 19	+ 59	+ 85	+ 53	+ 84	+ 48	+ 85	+ 102	+ 99	+ 51	+ 58	+ 49	+ 33	+ 67
15 19	+ 15	+ 17	− 4	+ 36	− 20	− 8	+ 15	+ 15	− 25	− 1	− 2	+ 4	+ 3
16 19	− 16	− 27	− 49	− 26	− 80	− 87	− 71	− 62	− 47	− 42	− 69	− 23	− 50
17 19	− 34	− 52	− 74	− 57	− 97	− 113	− 97	− 115	− 64	− 64	− 71	− 49	− 74
18 19	− 66	− 75	− 91	− 80	− 85	**− 137**	**− 122**	**− 136**	− 63	− 83	− 105	− 71	− 93
19 19	− 72	− 90	− 90	− 106	− 96	− 137	− 113	− 133	− 83	− 80	− 135	**− 96**	− 103
20 19	− 79	− 102	− 95	− 116	**− 101**	− 132	− 110	− 133	**− 92**	− 90	**− 157**	− 91	**− 108**
21 19	− 80	− 95	**− 104**	**− 135**	− 93	− 124	− 103	− 113	− 86	− 104	− 157	− 83	− 106
22 19	− 86	**− 110**	− 89	− 133	− 92	− 109	− 106	− 104	− 86	**− 107**	− 110	− 86	− 101
23 19	**− 91**	− 86	− 62	− 132	− 83	− 97	− 97	− 91	− 56	− 85	− 98	− 49	− 86
Range ...	268	363	362	461	332	428	398	382	310	385	419	248	355
Average progressive change per day.	− 1	− 4	− 4	− 3	− 4	− 3	− 3	− 4	− 3	− 3	− 2	− 1	− 3

TABLES 37 *and* 38.—*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1890 and 1891 and for the whole year.*

Unity = ·1γ = ·000001 C. G. S.

1890. Bombay Civil Time.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 19	− 66	− 109	− 103	− 112	− 102	− 88	− 86	− 82	− 93	− 74	− 67	− 111	− 91
1 19	− 58	− 98	− 88	− 105	− 93	− 93	− 91	− 72	− 58	− 67	− 67	− 100	− 82
2 19	− 53	− 74	− 80	− 99	− 87	− 82	− 85	− 59	− 58	− 52	− 63	− 85	− 73
3 19	− 32	− 79	− 88	− 94	− 80	− 76	− 74	− 67	− 47	− 49	− 53	− 70	− 67
4 19	− 33	− 79	− 73	− 86	− 83	− 82	− 79	− 60	− 41	− 40	− 56	− 45	− 63
5 19	− 16	− 54	− 76	− 74	− 70	− 68	− 75	− 53	− 37	− 42	− 44	− 30	− 53
6 19	− 2	− 45	− 71	− 59	− 47	− 44	− 47	− 40	− 64	− 42	− 23	+ 1	− 40
7 19	+ 23	− 5	− 25	− 28	+ 10	+ 26	+ 4	− 20	− 76	− 6	+ 49	+ 55	+ 1
8 19	+ 66	+ 64	+ 64	+ 79	+ 97	+ 99	+ 68	+ 39	− 9	+ 77	+ 133	+ 107	+ 74
9 19	+ 111	+ 152	+ 187	+ 216	+ 196	+ 172	+ 154	+ 133	+ 109	+ 187	+ 212	+ 145	+ 164
10 19	+ 150	+ 212	+ 283	+ 307	**+ 254**	+ 231	+ 237	+ 229	+ 219	+ 270	**+ 272**	+ 195	+ 238
11 19	**+ 163**	+ 257	**+ 319**	**+ 308**	+ 250	**+ 243**	**+ 262**	**+ 257**	**+ 269**	**+ 313**	+ 260	**+ 217**	**+ 260**
12 19	+ 132	**+ 262**	+ 274	+ 263	+ 212	+ 215	+ 240	+ 219	+ 250	+ 274	+ 182	+ 179	+ 225
13 19	+ 86	+ 185	+ 176	+ 189	+ 163	+ 168	+ 202	+ 165	+ 195	+ 183	+ 87	+ 110	+ 159
14 19	+ 25	+ 86	+ 70	+ 99	+ 85	+ 84	+ 119	+ 90	+ 94	+ 43	+ 3	+ 48	+ 70
15 19	− 12	+ 23	− 11	+ 19	+ 18	− 7	+ 38	+ 11	+ 13	− 35	− 45	+ 11	+ 2
16 19	− 36	− 27	− 52	− 29	− 38	− 61	− 46	− 47	− 50	− 101	− 81	− 40	− 51
17 19	− 46	− 50	− 60	− 70	− 62	− 78	− 85	− 85	− 61	− 99	− 96	− 54	− 70
18 19	− 49	− 83	− 79	− 97	− 82	**− 98**	− 112	− 85	− 73	− 118	− 115	− 62	− 88
19 19	− 49	− 91	− 97	− 121	− 106	− 96	− 112	**− 97**	− 89	− 134	**− 119**	− 74	− 99
20 19	− 62	− 103	**− 123**	− 126	− 111	− 98	**− 122**	− 95	− 90	− 132	− 115	− 87	− 105
21 19	**− 85**	− 103	− 114	− 128	− 112	− 93	− 109	− 97	**− 106**	**− 143**	− 93	− 90	**− 106**
22 19	− 75	**− 125**	− 117	**− 135**	**− 113**	− 90	− 106	− 95	− 106	− 115	− 90	− 110	− 106
23 19	− 84	− 116	− 112	− 116	− 101	− 84	− 94	− 88	− 91	− 100	− 70	**− 111**	− 97
Range ...	248	38.	442	443	367	341	384	354	375	456	391	328	366
Average progressive change per day.	− 2	− 2	− 3	− 4	− 3	− 1	− 3	− 4	− 4	− 3	− 1	− 1	− 3

1891. Bombay Civil Time.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 19	− 81	− 126	− 102	− 114	− 103	− 114	− 132	− 114	− 81	− 99	− 119	− 97	− 107
1 19	− 72	− 100	− 117	− 95	− 93	− 112	− 121	− 109	− 44	− 67	− 109	− 83	− 93
2 19	− 72	− 85	− 97	− 80	− 87	− 117	− 124	− 98	− 41	− 67	− 95	− 77	− 87
3 19	− 66	− 72	− 102	− 63	− 80	− 115	− 113	− 70	− 48	− 63	− 92	− 75	− 80
4 19	− 52	− 60	− 91	− 70	− 54	− 105	− 114	− 82	− 39	− 74	− 71	− 38	− 71
5 19	− 47	− 33	− 102	− 59	− 52	− 93	− 111	− 64	− 34	− 76	− 53	− 28	− 63
6 19	− 14	− 19	− 90	− 57	− 5	− 58	− 71	− 41	− 54	− 70	− 33	+ 5	− 42
7 19	+ 16	+ 24	− 46	− 24	+ 33	+ 5	+ 3	− 1	− 34	− 33	+ 38	+ 82	+ 5
8 19	+ 53	+ 100	+ 62	+ 75	+ 118	+ 87	+ 96	+ 78	+ 37	+ 67	+ 144	+ 133	+ 87
9 19	+ 105	+ 172	+ 206	+ 240	+ 233	+ 199	+ 211	+ 178	+ 155	+ 180	+ 248	+ 207	+ 194
10 19	+ 176	**+ 229**	+ 328	+ 336	+ 326	+ 283	+ 322	+ 244	+ 261	+ 285	+ 337	+ 269	+ 283
11 19	**+ 217**	+ 218	**+ 356**	**+ 360**	**+ 357**	**+ 309**	**+ 375**	**+ 281**	**+ 330**	**+ 354**	**+ 356**	**+ 274**	**+ 316**
12 19	+ 193	+ 147	+ 317	+ 300	+ 301	+ 297	+ 343	+ 267	+ 289	+ 334	+ 296	+ 216	+ 275
13 19	+ 120	+ 117	+ 221	+ 173	+ 227	+ 253	+ 273	+ 220	+ 208	+ 225	+ 181	+ 131	+ 196
14 19	+ 46	+ 88	+ 94	+ 81	+ 105	+ 167	+ 192	+ 127	+ 91	+ 81	+ 67	+ 49	+ 99
15 19	+ 9	+ 34	+ 7	+ 21	+ 8	+ 55	+ 61	+ 31	− 37	− 14	− 19	+ 2	+ 13
16 19	− 29	− 2	− 54	− 64	− 67	− 40	− 55	− 44	− 112	− 69	− 86	− 53	− 56
17 19	− 33	− 29	− 84	− 122	− 162	− 87	− 124	− 82	− 138	− 101	− 105	− 90	− 96
18 19	− 49	− 60	− 93	− 147	− 179	− 131	− 145	− 97	− 128	− 116	− 144	− 125	− 118
19 19	− 60	− 74	− 95	− 141	**− 215**	− 148	− 146	− 115	− 130	− 125	− 154	− 132	− 128
20 19	− 66	− 102	− 121	**− 151**	− 189	**− 152**	**− 167**	**− 143**	− 129	**− 152**	**− 172**	− 131	− 140
21 19	**− 111**	− 116	− 128	− 144	− 167	− 129	− 164	− 135	**− 145**	− 141	− 142	**− 168**	**− 141**
22 19	− 101	− 125	**− 146**	− 136	− 156	− 128	− 156	− 124	− 117	− 128	− 137	− 140	− 133
23 19	− 84	**− 127**	− 124	− 119	− 100	− 125	− 136	− 109	− 63	− 132	− 137	− 134	− 116
Range ...	328	356	502	511	572	461	542	424	475	506	528	442	457
Average progressive change per day.	− 3	− 5	− 6	− 6	− 3	− 1	− 2	− 4	− 3	− 1	− 2	− 3	− 3

TABLES 39 & 40 —*Horizontal Force Magnetograph —showing the mean diurnal inequalities for each month of the years 1892 and 1893 and for the whole year.*

Unity = ·1γ = ·000001 C. G. S

1892. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 67	−156	**−168**	−142	−183	−142	−105	−165	−120	−122	−139	− 76	−132
1 19	− 64	−145	−131	−129	−155	−141	−136	−168	− 91	− 92	−125	− 60	−120
2 19	− 74	−115	−118	−104	− 95	−142	−143	**−187**	−106	− 66	−110	− 56	−110
3 19	− 71	− 92	−130	−113	− 58	−132	−151	−114	− 90	− 70	−104	− 81	−100
4 19	− 45	− 80	− 57	−110	− 88	−113	−137	−133	− 69	− 62	−113	− 62	− 89
5 19	− 33	− 53	−109	−120	− 65	−116	−109	−126	− 59	− 53	− 95	− 32	− 81
6 19	− 5	− 49	− 85	−104	− 40	− 80	− 63	− 96	− 83	− 72	− 51	− 31	− 63
7 19	+ 13	− 6	− 16	− 58	+ 59	+ 16	+ 26	− 41	− 77	− 41	+ 11	+ 21	− 8
8 19	+ 72	+ 81	+ 89	+ 74	+156	+146	+114	+ 93	+ 24	+ 75	+126	+ 82	+ 24
9 19	+163	+182	+248	+272	+289	+273	+217	+232	+175	+223	+216	+132	+218
10 19	+260	+347	+351	**+420**	+373	+374	+325	+362	+288	+321	+332	+203	+330
11 19	**+311**	**+449**	**+395**	+416	**+386**	**+421**	**+368**	**+369**	**+344**	**+441**	**+365**	**+232**	**+375**
12 19	+243	+373	+342	+364	+361	+385	+347	+352	+332	+408	+306	+214	+336
13 19	+148	+266	+233	+249	+261	+313	+293	+277	+255	+252	+206	+155	+242
14 19	+ 77	+142	+126	+ 79	+107	+156	+189	+160	+144	+100	+114	+ 98	+124
15 19	− 4	+ 21	− 10	− 24	− 14	+ 14	+ 33	+ 46	+ 45	+ 6	+ 44	+ 63	+ 18
16 19	− 90	−101	− 95	− 64	− 82	− 87	− 78	− 51	− 37	−108	− 21	− 13	− 69
17 19	−103	−134	− 80	− 84	−126	−118	−144	−109	− 68	−149	− 66	− 76	−105
18 19	−113	−144	− 92	−121	−158	−161	−158	− 85	− 92	−156	− 91	− 96	−122
19 19	−128	**−190**	−110	−126	−171	−185	**−175**	− 97	−110	−184	−134	− 92	−142
20 19	**−158**	−152	−158	−150	−174	−180	−154	−117	−158	−182	−169	−129	−157
21 19	−153	−157	−124	−142	**−200**	−157	−159	−139	**−166**	**−190**	−170	−137	**−158**
22 19	−102	−152	−147	**−151**	−199	**−187**	−105	−170	−155	−155	**−175**	**−145**	−154
23 19	− 78	−138	−153	−129	−184	−156	− 98	− 92	−125	−124	−156	−114	−129
Range ...	469	639	563	571	586	608	543	556	510	631	540	377	533
Average progressive change per day.	− 7	− 6	− 2	− 5	− 4	− 2	0	+ 2	− 2	− 2	− 1	− 1	− 2

1893. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−126	−144	−183	−177	−181	−187	−172	−164	−114	−105	−125	−122	−150
1 19	−116	−105	**−209**	−180	−179	**−192**	**−189**	−155	−104	−151	−110	−123	−151
2 19	− 84	−112	−189	**−186**	−189	−188	−183	−144	− 89	−134	− 97	−117	−143
3 19	− 83	−111	−165	−185	−182	−174	−171	−128	− 78	−122	− 90	−105	−133
4 19	− 65	−105	−149	−174	−180	−163	−151	−126	− 61	− 99	− 85	− 89	−121
5 19	− 51	−107	−144	−152	−173	−147	−134	− 99	− 73	− 81	− 83	− 73	−110
6 19	− 21	− 85	−132	−136	−114	− 95	− 94	− 95	− 80	− 82	− 39	− 22	− 83
7 19	− 6	− 58	− 49	− 62	− 19	+ 21	+ 3	− 83	− 94	− 14	+ 50	+ 75	− 20
8 19	+ 60	+ 39	+110	+115	+134	+156	+114	+ 50	+ 3	+115	+158	+146	+100
9 19	+152	+206	+291	+308	+294	+305	+261	+216	+159	+266	+243	+224	+244
10 19	+258	+311	+440	+433	+429	+421	+368	+324	+269	+379	+334	+315	+357
11 19	**+298**	**+380**	**+485**	**+473**	**+468**	**+458**	**+422**	+397	+344	**+413**	**+354**	**+337**	**+402**
12 19	+263	+371	+439	+417	+442	+430	+397	**+402**	**+367**	+368	+276	+274	+370
13 19	+183	+278	+319	+330	+342	+344	+322	+352	+287	+238	+165	+180	+278
14 19	+112	+152	+167	+193	+202	+209	+226	+240	+181	+119	+ 65	+ 87	+163
15 19	+ 44	+ 33	+ 38	+ 61	+ 86	+ 57	+ 98	+130	+ 40	+ 5	− 13	+ 6	+ 49
16 19	− 38	− 42	− 33	− 23	− 24	− 73	− 13	− 6	− 61	− 40	− 70	− 65	− 41
17 19	− 76	− 70	− 62	− 74	−107	−131	− 86	−101	− 84	−112	− 85	−119	− 92
18 19	− 72	−115	− 81	−123	−146	−155	−138	−136	− 97	−112	−115	−101	−116
19 19	−105	−129	−118	−155	−157	−156	−163	−133	−121	−145	−148	−105	−136
20 19	−133	−144	−180	−185	−181	−185	−181	−172	**−152**	−162	−133	−139	−162
21 19	**−142**	−141	−200	−173	**−196**	−179	−179	−195	−147	**−207**	**−157**	−160	−173
22 19	−130	**−161**	−207	−174	−190	−185	−184	**−200**	−151	−203	−157	**−162**	**−175**
23 19	−122	−142	−189	−170	−179	−189	−175	−174	−145	−135	−135	−142	−158
Range ...	440	541	694	659	664	650	611	602	519	620	511	499	577
Average progressive change per day.	0	− 2	− 2	− 3	− 3	− 3	− 3	− 3	− 2	− 3	0	0	− 2

TABLES 41 & 42 —*Horizontal Force Magnetograph —showing the mean diurnal inequalities for each month of the years 1894 and 1895 and for the whole year.*

Unity = ·1γ = ·000001 C. G. S.

1894. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 118	− 152	− 161	− 153	− 144	− 151	− 137	− 106	− 103	− 143	− 173	− 103	− 137
1 19	− 84	− 139	− 149	− 157	− 136	− 136	− 115	− 104	− 120	− 103	− 168	− 99	− 126
2 19	− 109	− 150	− 141	− 161	− 139	− 138	− 93	− 92	− 98	− 120	− 125	− 81	− 121
3 19	− 106	− 128	− 136	− 145	− 137	− 131	− 98	− 83	− 74	− 101	− 106	− 64	− 109
4 19	− 87	− 85	− 121	− 138	− 124	− 114	− 92	− 90	− 69	− 119	− 87	− 61	− 99
5 19	− 77	− 94	− 142	− 122	− 128	− 111	− 77	− 68	− 71	− 113	− 57	− 50	− 92
6 19	− 31	− 69	− 122	− 112	− 96	− 69	− 31	− 39	− 83	− 91	− 19	− 29	− 66
7 19	+ 8	− 15	− 44	− 80	− 9	+ 24	+ 36	+ 25	− 85	− 41	+ 77	+ 44	− 5
8 19	+ 76	+ 84	+ 103	+ 67	+ 142	+ 159	+ 153	+ 145	+ 10	+ 98	+ 185	+ 120	+ 112
9 19	+ 161	+ 187	+ 259	+ 267	+ 287	+ 287	+ 258	+ 262	+ 152	+ 237	+ 284	+ 178	+ 235
10 19	+ 229	+ 347	+ 354	+ 394	+ 404	+ 397	+ 369	**+ 327**	+ 288	+ 345	+ 361	+ 245	+ 338
11 19	**+ 282**	**+ 372**	**+ 411**	**+ 441**	**+ 410**	**+ 442**	**+ 416**	+ 320	**+ 351**	**+ 422**	**+ 369**	**+ 256**	**+ 374**
12 19	+ 258	+ 366	+ 372	+ 412	+ 345	+ 403	+ 391	+ 301	+ 349	+ 375	+ 293	+ 222	+ 341
13 19	+ 179	+ 252	+ 267	+ 302	+ 253	+ 291	+ 314	+ 232	+ 280	+ 229	+ 174	+ 153	+ 244
14 19	+ 116	+ 137	+ 151	+ 168	+ 142	+ 155	+ 208	+ 46	+ 151	+ 83	+ 80	+ 74	+ 126
15 19	+ 45	+ 73	+ 41	+ 91	+ 16	+ 30	+ 28	− 53	+ 73	− 2	+ 25	+ 12	+ 32
16 19	− 4	− 22	− 10	+ 8	− 60	− 94	− 127	− 137	− 12	− 70	− 18	− 44	− 49
17 19	− 57	− 101	− 59	− 59	− 102	− 157	− 180	**− 139**	− 72	− 92	− 38	− 81	− 95
18 19	− 74	− 95	− 78	− 103	− 130	**− 192**	**− 228**	− 123	− 112	− 96	− 59	− 91	− 115
19 19	− 82	− 135	− 93	− 144	− 161	− 192	− 225	− 131	− 151	− 109	− 105	− 100	− 136
20 19	− 112	− 119	− 136	− 182	**− 174**	− 188	− 223	− 130	**− 163**	− 138	− 224	− 118	− 159
21 19	**− 140**	− 158	− 180	− 203	− 163	− 179	− 189	− 123	− 156	− 160	**− 257**	− 130	**− 170**
22 19	− 133	− 162	**− 194**	**− 210**	− 154	− 174	− 186	− 124	− 159	**− 163**	− 227	**− 133**	− 168
23 19	− 139	**− 192**	− 190	− 183	− 144	− 161	− 169	− 115	− 130	− 124	− 185	− 121	− 154
Range ...	422	564	605	651	584	634	644	466	514	585	626	389	544
Average progressive change per day.	− 5	− 4	− 2	− 3	− 3	− 5	− 4	− 2	+ 1	− 1	− 1	+ 1	− 2

1895. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 74	− 131	− 125	− 146	− 150	− 124	− 128	− 124	− 107	− 96	− 106	− 98	− 117
1 19	− 53	− 106	− 116	− 161	− 149	− 135	− 103	− 120	− 95	− 64	− 55	− 89	− 104
2 19	− 58	− 95	− 108	− 141	− 140	− 114	− 105	− 114	− 75	− 66	− 62	− 71	− 96
3 19	− 65	− 73	− 89	− 128	− 137	− 122	− 78	− 95	− 80	− 73	− 62	− 66	− 89
4 19	− 54	− 54	− 98	− 132	− 119	− 120	− 94	− 79	− 76	− 66	− 55	− 55	− 83
5 19	− 35	− 58	− 98	− 114	− 112	− 115	− 89	− 76	− 65	− 53	− 59	− 41	− 76
6 19	− 4	− 29	− 82	− 93	− 59	− 46	− 29	− 67	− 88	− 32	− 17	− 12	− 46
7 19	+ 20	+ 20	− 29	− 31	+ 27	+ 27	+ 25	− 20	− 96	− 13	+ 71	+ 43	+ 4
8 19	+ 69	+ 119	+ 110	+ 137	+ 162	+ 128	+ 88	+ 63	− 12	+ 105	+ 167	+ 112	+ 104
9 19	+ 121	+ 217	+ 249	+ 296	+ 289	+ 257	+ 202	+ 175	+ 140	+ 246	+ 253	+ 168	+ 218
10 19	+ 209	+ 290	+ 376	+ 395	**+ 387**	+ 379	+ 317	+ 274	+ 281	+ 330	**+ 327**	+ 228	+ 310
11 19	**+ 261**	**+ 342**	**+ 410**	**+ 434**	+ 387	**+ 382**	**+ 333**	**+ 313**	**+ 349**	**+ 361**	+ 322	**+ 233**	**+ 344**
12 19	+ 224	+ 323	+ 378	+ 361	+ 345	+ 340	+ 304	+ 296	+ 345	+ 300	+ 250	+ 203	+ 306
13 19	+ 145	+ 237	+ 273	+ 255	+ 249	+ 258	+ 254	+ 229	+ 239	+ 156	+ 154	+ 126	+ 215
14 19	+ 53	+ 141	+ 138	+ 105	+ 143	+ 143	+ 151	+ 147	+ 129	+ 33	+ 55	+ 89	+ 111
15 19	− 7	+ 46	− 15	+ 23	+ 20	+ 22	+ 30	+ 53	+ 35	− 42	− 7	+ 20	+ 15
16 19	− 62	− 49	− 92	− 48	− 62	− 78	− 70	− 45	− 32	− 80	− 76	− 45	− 62
17 19	− 103	− 88	− 114	− 86	− 110	− 142	− 113	− 90	− 82	− 90	− 173	− 81	− 106
18 19	− 78	− 118	− 140	− 105	− 134	− 162	− 141	− 107	− 98	− 115	− 172	− 115	− 124
19 19	− 88	− 164	− 136	− 151	− 154	− 158	− 170	− 115	− 129	− 137	**− 177**	**− 120**	− 142
20 19	− 110	− 196	− 167	− 168	**− 176**	**− 175**	**− 177**	− 123	**− 136**	**− 169**	− 169	− 105	**− 156**
21 19	**− 121**	**− 210**	− 182	− 167	− 166	− 168	− 143	**− 130**	− 128	− 163	− 148	− 112	− 153
22 19	− 116	− 180	**− 206**	**− 178**	− 168	− 152	− 141	− 118	− 118	− 127	− 145	− 115	− 147
23 19	− 74	− 180	− 139	− 156	− 171	− 126	− 123	− 126	− 104	− 143	− 116	− 98	− 130
Range ...	382	552	616	612	563	557	510	443	485	530	504	353	500
Average progressive change per day.	− 3	− 3	− 2	− 3	− 2	− 2	− 1	− 1	− 5	− 5	0	− 1	− 2

TABLES 43 & 44.—*Horizontal Force Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1896 and 1897 and for the whole year.*

Unity = ·1γ = ·000001 C. G. S.

1896. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 67	− 92	− 112	− 118	− 113	− 120	− 93	− 69	− 105	− 100	− 99	− 84	− 98
1 19	− 15	− 65	− 117	− 114	− 86	− 114	− 103	− 49	− 95	− 100	− 72	− 56	− 82
2 19	− 35	− 64	− 117	− 115	− 98	− 109	− 87	− 50	− 49	− 80	− 65	− 46	− 76
3 19	− 44	− 59	− 90	− 113	− 88	− 100	− 83	− 64	− 41	− 83	− 74	− 47	− 74
4 19	− 47	− 53	− 90	− 112	− 93	− 121	− 93	− 50	− 35	− 75	− 77	− 36	− 73
5 19	− 20	− 57	− 84	− 115	− 94	− 120	− 78	− 34	− 33	− 69	− 55	− 28	− 66
6 19	− 12	− 33	− 91	− 95	− 49	− 85	− 58	− 34	− 43	− 68	− 29	− 17	− 51
7 19	+ 20	+ 13	− 27	− 25	+ 10	− 10	− 12	− 37	− 47	− 6	+ 42	+ 32	− 4
8 19	+ 79	+ 99	+ 97	+ 85	+ 116	+ 80	+ 60	+ 35	+ 31	+ 100	+ 125	+ 73	+ 82
9 19	+ 129	+ 174	+ 235	+ 256	+ 228	+ 188	+ 153	+ 132	+ 173	+ 237	+ 209	+ 133	+ 187
10 19	+ 240	+ 244	+ 359	+ 358	+ 333	+ 273	+ 270	+ 218	+ 262	+ 342	+ 258	+ 198	+ 280
11 19	**+ 274**	**+ 282**	**+ 388**	**+ 387**	**+ 364**	**+ 330**	**+ 312**	**+ 247**	**+ 311**	**+ 377**	**+ 277**	**+ 241**	**+ 313**
12 19	+ 228	+ 276	+ 348	+ 344	+ 337	+ 277	+ 309	+ 233	+ 297	+ 318	+ 223	+ 207	+ 283
13 19	+ 131	+ 200	+ 240	+ 225	+ 259	+ 231	+ 263	+ 173	+ 199	+ 191	+ 148	+ 134	+ 199
14 19	+ 57	+ 73	+ 130	+ 114	+ 145	+ 168	+ 167	+ 94	+ 72	+ 71	+ 57	+ 63	+ 101
15 19	+ 2	− 9	+ 15	+ 37	+ 2	+ 95	+ 51	+ 14	− 8	+ 2	− 8	− 3	+ 16
16 19	− 67	− 55	− 38	− 51	− 75	− 24	− 58	− 36	− 60	− 47	− 58	− 62	− 53
17 19	− 97	− 71	− 86	− 85	− 135	− 83	− 109	− 68	− 70	− 79	− 90	− 104	− 90
18 19	− 140	− 100	− 100	− 129	**− 169**	− 117	− 123	− 101	− 103	− 129	− 112	− 103	− 119
19 19	− 131	− 127	− 148	− 135	− 164	**− 135**	− 134	**− 129**	− 116	− 176	− 115	− 101	− 134
20 19	− 149	− 123	− 184	− 147	− 166	− 128	− 148	− 125	− 141	**− 183**	**− 127**	**− 106**	**− 144**
21 19	**− 152**	− 146	**− 188**	**− 151**	− 163	− 110	**− 151**	− 115	**− 148**	− 162	− 123	− 103	− 143
22 19	− 113	**− 154**	− 187	− 150	− 162	− 122	− 150	− 98	− 142	− 150	− 113	− 94	− 136
23 19	− 70	− 154	− 153	− 150	− 140	− 117	− 106	− 86	− 105	− 133	− 121	− 88	− 119
Range ...	426	436	576	538	533	435	463	376	459	560	404	347	457
Average progressive change per day.	− 2	− 1	− 2	− 5	− 2	+ 1	− 2	− 3	− 2	− 2	− 1	− 1	− 2

1897. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 116	− 126	− 142	− 85	− 89	− 91	− 83	− 88	− 93	− 76	− 74	− 71	− 94
1 19	− 104	− 97	− 117	− 73	− 98	− 91	− 85	− 78	− 80	− 72	− 75	− 80	− 87
2 19	− 98	− 79	− 103	− 73	− 84	− 74	− 75	− 74	− 76	− 86	− 64	− 53	− 78
3 19	− 74	− 83	− 87	− 73	− 87	− 63	− 89	− 74	− 59	− 73	− 50	− 64	− 73
4 19	− 51	− 82	− 101	− 65	− 70	− 57	− 86	− 66	− 51	− 57	− 52	− 50	− 66
5 19	− 35	− 67	− 110	− 59	− 57	− 50	− 84	− 63	− 52	− 49	− 44	− 31	− 58
6 19	− 6	− 53	− 93	− 41	− 50	− 19	− 44	− 57	− 67	− 43	− 14	− 2	− 41
7 19	+ 29	− 16	− 30	− 10	+ 10	+ 21	+ 17	− 36	− 77	− 10	+ 70	+ 73	+ 3
8 19	+ 94	+ 68	+ 77	+ 85	+ 92	+ 87	+ 81	+ 26	− 21	+ 66	+ 141	+ 141	+ 78
9 19	+ 177	+ 161	+ 213	+ 208	+ 185	+ 153	+ 149	+ 140	+ 114	+ 163	+ 201	+ 203	+ 172
10 19	+ 259	+ 258	+ 322	+ 318	+ 267	+ 197	+ 246	+ 207	+ 231	+ 256	+ 240	+ 240	+ 253
11 19	**+ 306**	**+ 303**	**+ 374**	**+ 324**	**+ 283**	**+ 231**	**+ 262**	**+ 245**	**+ 291**	**+ 294**	**+ 247**	**+ 269**	**+ 286**
12 19	+ 269	+ 288	+ 330	+ 285	+ 230	+ 219	+ 248	+ 238	+ 269	+ 251	+ 167	+ 221	+ 251
13 19	+ 177	+ 205	+ 233	+ 194	+ 178	+ 194	+ 203	+ 193	+ 220	+ 144	+ 80	+ 149	+ 181
14 19	+ 84	+ 90	+ 125	+ 100	+ 95	+ 127	+ 119	+ 117	+ 141	+ 48	+ 5	+ 66	+ 93
15 19	+ 6	+ 16	+ 36	− 6	+ 28	+ 42	+ 37	+ 39	+ 46	− 25	− 31	+ 17	+ 17
16 19	− 38	− 37	− 41	− 63	− 25	− 55	− 40	− 25	− 27	− 66	− 56	− 53	− 44
17 19	− 79	− 73	− 74	− 101	− 99	− 110	− 94	− 59	− 72	− 78	− 67	− 105	− 84
18 19	− 121	− 79	− 99	− 147	− 134	**− 120**	− 121	− 79	− 84	− 79	− 82	− 129	− 106
19 19	− 152	− 103	− 112	− 161	− 134	− 113	− 121	− 94	− 111	− 98	− 108	− 163	− 122
20 19	**− 157**	− 109	− 132	**− 181**	**− 136**	− 113	**− 125**	**− 118**	**− 118**	− 107	**− 130**	− 159	**− 132**
21 19	− 135	− 127	− 152	− 162	− 111	− 113	− 115	− 108	− 116	**− 124**	− 116	**− 177**	− 130
22 19	− 119	**− 142**	**− 167**	− 129	− 106	− 102	− 106	− 96	− 108	− 96	− 89	− 134	− 116
23 19	− 118	− 116	− 148	− 85	− 86	− 100	− 95	− 90	− 103	− 83	− 95	− 107	− 102
Range ...	463	445	541	505	419	351	387	363	409	418	377	446	418
Average progressive change per day.	0	− 1	− 6	− 5	− 2	0	0	− 2	− 2	− 2	− 4	− 2	− 2

TABLES 45 & 46.—*Horizontal Force Magnetograph—showing the mean diurnal inequalities for each month of the years 1898 and 1899 and for the whole year.*

Unity = ·1γ = ·00001 C. G. S.

1898 Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 73	− 105	− 148	− 109	− 99	− 98	− 78	− 63	− 65	− 65	− 81	− 68	− 88
1 19	− 46	− 73	− 143	− 112	− 83	− 90	− 80	− 59	− 51	− 66	− 63	− 59	− 77
2 19	− 49	− 61	− 89	− 90	− 75	− 78	− 99	− 51	− 53	− 63	− 55	− 57	− 68
3 19	− 48	− 61	− 85	− 71	− 81	− 92	− 85	− 47	− 58	− 60	− 52	− 55	− 66
4 19	− 43	− 43	− 55	− 68	− 67	− 81	− 90	− 52	− 41	− 40	− 50	− 36	− 56
5 19	− 23	− 42	− 62	− 61	− 70	− 72	− 83	− 54	− 36	− 37	− 39	− 19	− 50
6 19	− 3	− 19	− 8	− 71	− 49	− 29	− 53	− 41	− 54	− 47	− 4	− 2	− 32
7 19	+ 38	+ 3	− 1	− 24	+ 5	+ 15	+ 8	− 29	− 68	− 20	+ 71	+ 41	+ 3
8 19	+ 87	+ 67	+ 108	+ 81	+ 90	+ 93	+ 79	+ 22	− 16	+ 66	+ 151	+ 92	+ 77
9 19	+ 146	+ 144	+ 211	+ 229	+ 168	+ 187	+ 152	+ 114	+ 98	+ 174	+ 212	+ 146	+ 165
10 19	**+ 184**	+ 223	+ 305	+ 299	+ 256	+ 265	+ 239	+ 164	+ 173	+ 236	+ 262	+ 190	+ 233
11 19	+ 184	**+ 271**	**+ 351**	**+ 319**	**+ 284**	**+ 280**	**+ 253**	**+ 194**	**+ 216**	**+ 275**	**+ 264**	**+ 203**	**+ 258**
12 19	+ 142	+ 269	+ 310	+ 266	+ 256	+ 265	+ 242	+ 185	+ 214	+ 240	+ 196	+ 166	+ 229
13 19	+ 80	+ 174	+ 172	+ 193	+ 183	+ 213	+ 195	+ 155	+ 156	+ 137	+ 115	+ 81	+ 154
14 19	+ 35	+ 91	+ 94	+ 112	+ 91	+ 124	+ 125	+ 112	+ 94	+ 40	+ 20	+ 28	+ 80
15 19	− 11	+ 22	+ 24	+ 49	+ 17	+ 40	+ 25	+ 27	+ 29	+ 4	− 50	− 11	+ 14
16 19	− 37	− 27	− 34	− 25	− 52	− 66	− 59	− 31	− 25	− 45	− 84	− 59	− 45
17 19	− 59	− 80	− 57	− 93	− 90	− 113	− 108	− 49	− 14	− 81	− 99	− 79	− 77
18 19	− 73	− 74	− 96	− 119	− 124	**− 143**	**− 116**	− 68	− 25	− 104	− 113	− 73	− 94
19 19	− 88	− 115	− 154	− 143	− 118	− 139	− 107	− 90	− 81	− 103	− 114	− 73	− 110
20 19	**− 91**	− 129	− 159	**− 160**	− 112	− 142	− 105	**− 97**	**− 111**	− 99	− 124	− 91	**− 118**
21 19	− 87	**− 154**	− 161	− 154	− 109	− 121	− 92	− 78	− 85	**− 123**	**− 147**	− 94	− 117
22 19	− 82	− 151	**− 171**	− 136	**− 149**	− 116	− 73	− 79	− 105	− 109	− 116	**− 97**	− 115
23 19	− 82	− 131	− 151	− 115	− 76	− 101	− 89	− 85	− 94	− 109	− 99	− 72	− 100
Range ...	275	425	522	479	433	423	369	291	327	398	411	300	376
Average progressive change per day.	− 3	− 3	− 4	− 2	− 2	0	− 2	− 7	− 3	+ 2	0	0	− 2

1899 Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 45	− 41	− 96	− 106	− 73	− 86	− 66	− 70	− 49	− 65	− 91	− 54	− 70
1 19	− 52	− 46	− 97	− 87	− 72	− 81	− 80	− 63	− 42	− 58	− 74	− 52	− 67
2 19	− 67	− 8	− 76	− 90	− 47	− 86	− 78	− 61	− 38	− 41	− 67	− 41	− 58
3 19	− 43	− 14	− 44	− 78	− 58	− 80	− 67	− 61	− 32	− 57	− 64	− 36	− 53
4 19	− 23	− 23	− 59	− 76	− 65	− 86	− 68	− 64	− 28	− 52	− 57	− 43	− 54
5 19	− 17	− 2	− 60	− 73	− 52	− 74	− 76	− 62	− 32	− 48	− 42	− 23	− 47
6 19	− 16	− 13	− 60	− 64	− 17	− 49	− 42	− 39	− 50	− 44	− 17	− 6	− 35
7 19	+ 10	+ 5	− 11	− 35	+ 23	+ 9	+ 11	+ 7	− 54	− 29	+ 52	+ 38	+ 2
8 19	+ 40	+ 34	+ 87	+ 61	+ 124	+ 92	+ 74	+ 82	− 4	+ 39	+ 127	+ 80	+ 70
9 19	+ 80	+ 105	+ 217	+ 192	+ 196	+ 190	+ 165	+ 153	+ 131	+ 131	+ 192	+ 129	+ 157
10 19	+ 140	+ 163	+ 292	+ 310	**+ 265**	+ 270	+ 246	+ 208	+ 189	+ 199	+ 234	+ 169	+ 224
11 19	**+ 157**	**+ 219**	**+ 326**	**+ 329**	+ 264	**+ 276**	**+ 274**	**+ 243**	+ 214	**+ 247**	**+ 238**	**+ 182**	**+ 247**
12 19	+ 140	+ 214	+ 267	+ 269	+ 209	+ 248	+ 249	+ 234	**+ 227**	+ 214	+ 185	+ 157	+ 218
13 19	+ 96	+ 155	+ 159	+ 198	+ 135	+ 175	+ 188	+ 182	+ 169	+ 122	+ 103	+ 88	+ 147
14 19	+ 60	+ 44	+ 54	+ 106	+ 64	+ 94	+ 105	+ 110	+ 74	+ 35	+ 32	+ 38	+ 68
15 19	+ 29	− 27	− 24	+ 36	− 32	− 2	+ 15	+ 18	− 20	0	− 16	− 11	− 3
16 19	− 21	− 95	− 67	− 29	− 85	− 77	− 57	− 57	− 74	− 35	− 54	− 39	− 57
17 19	− 48	**− 123**	− 89	− 106	− 115	− 93	− 86	− 101	− 95	− 58	− 77	− 64	− 88
18 19	− 64	− 121	− 110	− 140	**− 138**	− 104	− 121	− 118	− 100	− 79	− 94	− 83	− 106
19 19	− 73	− 90	− 127	**− 143**	− 133	− 112	− 129	**− 122**	**− 106**	− 80	− 101	− 94	**− 109**
20 19	**− 82**	− 94	− 128	− 130	− 120	**− 118**	**− 136**	− 121	− 82	− 85	− 94	− 95	− 107
21 19	− 64	− 82	**− 131**	− 122	− 104	− 105	− 119	− 119	− 74	− 80	**− 110**	**− 107**	− 101
22 19	− 68	− 87	− 104	− 123	− 97	− 105	− 107	− 106	− 72	− 87	− 105	− 80	− 95
23 19	− 69	− 74	− 119	− 97	− 72	− 98	− 94	− 75	− 51	**− 92**	− 103	− 54	− 83
Range ...	239	342	457	472	403	394	410	365	333	339	348	289	356
Average progressive change per day.	− 2	− 3	− 2	− 4	− 3	− 1	− 1	− 2	3	− 1	− 1	**− 2**	− 2

TABLES 47 & 48.—*Horizontal Force Magnetograph—showing the mean diurnal inequalities for each month of the years 1900 and 1901 and for the whole year.*

Unity = 1γ = ·000001 C. G. S.

1900. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 35	− 87	− 107	− 98	− 62	− 80	− 110	− 99	− 68	− 80	− 87	− 68	− 82
1 19	− 55	− 88	− 88	− 91	− 58	− 81	− 105	− 90	− 67	− 75	− 75	− 63	− 78
2 19	− 56	− 71	− 72	− 79	− 63	− 89	− 103	− 84	− 64	− 74	− 82	− 58	− 75
3 19	− 52	− 64	− 57	− 80	− 57	− 94	− 99	− 85	− 62	− 65	− 73	− 50	− 70
4 19	− 34	− 59	− 56	− 79	− 58	− 98	− 93	− 91	− 64	− 62	− 67	− 48	− 67
5 19	− 23	− 42	− 53	− 74	− 65	− 97	− 91	− 85	− 66	− 60	− 54	− 43	− 63
6 19	+ 1	− 33	− 37	− 74	− 41	− 65	− 66	− 66	− 71	− 53	− 22	− 20	− 46
7 19	+ 32	− 1	− 1	− 56	+ 2	+ 7	− 6	− 14	− 66	− 23	+ 41	+ 41	− 4
8 19	+ 73	+ 67	+ 86	+ 17	+ 102	+ 86	+ 78	+ 74	− 10	+ 46	+ 126	+ 96	+ 70
9 19	+ 109	+ 144	+ 197	+ 139	+ 176	+ 160	+ 174	+ 168	+ 126	+ 144	+ 197	+ 145	+ 157
10 19	+ 159	+ 210	+ 281	+ 245	+ 225	+ 238	+ 277	+ 236	+ 216	+ 233	**+ 231**	+ 175	+ 227
11 19	**+ 194**	**+ 261**	**+ 307**	**+ 290**	**+ 231**	**+ 259**	**+ 311**	**+ 260**	**+ 240**	**+ 266**	+ 227	**+ 198**	**+ 254**
12 19	+ 170	+ 229	+ 250	+ 262	+ 214	+ 242	+ 285	+ 245	+ 226	+ 238	+ 163	+ 141	+ 222
13 19	+ 124	+ 155	+ 148	+ 197	+ 160	+ 178	+ 230	+ 197	+ 172	+ 132	+ 82	+ 86	+ 155
14 19	+ 57	+ 68	+ 63	+ 118	+ 86	+ 96	+ 139	+ 108	+ 97	+ 49	+ 30	+ 37	+ 79
15 19	− 22	+ 14	+ 8	+ 51	+ 13	+ 9	+ 43	+ 34	+ 23	− 4	− 13	+ 2	+ 13
16 19	− 68	− 34	− 44	− 6	− 47	− 53	− 37	− 35	− 24	− 37	− 47	− 44	− 40
17 19	− 77	− 45	− 86	− 50	− 97	− 80	− 92	− 70	− 44	− 53	− 59	− 65	− 68
18 19	− 74	− 75	− 99	− 84	**− 128**	**− 98**	− 126	− 95	− 57	− 71	− 75	− 70	− 88
19 19	− 79	− 95	− 106	− 101	− 126	− 96	− 121	− 106	− 76	− 87	− 83	− 72	− 96
20 19	**− 112**	− 106	− 112	− 110	− 124	− 94	− 124	**− 108**	− 88	**− 96**	− 94	− 73	− 103
21 19	− 83	− 118	− 135	**− 119**	− 115	− 86	**− 128**	− 107	**− 97**	− 93	**− 96**	**− 81**	**− 105**
22 19	− 92	**− 120**	**− 153**	− 113	− 95	− 85	− 120	− 95	− 96	− 92	− 90	− 80	− 103
23 19	− 68	− 110	− 137	− 103	− 71	− 78	− 116	− 92	− 77	− 87	− 82	− 77	− 91
Range ...	296	381	460	409	360	357	439	368	337	362	327	279	359
Average progressive change per day.	0	− 2	− 3	− 4	− 2	+ 2	0	− 1	− 2	− 2	− 1	− 1	− 1

1901. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 77	− 97	− 116	− 119	− 89	− 66	− 80	− 72	− 63	− 66	− 66	− 70	− 82
1 19	− 67	− 95	− 119	− 109	− 75	− 70	− 84	− 69	− 59	− 66	− 67	− 62	− 78
2 19	− 56	− 89	− 101	− 101	− 82	− 71	− 83	− 70	− 50	− 56	− 54	− 55	− 72
3 19	− 53	− 76	− 91	− 98	− 87	− 75	− 81	− 75	− 41	− 58	− 52	− 45	− 69
4 19	− 47	− 67	− 87	− 90	− 94	− 78	− 74	− 71	− 46	− 58	− 45	− 38	− 66
5 19	− 38	− 57	− 83	− 77	− 86	− 70	− 74	− 66	− 50	− 57	− 37	− 32	− 61
6 19	− 27	− 37	− 70	− 74	− 76	− 53	− 41	− 47	− 56	− 55	− 18	− 19	− 48
7 19	+ 20	+ 1	− 24	− 44	− 36	0	+ 20	+ 2	− 67	− 23	+ 37	+ 36	− 6
8 19	+ 71	+ 85	+ 81	+ 48	+ 51	+ 66	+ 83	+ 66	− 15	+ 54	+ 108	+ 88	+ 74
9 19	+ 121	+ 179	+ 223	+ 189	+ 162	+ 152	+ 161	+ 155	+ 95	+ 158	+ 156	+ 144	+ 158
10 19	+ 160	+ 228	+ 305	+ 299	+ 242	+ 220	+ 230	+ 218	+ 184	+ 214	+ 205	+ 184	+ 224
11 19	**+ 187**	**+ 266**	**+ 316**	**+ 317**	**+ 272**	**+ 236**	**+ 256**	**+ 229**	**+ 220**	**+ 252**	**+ 207**	**+ 186**	**+ 245**
12 19	+ 160	+ 224	+ 259	+ 280	+ 239	+ 211	+ 233	+ 220	+ 207	+ 212	+ 148	+ 152	+ 212
13 19	+ 106	+ 138	+ 166	+ 208	+ 186	+ 160	+ 184	+ 161	+ 144	+ 116	+ 71	+ 85	+ 144
14 19	+ 60	+ 56	+ 80	+ 108	+ 106	+ 85	+ 104	+ 85	+ 74	+ 42	+ 8	+ 15	+ 69
15 19	+ 10	+ 1	+ 9	+ 30	+ 23	− 3	+ 17	+ 19	+ 22	− 16	− 20	− 32	+ 5
16 19	− 27	− 34	− 34	− 24	− 35	− 65	− 60	− 48	− 18	− 48	− 42	− 49	− 40
17 19	− 48	− 53	− 53	− 56	− 61	− 79	− 94	− 88	− 36	− 56	− 55	− 59	− 61
18 19	− 53	− 69	− 81	− 89	− 92	− 92	− 110	**− 104**	− 53	− 73	− 73	− 62	− 79
19 19	− 65	− 93	− 100	− 117	− 97	**− 98**	**− 114**	− 96	− 73	− 90	− 76	− 75	− 91
20 19	− 79	− 102	− 119	− 121	− 95	− 90	− 111	− 97	− 78	**− 93**	− 86	**− 76**	**− 96**
21 19	**− 87**	− 104	− 122	− 123	**− 99**	− 84	− 106	− 95	**− 87**	− 86	− 84	− 72	− 96
22 19	− 85	**− 109**	**− 125**	**− 124**	− 88	− 75	− 90	− 82	− 79	− 79	**− 92**	− 74	− 92
23 19	− 85	− 90	− 119	− 111	− 86	− 69	− 83	− 75	− 70	− 69	− 69	− 69	− 83
Range ...	274	375	441	441	371	334	370	333	307	346	299	262	341
Average progressive change per day.	− 1	− 2	− 4	− 4	− 3	− 1	0	− 2	− 2	− 2	− 1	− 1	− 2

TABLES 49 & 50.—*Horizontal Force Magnetograph—showing the mean diurnal inequalities for each month of the years 1902 and 1903 and for the whole year.*

Unity = ·1γ = ·000001 C. G. S.

1902. Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 19	– 53	– 86	– 91	– 83	– 96	– 71	– 61	– 76	– 75	– 83	– 77	– 61	– 76
1 19	– 53	– 82	– 96	– **84**	– 78	– 71	– 63	– 68	– 68	– 80	– 73	– 62	– 73
2 19	– 52	– 60	– 95	– 77	– 67	– 66	– 77	– 61	– 58	– 73	– 68	– 62	– 68
3 19	– 54	– 71	– 89	– 67	– 73	– 67	– 80	– 75	– 52	– 62	– 58	– 66	– 68
4 19	– 43	– 60	– 76	– 61	– 71	– 66	– 77	– 81	– 49	– 61	– 57	– 57	– 63
5 19	– 29	– 48	– 79	– 70	– 70	– 69	– 77	– 71	– 44	– 55	– 48	– 45	– 59
6 19	– 14	– 38	– 65	– 67	– 47	– 57	– 56	– 65	– 63	– 51	– 19	– 20	– 47
7 19	+ 13	+ 7	– 17	– 44	– 11	– 9	– 16	– 47	– 80	– 32	+ 58	+ 33	– 12
8 19	+ 47	+ 76	+ 88	+ 43	+ 71	+ 59	+ 47	+ 13	– 33	+ 55	+ 130	+ 83	+ 57
9 19	+ 80	+ 152	+ 220	+ 186	+ 159	+ 150	+ 135	+ 107	+ 83	+ 155	+ 204	+ 137	+ 147
10 19	+ 135	+ 187	+ 307	+ 282	+ 241	+ 227	+ 202	+ 182	+ 167	+ 246	+ 229	+ **187**	+ 216
11 19	+ **174**	+ **226**	+ **311**	+ **283**	+ **261**	+ **255**	+ **237**	+ **230**	+ 217	+ **283**	+ **237**	+ 187	+ **242**
12 19	+ 147	+ 211	+ 258	+ 244	+ 225	+ 235	+ 218	+ 221	+ **221**	+ 244	+ 176	+ 139	+ 212
13 19	+ 86	+ 136	+ 146	+ 153	+ 169	+ 175	+ 163	+ 195	+ 179	+ 142	+ 99	+ 81	+ 144
14 19	+ 37	+ 65	+ 42	+ 65	+ 89	+ 84	+ 94	+ 112	+ 99	+ 53	+ 24	+ 34	+ 66
15 19	+ 5	+ 4	– 30	– 1	+ 25	+ 5	+ 15	+ 45	+ 38	– 3	– 34	– 2	+ 6
16 19	– 23	– 48	– 66	– 46	– 32	– 54	– 39	– 21	– 8	– 36	– 65	– 35	– 39
17 19	– 36	– 77	– 71	– 81	– 68	– 91	– 70	– 54	– 26	– 61	– 83	– 61	– 65
18 19	– 43	– 78	– 83	– 94	– 94	– **106**	– 90	– 68	– 47	– 72	– 86	– 59	– 77
19 19	– 59	– 87	– 98	– **103**	– 106	– 99	– **92**	– 78	– 62	– 89	– 103	– 65	– 87
20 19	– **70**	– 84	– 101	– 102	– 113	– 101	– 88	– **96**	– 73	– 108	– **111**	– **74**	– 93
21 19	– 62	– 84	– **113**	– 100	– **116**	– 101	– 85	– 89	– 91	– **108**	– 102	– 73	– **94**
22 19	– 69	– **90**	– 108	– 97	– 105	– 90	– 75	– 85	– **94**	– 103	– 94	– 66	– 90
23 19	– 68	– 75	– 101	– 80	– 94	– 75	– 66	– 72	– 82	– 97	– 83	– 68	– 80
Range ...	244	316	424	386	377	361	329	326	315	391	348	261	336
Average progressive change per day.	– 1	– 1	– 4	– [illegible]	– 2	– 2	– 2	– 1	– 1	– 3	– 1	0	– 2

1903. Bombay Civil Time.	January.	February.	March.	April.	May.	June	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 19	– 71	– 64	– 105	– 105	– 92	– 96	– 88	– 69	– 54	– 77	– 65	– 87	– 81
1 19	– 68	– 66	– 102	– 102	– 98	– 90	– 89	– 68	– 35	– 62	– 46	– 71	– 75
2 19	– 57	– 66	– 95	– 105	– 92	– 88	– 93	– 56	– 29	– 35	– 54	– 65	– 70
3 19	– 56	– 62	– 90	– 94	– 85	– 71	– 90	– 60	– 30	+ 2	– 60	– 60	– 63
4 19	– 41	– 56	– 92	– 75	– 90	– 74	– 88	– 46	– 41	+ 17	– 42	– 40	– 56
5 19	– 27	– 50	– 95	– 66	– 81	– 74	– 90	– 37	– 41	– 6	– 47	– 37	– 54
6 19	– 19	– 30	– 77	– 55	– 73	– 55	– 54	– 35	– 54	– 27	– 14	– 27	– 43
7 19	+ 5	+ 4	– 34	– 13	– 20	– 7	– 8	– 19	– 75	+ 9	+ 42	+ 29	– 7
8 19	+ 48	+ 78	+ 70	+ 89	+ 74	+ 64	+ 58	+ 32	– 14	+ 63	+ 120	+ 104	+ 65
9 19	+ 103	+ 159	+ 196	+ 225	+ 176	+ 159	+ 142	+ 129	+ 105	+ 152	+ 209	+ 144	+ 158
10 19	+ 164	+ 198	+ 291	+ 322	+ 253	+ 246	+ 258	+ 203	+ 206	+ 311	+ 220	+ 201	+ 239
11 19	+ **191**	+ **211**	+ **334**	+ **345**	+ **281**	+ **279**	+ **299**	+ **262**	+ **235**	+ **399**	+ **243**	+ **219**	+ **27**[illegible]
12 19	+ 154	+ 179	+ 279	+ 288	+ 259	+ 260	+ 274	+ 253	+ 207	+ 358	+ 181	+ 189	+ 240
13 19	+ 102	+ 133	+ 193	+ 216	+ 204	+ 211	+ 222	+ 179	+ 146	+ 228	+ 104	+ 126	+ 172
14 19	+ 47	+ 65	+ 99	+ 120	+ 120	+ 127	+ 142	+ 99	+ 68	+ 57	+ 9	+ 70	+ 85
15 19	+ 11	– 7	+ 16	+ 14	+ 32	+ 31	+ 33	+ 22	+ 5	– 49	– 38	+ 17	+ 8
16 19	– 20	– 51	– 45	– 72	– 27	– 49	– 50	– 46	– 55	– 61	– 93	– 36	– 50
17 19	– 36	– 65	– 72	– 122	– 76	– 91	– 100	– 98	– 64	– 151	– 84	– 64	– 85
18 19	– 44	– 76	– 89	– 134	– 110	– 113	– **120**	– 119	– 77	– 188	– 89	– 66	– 102
19 19	– 67	– 84	– 102	– 142	– 114	– 117	– 118	– **128**	– 90	– **219**	– 101	– 90	– 114
20 19	– 79	– 91	– 111	– **146**	– 114	– **131**	– 114	– 121	– **91**	– 211	– 97	– 114	– **118**
21 19	– **85**	– **97**	– **126**	– 141	– **116**	– 110	– 117	– 104	– 90	– 202	– **104**	– **119**	– 118
22 19	– 82	– 91	– 125	– 129	– 106	– 123	– 116	– 95	– 71	– 173	– 98	– 110	– 110
23 19	– 77	– 76	– 112	– 113	– 103	– 91	– 93	– 76	– 67	– 131	– 94	– 110	– 95
Range ...	276	308	460	491	397	410	419	390	326	618	347	338	393
Average progressive change per day.	0	– 1	– 5	– 5	– 3	– 2	– 2	– 2	– 4	– 3	– 2	– 1	– 2

TABLES 51 *and* 52.—*Horizontal Force Magnetograph —showing the mean Diurnal Inequalities for each month of the years 1904 and 1905 and for the whole year.*

Unity = ·1γ = ·000001 C. G. S.

1904. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 49	− 91	−135	− 98	− 91	−109	− 95	−100	− 82	− 80	− 85	− 70	− 90
1 19	− 63	− 79	−114	−117	− 96	−105	−103	− 92	− 77	− 71	− 68	− 55	− 87
2 19	− 41	− 86	−114	−110	− 98	− 97	−111	− 89	− 64	− 59	− 64	− 53	− 82
3 19	− 30	− 61	−107	− 91	− 87	− 95	−106	− 81	− 54	− 56	− 52	− 53	− 73
4 19	− 20	− 55	−106	−100	− 80	− 96	−111	− 64	− 50	− 53	− 49	− 55	− 70
5 19	− 11	− 53	− 98	− 92	− 68	− 91	−109	− 68	− 49	− 42	− 31	− 39	− 63
6 19	− 8	− 35	− 92	− 93	− 44	− 50	− 83	− 57	− 80	− 45	− 8	− 16	− 51
7 19	+ 19	− 8	− 17	− 46	+ 18	+ 37	− 22	− 64	−102	− 24	+ 66	+ 55	− 7
8 19	+ 52	+ 43	+ 85	+ 86	+113	+150	+ 70	− 3	− 34	+ 48	+146	+126	+ 73
9 19	+ 83	+134	+252	+243	+222	+240	+182	+124	+118	+156	+235	+193	+182
10 19	+129	+197	+345	+335	+301	+318	+291	+233	+214	+246	**+298**	**+238**	+262
11 19	**+183**	**+250**	**+387**	**+353**	**+312**	**+348**	+331	+286	**+282**	**+307**	+297	+219	**+296**
12 19	+169	+227	+331	+335	+274	+309	**+333**	**+288**	+269	+269	+218	+164	+265
13 19	+112	+162	+217	+217	+204	+239	+276	+241	+195	+171	+104	+ 92	+186
14 19	+ 49	+ 82	+ 89	+100	+102	+117	+163	+146	+107	+ 78	+ 26	+ 26	+ 90
15 19	− 5	+ 11	− 6	+ 13	+ 19	− 6	+ 31	+ 71	+ 28	+ 10	− 24	− 31	+ 9
16 19	− 36	− 42	− 56	− 62	− 66	−105	− 70	+ 2	− 31	− 47	− 71	− 79	− 55
17 19	− 55	− 72	− 79	− 96	−120	−150	−114	− 51	− 42	− 73	−103	− 90	− 87
18 19	− 48	− 79	−102	−126	**−156**	**−163**	−128	− 81	− 72	− 99	−125	− 98	−106
19 19	− 69	− 76	−127	**−148**	−155	−154	−127	−105	− 92	−122	−158	− 89	−118
20 19	− 87	− 88	−136	−135	−144	−152	−133	−133	− 85	**−139**	−154	**−109**	−125
21 19	− 84	**−104**	**−146**	−123	−132	−137	**−141**	**−146**	−103	−136	**−166**	− 96	**−126**
22 19	− 91	− 86	−145	−126	−125	−130	−129	−133	**−105**	−129	−137	−101	−120
23 19	**− 95**	− 94	−131	−119	− 98	−115	− 98	−118	− 89	−107	−100	− 84	−104
Range ...	278	354	533	501	468	511	474	434	387	446	464	347	422
Average progressive change per day.	+ 1	+ 2	− 3	− 6	− 2	+ 1	+ 1	− 2	− 3	− 3	+ 1	− 1	− 1

1905. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−107	−121	−142	−140	−108	−133	−117	− 99	− 57	−123	−149	− 98	−116
1 19	− 63	−112	−139	−141	−125	−119	−121	− 87	− 60	−106	−142	−101	−110
2 19	− 61	− 84	−121	−135	−114	−113	−112	− 84	− 57	− 95	−152	− 85	−101
3 19	− 60	− 61	−137	−112	−109	−118	−116	− 81	− 50	− 93	−128	− 79	− 95
4 19	− 46	− 69	−137	− 94	−110	−114	−104	− 79	− 59	− 98	−111	− 80	− 92
5 19	− 27	− 63	−132	− 99	−110	− 96	− 95	− 75	− 58	− 91	− 97	− 74	− 85
6 19	− 18	− 47	− 99	− 99	− 98	− 66	− 75	− 40	− 87	− 90	− 42	− 43	− 67
7 19	+ 35	+ 2	− 22	− 68	− 56	+ 19	− 10	+ 14	−109	− 74	+ 70	+ 30	− 14
8 19	+ 89	+ 78	+104	+ 55	+ 40	+115	+ 62	+112	− 18	+ 18	+186	+ 92	+ 78
9 19	+132	+180	+254	+215	+161	+225	+187	+218	+139	+149	+284	+168	+193
10 19	+163	+218	+391	+349	+280	+314	+287	+299	+253	+277	+372	+222	+285
11 19	**+204**	**+293**	**+422**	**+372**	**+326**	**+347**	**+336**	**+325**	**+294**	**+372**	**+407**	**+246**	**+329**
12 19	+175	+292	+373	+325	+300	+337	+304	+269	+271	+345	+294	+205	+291
13 19	+132	+210	+268	+249	+250	+279	+253	+190	+207	+240	+158	+129	+214
14 19	+ 74	+115	+137	+137	+162	+177	+180	+106	+107	+140	+ 72	+ 80	+124
15 19	+ 27	+ 22	+ 6	+ 44	+ 66	+ 37	+ 77	+ 19	+ 12	+ 46	− 14	+ 29	+ 31
16 19	− 33	− 38	− 60	− 26	− 3	− 80	− 28	− 52	− 52	− 34	− 63	− 25	− 41
17 19	− 66	− 78	− 81	− 58	− 62	−132	− 95	−110	− 68	− 61	− 74	− 35	− 77
18 19	− 66	− 91	− 87	− 77	− 96	−138	−140	−138	− 88	− 74	− 99	− 54	− 96
19 19	− 74	−105	−151	−122	−108	−145	−142	**−153**	−112	−101	−116	− 66	−116
20 19	− 90	−127	−143	−138	−112	−148	**−144**	−153	−107	−128	−144	− 95	−127
21 19	−105	**−155**	−165	**−157**	−117	**−161**	−133	−144	**−123**	**−147**	**−180**	−122	**−142**
22 19	− 96	−139	**−176**	−150	**−129**	−137	−130	−135	−104	−147	−169	**−129**	−137
23 19	**−119**	−119	−160	−130	−128	−147	−119	−117	− 80	−129	−168	−122	−128
Range ...	323	448	598	529	455	508	480	478	417	519	587	375	471
Average progressive change per day.	−2	−1	−2	−3	−3	−2	−1	−3	−2	−4	−1	+4	−2

TABLE 53.—*Inequalities of Temperature in Horizontal Force Magnetograph Enclosure.*

Years.	January.						February.						March.						April.					
	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.
1873 ...	+·19	+·07	−·04	−·11	−·12	87°·86	+·18	+·01	−·11	−·18	+·08	87°·99	+·12	·00	−·09	−·12	+·10	89°·21	+·13	−·03	−·11	−·12	+·14	92°·00
1874 ...	−·05	+·02	+·03	+·02	−·02	84·91	−·11	+·04	+·04	+·03	·00	84·17	+·06	+·06	+·08	+·02	−·10	84·84	−·14	+·06	+·03	+·06	−·02	86·68
1875 ...	−·10	+·05	+·09	+·05	−·09	84·86	−·10	+·07	+·06	+·03	−·05	83·59	...	...	...	...	...	...	...	...	...	...	...	...
1876 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1877 ...	...	...	...	...	...	...	...	...	...	...	...	...	−·02	+·12	−·04	−·08	·00	89·08	−·05	+·19	−·06	−·10	+·01	90·71
1878 ...	+0·5	+·14	−·03	−·14	−·04	88·74	+·03	+·16	−·06	−·13	+·01	88·21	+·01	+·13	−·03	−·15	+·02	89·34	+·04	+·15	−·03	−·09	−·05	91·02
1879 ...	·00	+·10	−·05	−·03	−·02	87·51	+·01	+·06	−·03	−·04	+·01	87·62	+·01	+·15	−·01	−·08	−·07	88·06	+·03	+·08	−·02	−·03	−·04	89·92
1880 ...	−·09	+·01	+·06	+·03	−·01	84·70	+·04	+·09	−·02	−·11	+·02	84·01	−·03	+·10	−·03	−·06	+·03	85·53	−·06	+·06	+·02	−·01	−·03	88·47
1881 ...	−·01	+·02	+·02	−·02	·00	86·12	−·08	+·06	+·03	+·02	−·03	86·00	−·04	+·13	−·02	−·04	−·01	87·09	−·02	+·16	−·01	−·06	−·07	88·21
1882 ...	+·23	+·09	−·06	−·12	−·15	86·73	+·31	+·13	−·12	−·18	−·14	86·15	+·17	+·11	−·07	−·12	−·07	87·02	+·20	+·06	−·07	−·11	−·09	89·13
1883 ...	+·21	+·09	−·07	−·10	−·11	87·64	+·25	+·10	−·08	−·15	−·12	86·22	+·26	+·09	−·08	−·15	−·10	86·63	+·10	−·04	−·02	−·02	−·03	89·31
1884 ...	−·08	+·09	+·03	·00	−·02	83·41	−·04	+·14	+·01	−·03	−·07	83·15	+·04	+·12	−·01	−·06	−·08	84·93	+·09	+·09	−·04	−·09	−·06	87·37
1885 ...	−·02	+·13	·00	−·05	−·05	86·71	+·01	+·17	−·03	−·09	−·05	85·94	+·11	+·13	−·12	−·11	−·01	87·05	+·09	+·15	−·05	−·10	−·07	89·07
1886 ...	−·10	+·14	+·01	−·03	−·03	88·04	+·03	+·12	−·05	−·07	−·01	87·39	+·02	+·13	−·01	−·06	−·10	88·35	+·06	+·08	−·02	−·07	−·06	89·98
1887 ...	−·03	+·07	−·01	−·03	·00	87·72	−·03	+·04	+·01	·00	−·01	86·95	+·07	+·05	−·03	−·06	−·03	88·09	+·07	+·04	−·02	−·06	−·03	90·00
1888 ...	−·04	+·04	+·01	·00	+·01	87·51	−·02	+·02	·00	·00	·00	87·42	+·06	+·05	−·05	−·07	−·02	89·20	+·09	+·12	−·05	−·10	−·07	91·48
1889 ...	−·04	+·10	−·02	−·03	−·03	89·63	−·02	+·10	−·01	−·05	−·04	89·23	+·04	+·12	−·07	−·07	−·02	90·23	+·05	+·12	−·05	−·06	−·06	91·58
1890 ...	−·03	+·12	−·02	−·03	−·02	88·17	−·01	+·13	−·03	−·05	−·05	88·42	·00	+·14	−·03	−·02	−·09	89·79	−·01	+·06	−·01	−·01	−·03	91·44
1891 ...	−·08	+·12	+·01	+·01	−·04	88·72	−·07	+·11	·00	+·01	−·03	87·75	−·03	+·12	−·01	−·03	−·07	88·64	+·01	+·08	−·03	−·04	−·02	91·21
1892 ...	−·06	+·07	+·01	−·01	−·01	88·30	−·07	+·06	·00	+·01	·00	88·50	−·05	+·10	·00	−·01	−·01	89·00	+·02	+·08	−·04	−·04	−·01	92·97
1893 ...	−·11	+·12	+·02	+·01	−·03	87·83	−·09	+·06	·00	+·03	−·01	86·87	−·03	+·07	−·03	·00	·00	88·40	+·03	·00	−·07	−·02	+·05	91·35
1894 ...	−·10	+·17	−·02	−·05	−·01	89·29	−·01	+·18	−·05	−·07	−·07	89·28	+·01	+·15	−·06	−·11	+·01	90·40	+·03	+·11	−·08	−·06	−·01	92·53
1895 ...	−·13	+·18	−·02	−·01	−·01	88·56	−·06	+·19	−·05	−·05	−·04	88·65	−·03	+·19	−·04	−·06	−·04	90·57	−·02	+·14	−·06	−·07	·00	92·11
1896 ...	−·08	+·22	−·01	−·08	−·07	89·88	−·10	+·22	−·01	−·03	−·10	89·41	+·03	+·19	−·07	−·10	−·04	90·50	+·03	+·12	−·07	−·09	·00	93·34
1897 ...	−·07	+·19	−·03	−·04	−·02	88·76	−·01	+·16	−·05	−·07	−·04	88·07	+·05	+·17	−·09	−·11	+·01	88·95	+·06	+·12	−·06	−·08	−·02	91·37
1898 ...	−·08	+·12	−·03	−·02	+·01	88·13	−·03	+·20	−·03	−·08	−·05	88·64	+·02	+·17	−·08	−·13	+·01	89·63	+·01	+·20	−·05	−·10	−·07	92·17
1899 ...	−·09	+·21	·00	−·04	−·06	88·14	−·04	+·16	−·05	−·04	−·01	88·24	+·05	+·17	−·08	−·10	−·03	89·60	+·02	+·19	−·07	−·10	−·01	92·26
1900 ...	−·07	+·30	−·06	−·10	−·06	89·61	−·01	+·25	−·10	−·10	−·03	88·82	+·02	+·23	−·13	−·09	−·02	90·14	+·04	+·17	−·09	−·10	−·01	92·15
1901 ...	·00	+·24	−·06	−·09	−·08	88·93	+·06	+·22	−·09	−·16	−·03	87·63	+·11	+·19	−·13	−·17	−·02	89·67	+·06	+·19	−·12	−·16	·00	92·52
1902 ...	−·02	+·22	−·11	−·11	+·01	89·44	+·03	+·21	−·11	−·11	·00	89·06	+·08	+·24	−·12	−·19	·00	90·68	+·06	+·21	−·08	−·13	−·05	92·94
1903 ...	−·01	+·16	−·10	−·06	·00	89·20	−·01	+·14	−·10	−·06	+·03	87·76	·00	+·14	−·08	−·08	+·02	88·89	+·08	+·09	−·09	−·08	+·02	90·80
1904 ...	−·03	+·15	−·03	−·07	·00	87·57	·00	+·13	−·05	−·07	·00	88·36	−·01	+·17	−·05	−·07	−·03	89·14	+·02	+·14	−·02	−·06	−·08	91·18
1905 ...	−·05	+·12	−·02	−·04	+·01	88·73	−·01	+·15	−·07	−·07	·00	86·85	+·03	+·18	−·07	−·09	−·04	87·99	+·12	+·16	−·13	−·14	·00	90·23

TABLE 53.—*Inequalities of Temperature in Horizontal Force Magnetograph Enclosure.*

Years.	May. 6	10	14	16	22	Monthly mean.	June. 6	10	14	16	22	Monthly mean.
1873 ...	+·20	−·06	−·10	−·16	+·10	93°·93	+·01	−·02	+·05	+·06	−·11	94°·41
1874 ...	−·14	·00	+·07	+·06	−·01	90·02	−·08	+·01	+·05	+·02	−·02	91·87
1875 ...	...	...	...	...	...	...	...	...	...	...	...	...
1876 ...	...	...	...	...	...	...	...	...	...	...	...	...
1877 ...	−·07	+·08	−·01	−·03	+·04	92·86	−·06	+·04	+·02	+·01	+·01	94·96
1878 ...	−·02	+·06	·00	−·05	+·03	92·93	−·06	+·03	+·02	+·02	·00	94·79
1879 ...	−·05	+·05	+·02	+·03	−·03	91·86	−·06	−·01	+·03	+·03	+·02	92·57
1880 ...	−·01	+·03	−·01	−·05	+·03	90·21	−·01	+·02	+·03	+·01	−·04	91·67
1881 ...	−·07	+·08	−·03	−·03	+·03	90·55	−·01	+·04	−·02	−·03	+·02	91·28
1882 ...	+·23	+·03	−·08	−·10	−·07	91·07	+·24	+·01	−·08	−·07	−·12	91·51
1883 ...	−·19	+·01	+·12	+·15	−·11	92·33	+·10	+·03	−·07	−·05	−·02	92·72
1884 ...	+·07	+·04	−·05	−·03	−·02	90·24	−·02	+·03	+·01	−·01	·00	91·79
1885 ...	+·09	+·04	−·06	−·07	+·02	91·43	·00	+·06	−·02	−·02	·00	93·01
1886 ...	+·04	+·04	−·02	−·03	−·03	92·69	+·01	+·06	−·02	+·01	−·03	92·93
1887 ...	+·04	+·01	−·01	−·03	·00	92·25	−·01	+·04	+·01	−·01	−·02	92·34
1888 ...	+·01	+·02	−·01	·00	·00	93·32	−·02	+·04	+·03	−·01	−·05	93·96
1889 ...	+·03	+·03	−·03	−·04	−·01	93·13	·00	+·06	−·03	−·03	−·02	93·68
1890 ...	+·02	+·06	−·03	−·04	−·02	93·08	−·04	+·06	+·01	−·01	−·01	93·36
1891 ...	·00	+·05	−·02	·00	−·02	93·40	−·02	+·03	−·01	·00	+·01	94·94
1892 ...	−·02	+·10	−·02	−·02	−·03	95·47	−·09	+·11	+·01	·00	−·04	95·35
1893 ...	+·02	+·04	−·02	−·05	+·01	93·95	−·06	+·10	+·03	·00	−·06	94·25
1894 ...	+·01	+·11	−·03	−·04	−·04	94·44	−·09	+·10	+·01	−·02	−·01	95·04
1895 ...	·00	+·09	−·05	−·05	+·01	94·34	−·03	+·15	−·03	−·05	−·02	95·11
1896 ...	+·01	+·12	−·05	−·06	−·01	95·52	−·07	+·11	+·01	−·02	−·01	95·61
1897 ...	+·04	+·08	−·03	−·07	−·03	94·07	·00	+·10	−·04	−·05	+·02	95·50
1898 ...	+·03	+·13	−·06	−·08	−·04	94·43	−·02	+·12	−·03	−·05	−·03	94·38
1899 ...	−·03	+·11	−·04	−·04	−·01	94·27	−·01	+·14	−·05	−·05	−·01	94·69
1900 ...	+·04	+·17	−·07	−·10	−·05	94·01	−·03	+·13	−·05	−·05	·00	94·81
1901 ...	+·05	+·16	−·10	−·08	−·03	94·41	−·02	+·14	−·05	−·07	−·02	94·79
1902 ...	+·07	+·10	−·09	−·10	+·03	95·14	−·09	+·10	−·03	−·02	+·02	95·76
1903 ...	+·03	+·09	−·07	−·07	+·03	93·32	·00	+·06	−·04	−·02	·00	93·67
1904 ...	+·04	+·08	−·03	−·05	−·01	93·18	−·04	+·09	·00	−·01	−·04	93·51
1905 ...	+·03	+·16	−·07	−·09	−·05	93·35	−·04	+·09	−·04	−·02	+·02	94·88

Years.	July. 6	10	14	16	22	Monthly mean.	August. 6	10	14	16	22	Monthly mean.
1873 ...	·00	−·04	+·04	+·05	−·04	91°·39	−·04	·00	+·03	+·01	+·01	90°·11
1874 ...	−·03	+·01	−·01	+·01	+·01	90·40	−·08	+·02	+·04	+·03	−·01	89·07
1875 ...	...	...	...	...	...	...	...	...	...	...	...	...
1876 ...	...	...	...	...	...	...	...	...	...	...	...	...
1877 ...	−·03	+·01	−·02	+·01	+·01	94·60	−·06	+·02	·00	+·01	+·05	93·95
1878 ...	−·20	−·17	+·12	+·11	+·12	92·74	−·07	+·01	+·01	+·02	+·05	91·50
1879 ...	−·05	+·02	+·01	+·02	+·01	92·13	−·01	−·01	·00	+·01	−·01	91·16
1880 ...	−·02	−·01	+·01	+·01	+·02	89·85	−·03	+·02	+·02	·00	−·03	89·50
1881 ...	−·02	+·05	·00	−·03	+·01	90·08	−·08	+·01	+·02	+·03	+·01	89·93
1882 ...	+·13	+·05	−·07	−·04	−·08	90·48	+·14	+·04	−·06	−·06	−·07	89·82
1883 ...	+·14	+·04	−·05	−·04	−·11	90·79	+·22	+·04	−·05	−·06	−·15	90·01
1884 ...	−·02	+·08	+·02	·00	−·07	90·99	−·02	+·03	−·01	−·01	·00	89·82
1885 ...	+·01	+·05	−·01	−·03	·00	92·35	−·03	+·03	·00	·00	−·01	90·64
1886 ...	−·03	+·03	+·01	+·02	−·03	90·33	·00	+·05	−·01	−·02	·00	89·51
1887 ...	−·05	+·04	+·01	+·02	−·02	89·94	−·02	+·03	−·01	·00	−·02	89·28
1888 ...	−·02	+·07	+·01	−·01	−·04	92·35	−·03	+·04	·00	·00	−·01	91·01
1889 ...	−·05	+·06	·00	−·01	−·02	91·95	−·03	+·02	+·01	+·01	−·01	91·19
1890 ...	−·08	+·08	+·01	−·01	−·03	90·95	−0·5	+·03	−·01	+·04	−·06	89·77
1891 ...	−·06	+·07	·00	−·01	−·01	93·63	−·03	+·05	−·02	−·01	−·01	92·18
1892 ...	−·07	+·10	+·04	·00	−·05	94·41	−·10	+·14	+·02	−·01	−·07	92·23
1893 ...	−·09	+·08	−·01	−·01	+·02	92·41	−·04	+·06	·00	+·02	−·02	91·98
1894 ...	−·12	+·16	+·03	−·03	−·02	93·31	−·02	+·08	−·03	−·06	+·03	91·98
1895 ...	−·08	+·14	+·03	−·05	−·04	93·72	−·04	+·10	−·02	−·04	−·01	91·89
1896 ...	−·05	+·13	+·01	−·05	−·03	92·75	−·03	+·15	−·05	−·05	·00	90·77
1897 ...	−·04	+·10	−·01	−·03	·00	93·97	−·04	+·11	−·01	−·02	−·04	92·16
1898 ...	−·09	+·11	−·01	−·02	·00	92·81	−·04	+·09	−·05	−·02	+·01	91·71
1899 ...	−·04	+·13	−·05	−·01	−·02	93·02	−·02	+·10	−·05	−·04	·00	92·72
1900 ...	−·01	+·14	−·06	−·06	−·01	93·55	−·03	+·13	−·04	−·04	−·01	91·77
1901 ...	−·05	+·16	−·01	−·04	−·05	92·68	−·05	+·13	−·03	−·05	·00	91·12
1902 ...	−·06	+·11	−·03	−·01	+·01	94·74	−·01	+·16	−·06	−·07	−·02	93·88
1903 ...	−·02	+·11	−·06	−·04	+·01	92·72	−·01	+·10	−·05	−·02	·00	91·01
1904 ...	−·01	+·04	−·01	−·01	·00	92·06	−·03	+·07	−·02	−·02	−·02	91·66
1905 ...	−·02	+·10	−·01	−·04	−·02	93·55	−·01	+·10	−·03	−·05	−·03	92·51

TABLE 53.—*Inequalities of Temperature in Horizontal Force Magnetograph Enclosure.*

Years.	September.						October.						November.						December.					
	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.
1873 ...	−·10	−·01	+·03	+·09	−·02	89°·42	−·08	+·02	+·04	+·01	−·01	89°·56	−·05	+·04	+·03	−·01	−·01	89°·14	−·08	+·02	+·07	+·03	−·05	87°·41
1874 ...	−·12	+·05	+·08	+·08	−·09	89·06	−·11	+·03	+·07	+·07	−·04	88·75	−·13	−·02	+·08	+·09	−·04	87·83	−·10	+·02	+·07	+·06	−·04	87·09
1875 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1876 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1877 ...	−·02	+·08	−·05	−·05	+·04	93·25	−·08	+·05	+·04	·00	−·03	93·16	−·07	+·11	+·03	−·04	−·02	92·23	+·02	+·11	−·01	−·09	−·02	91·11
1878 ...	−·03	+·01	−·01	−·01	+·02	91·70	·00	·00	−·01	+·01	+·01	91·56	+·01	−·01	−·02	−·03	+·06	90·95	−·04	+·03	−·01	+·02	+·02	89·23
1879 ...	−·06	+·08	+·04	−·01	−·03	90·52	·00	+·07	−·01	−·05	−·01	90·19	−·03	+·06	+·04	−·03	−·03	89·06	−·05	+·06	+·03	−·05	−·01	86·78
1880 ...	+·02	+·04	−·03	−·05	+·01	88·60	+·02	+·07	−·03	−·04	·00	88·54	+·02	+·04	·00	−·02	−·04	88·04	−·01	+·04	·00	−·04	+·01	86·79
1881 ...	−·01	+·06	−·01	−·02	−·03	90·73	+·17	+·11	−·06	−·11	−·10	89·75	+·21	+·07	−·02	−·09	−·15	89·26	+·27	+·09	−·05	−·11	−·19	87·74
1882 ...	+·19	+·04	−·05	−·09	−·07	89·59	+·18	+·07	−·06	−·09	−·08	89·69	+·20	+·10	−·06	−·08	−·16	88·79	+·23	+·06	−·08	−·14	−·07	88·02
1883 ...	+·18	+·04	−·04	−·06	−·11	89·07	+·25	+·05	−·05	−·09	−·14	88·85	+·28	+·06	−·06	−·09	−·19	87·68	−·08	+·12	+·03	−·02	−·08	84·97
1884 ...	+·01	+·05	−·04	−·04	·00	89·03	+·01	+·10	+·01	−·02	−·07	88·44	−·08	+·09	+·04	·00	−·05	87·44	−·09	+·06	+·05	+·02	−·07	86·52
1885 ...	+·02	+·08	−·03	−·03	−·02	89·80	−·02	+·06	+·02	−·02	−·03	90·06	+·06	+·15	−·01	−·09	−·10	90·26	+·01	+·13	−·01	−·07	−·08	89·22
1886 ...	+·03	+·07	−·03	−·05	−·02	89·04	+·02	+·10	−·03	−·08	−·03	89·34	−·08	+·04	+·05	+·02	−·02	89·34	·00	+·03	·00	−·02	·00	88·67
1887 ...	−·02	+·04	−·01	·00	−·02	88·75	−·02	+·05	+·03	−·04	−·03	88·67	−·04	+·08	+·02	−·02	−·04	88·53	−·04	+·08	+·02	−·04	−·04	87·61
1888 ...	+·02	+·05	−·01	−·02	−·02	90·79	+·02	+·08	−·02	−·05	−·01	91·13	+·03	+·05	−·02	−·03	−·05	91·64	−·02	+·07	·00	−·03	−·04	90·78
1889 ...	+·01	+·07	−·02	−·04	−·02	90·93	−·05	+·05	+·01	+·02	−·02	91·12	−·07	+·10	+·03	+·02	−·08	90·03	−·05	+·11	+·01	·00	−·07	88·65
1890 ...	−·05	+·07	−·02	+·02	−·01	89·42	−·03	+·10	−·04	−·02	−·01	89·46	−·07	+·05	−·02	+·04	−·01	89·53	−·06	+·08	−·01	+·01	−·01	89·63
1891 ...	−·06	+·10	+·01	·00	−·04	91·15	−·03	+·09	−·01	−·02	−·01	90·09	−·07	+·07	·00	·00	−·01	89·83	−·08	+·09	+·02	·00	−·01	88·93
1892 ...	−·08	+·09	+·03	+·01	−·05	90·06	−·06	+·09	+·01	−·01	−·05	90·03	−·09	+·12	+·02	−·02	−·04	89·43	−·07	+·07	·00	·00	−·01	88·76
1893 ...	−·04	+·06	−·02	−·02	·00	92·01	−·07	+·11	−·02	−·01	−·01	91·98	−·05	+·10	−·01	−·02	−·04	91·99	−·06	+·18	·00	−·04	−·10	90·87
1894 ...	−·06	+·14	·00	−·05	−·05	91·13	−·06	+·14	−·04	−·05	+·01	90·87	−·08	+·14	·00	−·03	−·02	90·08	−·06	+·14	−·03	−·04	·00	89·21
1895 ...	−·05	+·15	−·01	−·07	−·02	91·04	−·06	+·16	·00	−·06	−·06	91·36	−·04	+·13	−·02	−·04	−·02	91·16	−·09	+·24	+·01	−·07	−·07	90·39
1896 ...	·00	+·17	−·05	−·07	−·07	90·85	−·02	+·15	−·04	−·05	−·04	91·70	−·08	+·20	−·01	−·06	−·04	91·84	−·09	+·18	·00	−·06	−·05	90·65
1897 ...	−·04	+·11	−·03	−·03	−·02	91·79	−·04	+·15	−·04	−·07	−·01	91·34	−·09	+·13	·00	−·01	−·03	90·32	−·11	+·17	+·01	·00	−·08	89·09
1898 ...	−·06	+·13	−·03	−·02	−·03	91·05	−·03	+·10	−·05	−·03	−·01	91·56	−·04	+·19	−·03	−·05	−·06	91·63	−·09	+·17	−·05	−·02	−·03	90·93
1899 ...	−·01	+·14	−·07	−·05	·00	92·42	·00	+·18	−·07	−·05	−·03	92·96	−·06	+·24	−·05	−·08	−·06	92·64	−·09	+·25	−·03	−·10	−·04	91·64
1900 ...	−·01	+·13	−·04	−·06	−·02	91·21	−·06	+·21	−·01	−·08	−·07	91·14	−·05	+·18	−·03	−·07	−·03	91·02	−·07	+·22	−·02	−·06	−·05	90·64
1901 ...	·00	+·13	−·06	−·08	+·01	90·88	·00	+·21	−·09	−·10	−·02	91·39	−·01	+·20	−·07	−·08	−·06	91·32	−·03	+·17	−·07	−·06	−·01	90·09
1902 ...	−·03	+·17	−·07	−·05	−·02	92·61	−·03	+·18	−·09	−·05	−·01	92·52	−·04	+·15	−·06	−·05	−·02	92·33	−·06	+·15	−·03	−·05	·00	91·05
1903 ...	−·04	+·13	−·05	−·06	+·01	90·82	−·03	+·17	−·04	−·08	−·03	90·71	−·08	+·12	−·03	−·01	·00	89·82	−·07	+·16	−·01	−·06	−·02	88·67
1904 ...	−·02	+·14	−·03	−·05	−·02	91·29	−·01	+·14	−·02	−·08	−·03	92·04	−·06	+·12	−·03	−·05	·00	91·88	−·06	+·09	+·01	−·01	−·01	90·21
1905 ...	−·01	+·15	−·02	−·08	−·05	92·55	+·01	+·16	−·07	−·10	·00	93·44	−·04	+·23	−·03	−·07	−·07	93·64	−·06	+·14	·00	−·03	−·04	91·51

TABLE 53.—*Inequalities of Temperature in Horizontal Force Magnetograph Enclosure.*

Years.	April to September.						October to March.						Year.					
	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.
1872	...	...	...	...	...	......	...	...	...	...	...	......	...	...	...	...	...	...
1873	+·03	−·03	−·01	−·01	+·01	91·88	+·05	+·03	−·02	−·06	·00	88·53	+0·4	·00	−·01	−·04	+·01	90·20
1874	−·10	+·02	+0·4	+·04	−·02	89·52	−0·9	+·02	+·06	+·05	−·04	86·26	−·10	+·02	+0·5	+·05	−·03	87·89
1875	...	...	...	...	...	......	...	...	...	...	...	......	...	...	...	...	...	...
1876	...	...	...	...	...	......	...	...	...	...	...	......	...	...	...	...	...	...
1877	−0·5	+·07	−0·2	−·02	+·03	93·39	...	...	...	...	...	......	...	...	...	...	...	...
1878	−·06	+·01	+·02	·00	+·03	92·45	+·01	+·07	−·03	−·07	+·01	89·67	−·02	+·04	·00	−·03	+·02	91·06
1879	−·03	+·03	+·01	+·01	−·01	91·36	−·01	+·08	·00	−·05	−·02	88·20	−·02	+·06	·00	−·02	−·02	89·78
1880	−·02	+·03	+·01	−·01	−·01	89·72	−0·1	+·06	·00	−·04	·00	86·27	−0·1	+·04	·00	−0·3	·00	87·99
1881	−·03	+·07	−·01	−·02	·00	90·13	+·09	+·08	−·02	−·06	−·08	87·66	+0·3	+·07	−·01	−·04	−·04	88·89
1882	+·19	+·04	−07	−·08	−·08	90·27	+·22	+·09	−·07	−·12	−·11	87·73	+·20	+·07	−·07	−·10	−·10	89·00
1883	+·09	+·02	−·02	−·01	−·09	90·70	−·19	+·08	−·05	−·10	−·12	87·00	+·14	+·05	−·03	−·06	−·11	88·85
1884	+·02	+·05	−0·2	−·03	−·02	89·87	−·04	+·10	+·02	−·01	−·06	85·65	−·01	+·08	·00	−·02	−·04	87·76
1885	+·03	+·07	−·03	−·04	−·01	91·05	+·02	+·13	−·02	−·07	−·05	88·21	+·03	+·10	−·03	−·06	−·03	89·63
1886	+·02	+·05	−·01	−·02	−·03	90·75	−·02	+·09	·00	−·04	−·03	88·52	·00	+·07	−·01	−·03	−·03	89·63
1887	·00	+·03	·00	−·01	−·02	90·43	−·01	+·06	+·01	−·03	−·02	87·93	−·01	+·05	·00	−·02	−·02	89·18
1888	+·01	+·06	·00	−·02	−·03	92·15	·00	+·05	−·01	−·03	−·02	89·61	+·01	+0·5	−·01	−·03	−·02	90·88
1889	·00	+·06	−·02	−·03	−·02	92·08	−·03	+·10	−·01	−·02	−·04	89·81	−·01	+·08	−·01	−·02	−·03	90·95
1890	−·03	+·06	−·01	·00	−·03	91·34	−·03	+·10	−·02	−·01	−·03	89·17	−·03	+·08	−·02	−·01	−·03	90·25
1891	−·03	+·06	−·01	−·01	−·01	92·75	−·06	+·10	·00	·00	−·03	88·99	−·04	+·08	·00	−·01	−·02	90·87
1892	−·06	+·10	+·01	−·01	−·04	93·41	−·07	+·08	+·01	−·01	−·02	89·00	−·06	+·09	+·01	−·01	−·03	91·21
1893	−·03	+·06	−·01	−·01	·00	92·66	−·07	+·11	−·01	·00	−·03	89·66	−·05	+·08	−·01	−·01	−·02	91·16
1894	−·04	+·12	−·02	−·04	−·02	93·07	−·05	+·15	−·03	−·06	−·01	89·85	−·05	+·13	−·02	−·05	−·01	91·46
1895	−·04	+·13	−·02	−·05	−0·1	93·03	−·07	+·18	−·02	−·05	−·04	90·11	−·05	+·15	−0·2	−·05	−·03	91·57
1896	−·02	+·13	−·03	−·06	−0·2	93·14	−·06	+·19	−·02	−·06	−·06	90·66	−·04	+·16	−·03	−·06	−·04	91·90
1897	·00	+·10	−·03	−·05	−·01	93·14	−·04	+·16	−·03	−·05	−·03	89·42	−·02	+·13	−·03	−·05	−·02	91·28
1898	−·03	+·13	−·04	−·05	−·03	92·76	−·04	+·16	−·04	−·05	−·02	90·09	−·03	+·14	−·04	−·05	−·02	91·42
1899	−·01	+·13	−·05	−·05	−·01	93·23	−·04	+·20	−·05	−·07	−·04	90·54	−·03	+·17	−·05	−·06	−·02	91·88
1900	·00	+·14	−·06	−·07	−·02	92·92	−·04	+·23	−·06	−·08	−·04	90·23	−·02	+·19	−·06	−·08	−·03	91·57
1901	·00	+·15	−·06	−·08	−·01	92·73	+·02	+·20	−0·8	−·11	−·04	89·84	+·01	+·18	−·07	−·09	−·03	91·29
1902	−·01	+·14	−·06	−·06	·00	94·18	−·01	+·19	−·09	−0·9	·00	90·85	−·01	+·17	−·07	−·08	·00	92·51
1903	+·01	+·10	−·06	−·05	+·01	92·06	−·03	+·15	−·06	−·06	·00	89·17	−·01	+·12	−·06	−·05	+·01	90·62
1904	−·01	+·09	−0·2	−·03	−·03	92·15	−·03	+·13	−·03	−·06	−·01	89·87	−·02	+·11	−·02	−·05	−·02	91·01
1905	+0·1	+·13	−·05	−·07	−0·2	92·84	−·02	+·16	−·04	−·07	−·02	90·36	·00	+·14	−·05	−·07	−·02	91·60

7. Temperature errors in the diurnal inequality by Horizontal Force Magnetograph.

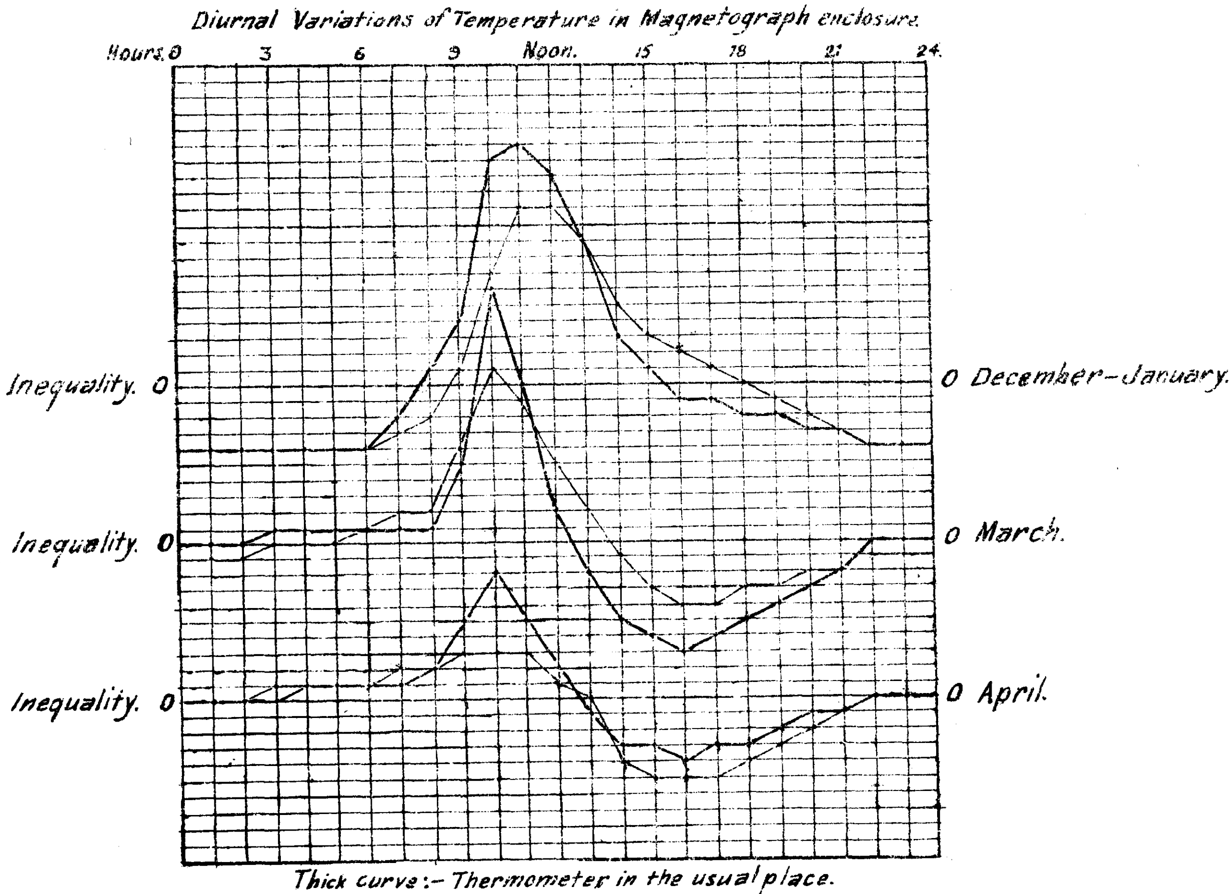
116. The thermometers in the magnetograph enclosures are all read daily five times a day at 6, 10, 14, 16 and 22 hours. Table 53 gives the data of these temperature readings in the horizontal force magnetograph enclosure for the average day of every month and the year.

It will be noticed that the variation as recorded by the thermometer indicates at 10 hours only, a significant correction, the co-efficient of temperature being $-3{\cdot}2\gamma$. This correction is however less than $\frac{1}{2}\gamma$ for that hour, while for the other hours of observation and presumably for the intervening hours also, the corrections are practically *nil*.

117. In order to secure a continuous series from hour to hour, as also to ensure that the thermometer does actually measure the temperature changes of the magnet, special experiments were conducted in the enclosure of one of the magnetographs (*vide* Chapter VI for details). Special thermometers with open scales were introduced in the enclosure—one in actual contact with the magnet which was fixed for the occasion by a suitable arrangement, and the other in the place where the attached thermometer was usually located in the enclosure. Hourly observations of these two thermometers were taken and the results of comparison are given below in table 54. They show that the actual range of the magnet temperature is decidedly smaller than that recorded by the thermometer. And as the experiments were performed during the winter months, when the range itself is large, they enable us to form an exact idea as to the probable maximum correction applicable to the hourly ordinates recorded by the magnetograph.

TABLE 54.

	Hour.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Means.
December 16th 1907 to January 23rd 1908.	Thermometer in usual place ...	−·04	−·04	−·04	−·04	−·04	−·04	−·04	−·02	+·01	+·04	+·14	+·15	+·13	+·09	+·03	+·01	−·01	−·01	−·02	−·02	−·03	−·03	−·04	−·04	84°·23
	Thermometer on Magnet.	−·04	−·04	−·04	−·04	−·04	−·04	−·04	−·03	−·02	+·01	+·07	+·11	+ 11	+·09	+·05	+·03	+·02	+·01	·00	−·01	−·02	−·03	−·04	·04	84°·18
	Difference ...	·00	·00	·00	·00	·00	·00	·00	+·01	+·03	+·03	+·07	+·04	+·02	·00	−·02	−·02	−·03	−·02	−·02	−·01	−·01	·00	−·00	·00	+·05
March 1908.	Thermometer in usual place ...	·00	·00	·00	+·01	+·01	+·01	+·01	+·01	+·01	+·05	+1·6	+·10	+·02	−·02	−·05	−·06	−·07	−·06	−·05	−·04	−·03	−·02	·00	·00	83°·62
	Thermometer on Magnet.	−·01	−·01	−·01	·00	·00	·00	+·01	+·02	+·02	+·06	+·11	+·09	+·05	+·02	−·01	−·03	−·04	−·04	−·03	−·03	−·02	−·02	−·01	−·01	83°·52
	Difference ...	+·01	+·01	+·01	+·01	+·01	+·01	·00	−·01	−·01	−·01	+·05	+·01	−·03	−·04	−·04	−·03	−·03	−·02	−·02	−·01	−·01	·00	+·01	+·01	+·10
April 1908.	Thermometer in usual place ...	·00	·00	·00	·00	+·01	+·01	+·01	+·01	+·02	+·05	+·08	+·05	+·02	−·01	−·03	−·03	−·04	−·03	−·03	−·02	−·01	−·01	·00	·00	86°·03
	Thermometer on Magnet.	·00	·00	·00	+·01	+·01	+·01	+·01	+·02	+·02	+·03	+·03	+·03	+·01	·00	−·04	−·05	−·05	−·05	−·04	−·03	−·02	−·01	·00	·00	85°·88
	Difference ...	·00	·00	·00	−·01	·00	·00	·00	−·01	·00	+·02	+0·5	+·02	+·01	−·01	+·01	+·02	+·01	+·02	+·01	+·01	+·01	·00	·00	·00	+·15



Thick curve :– Thermometer in the usual place.
Thin curve :– Thermometer in contact with the magnet.
Scale :– 1 small division = 0°.01 F.

118. This possible maximum value indicated by the thermometer in contact with the magnet which amounts to about $\cdot 3\gamma$, seems to affect the ordinates of not more than two or three hours of the day about 11 a.m. and that too only during the winter months. As the greatest departure made out in the table is about $0^{\circ}\cdot 11$ F., and as also some uncertainty must prevail in these minute variations (*vide* figures charted above on an enlarged scale), the diurnal magnetic inequality as recorded by the Colaba magnetograph may be advantageously accepted as compensated for temperature, as it is always safer, whenever the corrections are minutely small and some uncertainty prevails about them, not to tamper with an otherwise presumably fairly correct record.

119 The practice some time adopted at other observatories, is to make use of the results of a thermograph placed in the magnetograph room and to utilise its indications for the application of the corrections to the ordinates given by the force magnet in the enclosure. How erroneous is this view, will appear from table 55 which gives a year's result of the indications of a thermograph 'Richard Freres' placed in the magnetograph room at Colaba in a central and suitable position. The comparison of the temperature variations as recorded by this instrument and those of the thermometer in contact with the magnet in the enclosure, clearly shows that the former can hardly be accepted as a measure, in point of view of either amplitude or phase, of the actual phenomenon, and it is obvious that its use as a refinement in the process is problematic.

TABLE 55.

Showing the mean diurnal inequality of temperature in the Magnetograph room, as given by Richard Freres' Thermograph.

Unity = 1° F.

1905.	Month.												Year.
Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
H.													
0 ...	+·07	+·03	·00	-·01	-·04	-·01	+·04	+·02	-·02	·00	-·05	+·03	·00
1 ...	+·05	+·03	+·02	-·01	-·04	-·02	+·03	·00	-·02	·00	-·07	+·01	·00
2 ...	+·03	+·03	+·04	-·01	-·03	-·02	+·02	-·01	-·02	+·01	-·09	·00	·00
3 ...	-·01	+·02	+·04	·00	-·03	-·03	-·01	-·02	-·01	-·03	-·07	-·02	-·01
4 ...	-·04	+·01	+·05	+·01	-·03	-·04	-·03	-·02	·00	-·06	-·04	-·04	-·02
5 ...	-·06	-·02	+·04	+·03	-·02	-·04	-·03	-·03	·00	-·05	-·01	-·07	-·02
6 ...	-·08	-·04	+·04	+·05	-·01	-·03	-·03	-·04	·00	-·04	+·02	-·10	-·02
7 ...	-·06	-·03	+·05	+·08	+·01	-·02	-·02	-·04	·00	+·01	+·08	-·08	·00
8 ...	-·03	-·01	+·06	+·11	+·03	-·01	-·01	-·04	+·01	+·06	+·14	-·05	+·02
9 ...	-·03	+·03	+·11	+·18	+·08	+·02	+·04	+·05	+·07	+·11	+·25	-·01	+·07
10 ...	+·32	+·34	+·32	+·30	+·19	+·11	+·14	+·16	+·11	+·47	+·45	+·25	+·26
11 ...	+·07	+·08	-·04	-·04	+·03	+·02	+·01	+·05	+·12	+·18	+·26	+·08	+·07
12 ...	·00	-·08	-·11	-·13	-·02	+·01	+·01	+·01	+·01	+·07	+·16	+·05	·00
13 ...	-·08	-·11	-·13	-·15	-·05	-·01	-·02	-·02	-·01	-·04	·00	·00	-·05
14 ...	-·15	-·13	-·15	-·16	-·08	-·02	-·04	-·05	-·03	-·15	-·15	-·05	-·10
15 ...	-·10	-·10	-·13	-·17	-·07	·00	-·04	-·02	-·02	-·16	-·15	-·04	-·08
16 ...	-·05	-·07	-·11	-·17	-·05	+·02	-·03	+·01	·00	-·16	-·15	-·02	-·06
17 ...	-·02	-·07	-·10	-·15	-·04	+·02	-·03	·00	-·02	-·12	-·14	-·02	-·06
18 ...	+·01	-·06	-·09	-·12	-·02	+·03	-·03	-·01	-·04	-·07	-·13	-·01	-·04
19 ...	+·03	-·02	-·06	-·04	·00	+·02	-·01	+·01	-·04	-·05	-·10	·00	-·02
20 ...	+·06	+·03	-·03	+·05	+·02	+·02	+·02	+·03	-·04	-·02	-·07	+·01	+·01
21 ...	+·05	+·05	+·01	+·07	+·03	+·02	+·01	+·02	-·02	·00	-·05	+·01	+·02
22 ...	+·05	+·08	+·05	+·10	+·04	+·03	+·01	+·02	+·01	+·03	-·03	+·01	+·03
23 ...	+·06	+·05	+·02	+·04	·00	+·01	+·02	+·02	-·01	+·01	-·04	+·02	+·02

120. It will be seen later (*vide* Chapter VI) how, before the results of the special temperature observations referred to in paragraph 117 were known, the acceptance of the thermograph results delayed, for some time at least, the progress of the comparison of the records of the two vertical force magnetographs, as unfortunately a marked peculiarity in which the two instrumental records differed, accidentally happened to coincide in time with the sudden changes of temperature between 9 a.m. and 1 p.m. as shown by the thermograph, and thus diverted the discussion into different lines altogether.

121. Having shown how far the hourly ordinates of the magnetograph are reliable in regard to temperature errors, the correction which falls next to be considered is the progressive or aperiodic change in the inequality.

TABLE 56.—*Progressive Change per day of Horizontal Force Magnetograph derived from a single tabulated reading at 10 hours of each month.*

Unity = 0·1γ = ·000001 C. G. S.

Years.	Months.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
1872 ...	− 56	**− 28**	− 8	− 49	− 61	− 67	− 47	− 49	− 29	− 35	− 33	− 25	− 41
1873 ...	− 32	− 10	− 20	− 54	− 18	− 54	− 30	− 24	**− 25**	− 11	− 28	− 10	− 26
1874 ...	− 15	− 17	− 5	− 31	− 14	− 16	− 19	− 21	− 23	− 7	− 32	− 1	− 17
1875 ...	− 20	− 27	+ 9	− 16	− 19	− 25	− 23	− 13	− 24	− 1	− 25	− 10	− 16
1876 ...	− 15	− 3	− 16	− 13	− 13	− 20	− 12	− 16	− 12	− 18	− 6	− 13	− 13
1877 ...	− 7	**+ 6**	− 7	− 14	− 22	− 8	− 22	− 9	− 7	− 16	− 16	− 13	− 11
1878 ...	− 4	− 9	− 3	− 15	− 13	− 9	− 12	− 16	− 4	− 5	− 22	− 8	− 10
1879 ...	− 1	− 8	0	− 9	− 14	− 5	− 6	− 11	− 2	− 9	− 1	− 9	− 6
1880 ...	− 18	+ 2	0	− 21	− 1	− 2	− 18	0	− 4	− 20	+ 11	− 4	− 6
1881 ...	− 39	+ 29	− 10	+ 8	− 13	+ 5	− 14	− 8	− 8	− 6	− 9	− 7	− 6
1882 ...	+ 3	− 3	− 4	− 13	− 8	**− 5**	− 21	+ 16	− 4	− 12	− 13	− 3	− 6
1883 ...	+ 3	− 15	+ 10	+ 1	− 22	+ 1	− 21	+ 17	+ 1	+ 6	− 20	+ 6	− 3
1884 ...	+ 1	− 35	+ 12	+ 18	− 30	+ 5	0	− 10	− 1	− 2	− 5	**− 2**	− 4
1885 ...	− 7	+ 2	+ 3	− 6	− 9	+ 3	− 14	− 6	− 2	− 2	+ 6	− 4	− 3
1886 ...	− 13	+ 6	− 33	+ 28	− 9	− 24	+ 12	0	− 2	− 6	− 12	− 6	− 5
1887 ...	+ 13	− 9	+ 9	− 19	− 1	+ 1	+ 1	− 18	− 1	+ 8	− 9	0	− 2
1888 ...	− 1	− 3	− 3	+ 5	**− 18**	− 3	+ 3	− 5	− 4	− 7	+ 3	− 4	− 3
1889 ...	+ 1	− 9	+ 7	− 7	− 9	+ 12	− 21	+ 5	+ 11	− 9	− 14	− 7	− 3
1890 ...	+ 8	+ 7	− 2	− 14	− 7	+ 6	+ 3	− 9	− 11	+ 3	− 8	− 4	− 2
1891 ...	+ 6	− 1	− 23	+ 12	− 5	0	− 1	− 16	+ 4	+ 4	− 9	+ 4	− 2
1892 ...	− 8	− 24	+ 21	− 22	− 7	**+ 9**	− 1	− 6	+ 2	+ 6	− 3	− 4	− 3
1893 ...	− 3	+ 16	− 11	− 5	− 1	− 14	+ 11	− 9	− 8	− 3	− 4	0	− 3
1894 ...	+ 2	− 41	+ 23	+ 11	− 5	− 2	− 2	− 4	− 4	− 2	0	0	− 2
1895 ...	+ 3	+ 3	− 14	+ 9	− 14	+ 1	+ 1	− 5	− 20	+ 11	− 7	+ 7	− 2
1896 ...	− 11	− 2	+ 5	+ 5	− 13	+ 3	+ 1	− 12	+ 9	− 5	− 3	− 2	− 2
1897 ...	+ 5	− 5	− 3	− 4	− 13	+ 7	− 14	+ 18	− 10	− 1	+ 2	− 15	− 3
1898 ...	**+ 6**	0	− 6	0	− 8	+ 4	− 4	+ 1	− 11	+ 5	0	+ 1	− 1
1899 ...	− 10	+ 2	+ 13	− 14	− 8	− 2	+ 5	− 6	0	− 1	− 3	0	− 2
1900 ...	− 5	+ 2	+ 1	− 23	+ 10	+ 2	− 4	+ 6	− 7	− 4	+ 4	− 9	− 2
1901 ...	+ 4	+ 5	− 1	− 11	− 2	− 6	+ 2	− 5	− 1	+ 6	− 8	− 8	− 2
1902 ...	+ 7	+ 1	− 1	− 10	− 4	− 7	+ 2	− 3	0	− 12	+ 13	− 3	− 1
1903 ...	− 1	+ 7	− 3	− 8	0	− 7	− 8	+ 4	+ 1	− 76	**+ 62**	− 12	− 3
1904 ...	+ 8	+ 5	+ 2	− 13	− 1	+ 13	− 7	− 8	− 3	+ 2	− 2	+ 1	0
1905 ...	0	+ 1	+ 2	− 7	− 5	− 5	+ 8	− 11	− 1	+ 1	− 5	+ 2	− 2

Values in thick type are derived from the two available tabulated readings at longest interval soon after the adjustment.

TABLE 57.—*Progressive Change in H. derived from mean reading of the first and last day of the month*

Unity = 0·1γ = ·000001 C. G. S.

Years.	Months. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
1872 ...	− 51	+ 6	− 18	− 54	− 46	− 59	− 53	− 40	− 42	− 35	− 22	− 31	− 37
1873 ...	− 22	− 15	− 20	− 36	− 33	− 43	− 31	− 23	− 25	− 13	− 13	− 14	− 24
1874 ...	− 16	− 5	− 13	− 17	− 16	− 22	− 27	0	− 26	− 11	− 26	− 5	− 15
1875 ...	− 11	− 33	− 2	− 15	− 21	− 25	− 22	− 15	− 22	− 13	− 19	− 7	− 17
1876 ...	− 14	− 8	− 20	− 10	− 13	− 22	− 11	− 19	− 15	− 15	− 8	− 11	− 14
1877 ...	− 11	0	− 10	− 12	− 22	− 6	− 13	− 11	− 12	− 3	− 14	− 10	− 10
1878 ...	− 8	− 9	− 7	− 11	− 12	− 8	− 10	− 15	− 10	− 5	− 13	− 7	− 10
1879 ...	0	− 13	− 9	− 6	− 12	− 3	− 5	− 11	− 1	− 11	− 2	− 5	− 6
1880 ...	− 12	0	− 5	− 15	− 4	+ 1	− 8	− 5	+ 1	− 26	0	+ 3	− 6
1881 ...	− 42	+ 13	− 8	− 1	− 4	− 4	− 5	− 6	− 9	− 11	− 10	− 1	− 7
1882 ...	− 3	− 4	− 4	− 20	− 2	− 2	− 13	+ 12	− 6	− 11	− 10	0	− 5
1883 ...	0	− 15	+ 7	− 5	− 6	− 10	− 14	+ 12	− 10	+ 1	− 7	+ 6	− 3
1884 ...	− 1	− 11	+ 1	+ 3	+ 6	+ 9	− 4	− 1	+ 1	− 3	− 8	− 1	− 1
1885 ...	− 7	− 2	+ 1	− 1	− 16	+ 4	+ 5	+ 3	− 3	− 4	+ 5	0	− 1
1886 ...	− 12	+ 3	− 35	+ 16	− 2	− 14	+ 4	+ 1	− 6	− 3	− 12	− 1	− 5
1887 ...	0	+ 2	+ 3	− 14	− 4	+ 4	+ 4	− 6	− 3	+ 1	− 5	− 1	− 2
1888 ...	− 4	+ 1	− 5	− 3	+ 2	0	+ 3	− 7	− 5	− 6	+ 2	− 2	− 2
1889 ...	− 1	− 5	+ 5	− 6	− 7	+ 1	− 7	− 1	− 3	− 5	+ 6	0	− 2
1890 ...	+ 2	− 3	− 3	− 1	− 3	0	+ 2	− 4	− 8	− 5	− 1	− 1	− 2
1891 ...	0	− 1	− 16	+ 6	− 8	+ 1	− 1	− 15	− 3	− 1	− 2	− 1	− 3
1892 ...	− 4	− 7	+ 12	− 15	− 3	− 7	− 1	+ 2	+ 1	+ 4	− 1	0	− 2
1893 ...	+ 5	0	− 9	− 8	+ 1	− 2	+ 5	− 4	− 16	− 4	+ 11	− 2	− 2
1894 ...	− 2	− 36	− 15	+ 7	− 6	− 3	− 8	− 6	− 10	− 1	− 3	+ 3	− 7
1895 ...	+ 3	− 5	− 8	+ 2	− 12	− 2	+ 9	− 1	− 28	+ 1	− 1	+ 4	− 3
1896 ...	− 10	− 3	− 1	− 2	− 7	+ 4	+ 3	− 2	+ 1	− 5	− 1	0	− 2
1897 ...	− 4	− 5	− 8	− 2	− 9	+ 1	− 22	+ 10	− 2	− 3	+ 3	− 9	− 4
1898 ...	+ 7	− 2	− 7	− 2	− 8	+ 1	+ 2	− 2	− 9	− 3	− 1	0	− 2
1899 ...	− 7	− 2	+ 1	− 9	0	− 15	+ 11	− 9	− 2	0	− 1	− 3	− 3
1900 ...	− 3	− 2	− 5	− 3	+ 6	− 3	0	+ 1	− 4	− 5	+ 2	− 7	− 2
1901 ...	− 3	− 1	− 7	− 4	− 2	− 3	+ 4	− 1	− 2	0	− 2	− 10	− 3
1902 ...	+ 2	− 3	− 4	− 2	− 4	− 3	+ 1	− 1	− 2	− 19	+ 7	+ 2	− 2
1903 ...	− 4	0	− 5	− 4	− 3	− 4	0	− 2	− 6	− 98	+ 36	− 13	− 9
1904 ...	+ 6	+ 3	+ 1	+ 12	+ 1	+ 6	− 6	− 7	+ 1	− 8	+ 5	+ 4	+ 1

TABLE 58.—*Progressive Change per day of Horizontal Force Magnetograph derived from monthly means of tabulation.*

Unity = 0·1γ = ·000001 C. G. S.

Years.	Month.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
1872 ...	**−52**	**−50**	**−48**	−46	−55	−59	−51	−39	−36	−33	−27	−30	−44
1873 ...	−25	−23	−27	−29	−36	−36	−29	−25	**−22**	**−20**	−18	−19	−26
1874 ...	−17	−13	−14	−15	−17	−22	−20	−18	−19	−16	−12	−12	−16
1875 ...	−13	−15	−13	−14	−19	−21	−19	−19	−17	−14	−13	−12	−16
1876 ...	−12	−12	−10	−12	−15	−16	−16	−15	−15	−13	−12	−12	−13
1877 ...	**−12**	**−12**	**−12**	−13	−15	−13	−14	−14	−14	−14	−11	−9	−13
1878 ...	−9	−8	−9	−11	−13	−9	−8	−11	−11	−10	−10	−8	−10
1879 ...	−6	−8	−8	−7	−8	−7	−7	−9	−9	−6	−7	−7	−7
1880 ...	−7	−9	**−8**	**−7**	−6	−4	−11	−9	−4	−6	−5	−4	−7
1881 ...	−7	−5	−2	−5	−5	−6	−5	−8	−8	−5	−6	−3	−5
1882 ...	−4	−4	−9	−10	−3	**−3**	**−3**	−3	−6	−12	−4	+2	−5
1883 ...	−2	−4	−4	−4	−5	−5	−4	−5	−5	−3	−2	0	−4
1884 ...	−1	−4	−5	−4	−5	−6	−3	−2	−5	−4	−2	**−2**	−4
1885 ...	**−2**	−2	−4	−6	−6	−2	−3	−6	−3	−2	−2	−4	−3
1886 ...	−4	−3	−6	−6	−3	−2	−3	−2	−4	−4	−3	−2	−3
1887 ...	−2	−2	−4	−6	−3	−1	−3	−5	−3	−2	−3	−4	−3
1888 ...	−2	−1	−4	−6	**−4**	**−3**	−2	−3	−4	−4	−2	−1	−3
1889 ...	−1	−4	−4	−3	−4	−3	−3	−4	−3	−3	−2	−1	−3
1890 ...	−2	−2	−3	−4	−3	−1	−3	−4	−4	−3	−1	−1	−3
1891 ...	−3	−5	−6	−6	−3	−1	−2	−4	−3	−1	−2	−3	−3
1892 ...	−7	−6	−2	−5	−4	**−2**	**0**	+2	−2	−2	−1	−1	−2
1893 ...	0	−2	−2	−3	−3	−3	−3	−3	−2	−3	0	0	−2
1894 ...	−5	−4	−2	−3	−3	−5	−4	−2	+1	−1	−1	+1	−2
1895 ...	−3	−3	−2	−3	−2	−2	−1	−1	−5	−5	0	−1	−2
1896 ...	−2	−1	−2	−5	−2	+1	−2	−3	−2	−2	−1	−1	−2
1897 ...	0	−1	−6	−5	−2	0	0	−2	−2	−2	−4	−2	−2
1898 ...	**−3**	**−3**	−4	−2	−2	0	−2	−7	−3	+2	0	0	−2
1899 ...	−2	−3	−2	−4	−3	−1	−1	−2	−3	−1	−1	−2	−2
1900 ...	0	−2	−3	−4	−2	+2	0	−1	−2	−2	−1	−1	−1
1901 ...	**−1**	−2	−4	−4	−3	−1	0	−2	−2	−2	−1	−1	−2
1902 ...	−1	−1	−4	−5	−2	−2	−2	−1	−1	−3	−1	0	−2
1903 ...	0	−1	−5	−5	−3	−2	−2	−2	−4	**−3**	**−2**	**−1**	−2
1904 ...	+1	+2	−3	−6	−2	+1	+1	−2	−3	−3	+1	−1	−1

Values in thick type are due to adjustment and are interpolated between the preceding and succeeding values.

TABLE 59.—*Progressive Change per day of the tabulation of H. F. Magnetograph derived from a single tabulated reading at midnight of first day of each month.*

Unity = 0·1γ = ·000001 C. G. S.

Years.	Month.												Year.
	January.	February.	March.	April.	May.	June.	July.	August	September.	October.	November.	December.	
1872 ...	- 54	**- 53**	- 19	- 51	- 53	- 56	- 55	- 42	- 36	- 25	- 30	- 43	- 43
1873 ...	- 16	- 22	- 23	- 37	- 34	- 46	- 21	- 25	- 20	**- 15**	- 20	- 14	- 24
1874 ...	- 20	- 13	- 12	- 23	- 13	- 21	- 27	- 9	- 31	- 4	- 22	- 3	- 16
1875 ...	- 14	- 30	- 2	- 15	- 16	- 25	- 19	- 15	- 18	- 12	- 17	- 9	- 16
1876 ...	- 18	- 6	- 20	- 5	- 11	- 21	- 13	- 14	- 18	- 8	- 9	- 15	- 13
1877 ...	- 9	**+ 12**	- 12	- 11	- 21	- 9	- 13	- 16	- 11	- 11	- 14	- 9	- 10
1878 ...	- 11	- 7	- 11	- 11	- 9	- 12	- 7	- 17	- 9	- 3	- 10	- 15	- 10
1879 ...	- 1	- 11	- 8	- 5	- 8	- 5	- 8	- 3	- 15	- 8	- 2	- 7	- 7
1880 ...	- 14	- 3	- 7	- 12	- 4	+ 1	- 5	- 15	- 7	- 18	+ 3	+ 4	- 6
1881 ...	- 67	+ 59	- 12	+ 6	- 5	- 3	- 7	- 3	- 10	- 15	+ 2	- 3	- 5
1882 ...	0	- 7	- 3	- 22	0	- 2	**- 25**	+ 22	- 2	- 8	- 9	- 6	- 5
1883 ...	- 1	- 11	+ 6	- 8	- 3	- 10	- 14	+ 17	- 12	+ 1	- 7	+ 2	- 3
1884 ...	- 1	- 4	- 11	- 1	0	- 7	- 4	- 1	- 6	- 1	+ 5	- 2	- 4
1885 ...	**- 7**	- 3	- 2	**- 4**	- 14	+ 6	- 1	- 12	- 1	- 2	+ 5	0	- 3
1886 ...	- 13	+ 4	- 21	+ 7	- 5	- 13	+ 4	+ 3	- 12	+ 2	+ 6	- 11	- 4
1887 ...	+ 1	- 7	+ 2	- 11	- 6	+ 3	+ 1	- 8	- 8	+ 2	- 3	- 2	- 3
1888 ...	- 6	+ 3	- 10	- 2	- 2	**+ 8**	- 10	- 7	- 2	- 4	- 1	- 1	- 3
1889 ...	0	- 3	- 5	- 4	- 6	0	- 7	+ 2	- 1	- 9	- 5	+ 2	- 3
1890 ...	+ 3	- 4	- 1	- 8	- 3	0	- 1	- 5	- 4	- 1	- 5	- 1	- 2
1891 ...	- 2	- 4	- 12	+ 5	- 6	- 3	+ 1	- 10	- 3	- 2	+ 4	- 3	- 3
1892 ...	- 5	0	- 10	- 9	- 5	- 1	**+ 1**	+ 1	- 2	0	+ 1	- 4	- 3
1893 ...	+ 3	- 3	- 9	- 2	+ 1	- 13	+ 9	- 6	- 16	+ 6	+ 2	0	- 2
1894 ...	0	+ 5	0	+ 20	- 7	+ 12	- 8	- 4	- 10	+ 9	- 1	+ 5	+ 2
1895 ...	- 1	- 1	0	+ 1	- 13	+ 5	+ 6	- 3	- 20	+ 2	+ 4	+ 3	- 1
1896 ...	- 4	- 12	+ 9	- 5	- 4	+ 2	0	- 5	- 1	- 5	+ 1	+ 2	- 2
1897 ...	- 4	- 4	- 6	- 4	- 4	+ 3	- 5	+ 5	- 4	- 3	+ 3	- 17	- 3
1898 ...	+ 12	**- 4**	- 7	- 3	- 7	+ 1	+ 5	+ 2	- 17	0	+ 5	0	- 1
1899 ...	- 5	- 3	- 2	- 6	- 2	- 15	+ 16	- 3	- 4	- 1	- 2	- 1	- 2
1900 ...	- 1	+ 3	- 5	- 2	- 6	- 1	+ 3	- 1	- 4	- 3	+ 2	- 4	- 2
1901 ...	**- 7**	+ 2	- 8	- 1	+ 1	- 6	+ 4	- 3	- 5	0	0	- 5	- 2
1902 ...	+ 3	- 1	- 4	- 6	- 5	- 3	+ 3	- 4	- 2	- 21	+ 19	+ 3	- 1
1903 ...	- 4	+ 1	- 5	- 4	- 3	- 6	+ 2	- 2	- 4	- 92	**+ 26**	**- 3**	- 8
1904 ...	0	0	+ 3	- 10	- 2	+ 3	- 1	- 2	0	- 5	+ 6	- 1	- 1

Values in thick type are derived from the two available tabulated readings at longest interval soon after the adjustment.

8. Aperiodic element in the diurnal inequality.

122. In an inequality given by an instrument like the magnetograph the true cyclic phenomenon is obviously mixed up with an aperiodic contribution, to the building up of which more causes than one co-operate. When all days are taken together the difference between the values of the magnetogram ordinates at midnight of the first day of the month and the midnight of the first day of the succeeding month, (in the case of Colaba 10 a.m. to 10 a.m.), divided by the number of days is usually accepted as the average measure of the magnitude of the non-cyclic element. This difference is made up of the average natural change of force and of the instrumental creep in an interval of 24 hours. How far the corrections of this magnitude bring out the character of the truly cyclic inequality will be presently seen. With regard, however, to its distribution, the usual practice is to assume that the progression of this effect takes place uniformly from hour to hour. This may or may not be correct, but for want of precise knowledge on the subject there is no other alternative but to accept the old practice as a workable hypothesis. It enables us to remove at least, if the magnitude of the element is correctly derived, that portion of the phenomenon which is dependent upon the linear function of time, leaving the other changes which may be periodic (submultiples of a day), mixed up in the inequality.

123. Coming to the question of the correct magnitude of this linear correction, considerable judgment has to be exercised in its determination, as it is not always that the apparent difference between the two hourly values as referred to above should necessarily give its correct magnitude. The assumption, that this contribution progresses uniformly throughout the hours, must obviously put out of court the consideration of any of the two ordinates which alone may happen to be *suddenly and largely* disturbed, as this sudden change cannot be held to have acquired that magnitude by growing steadily through the preceding 24 hours. For the careful consideration hence of this non-cyclic correction tables 56 to 59 have been prepared. Table 56 gives the differences of the ordinates from 10 hours to 10 hours ; table 57 gives the differences derived from the mean tabulations of the *1st and last day* of the month ; table 58 shows the differences derived from the values of the two consecutive mean monthly tabulations, which have been reduced eventually to the proper epoch to denote the change from the 1st day to the last day of the month ; and table 59 gives the differences from 0h. to 24h. A glance at the last table will show for example (*vide* figures for October and November 1903) that, owing to a great magnetic storm which occurred on 31st October and 1st of November, both the hourly differences are affected and they could hardly be accepted under such circumstances as the proper correction without consideration. That the indiscriminate use of these differences must adversely affect the inequality so corrected there can be little doubt and a reference hence to the other tables, on that account, becomes helpful at least in reducing the possibility of an error in the determination of the correction. The adopted corrections are shown at the bottom of each inequality table.

124. As practically every day is included in the results it must follow that the total non-cyclic effect during the month or the year or any other period of years, unlike the results of *quiet* days in which a limited number of days is selected, must be equal to the average magnetic change *plus* the instrumental creep for the period, as no differentiating effect* such as exists in the results of quiet days for any particular year as compared with that of other years in the 11-yearly cycle is prominently noticeable in the results of *all* days. This and other points will be referred to in connection with the discussion on quiet days in Chapter XI, Part II.

125. The question of the periodic irregularity to which each hour of the day is subject owing to disturbance effects will be treated in Chapter X, Part II.

9. Use of the variation instrument for the derivation of the daily means.

126. The data in table 13 have been used and the operations are extended for the derivation of the daily means for the last 12 years, from 1894 to 1905 both inclusive. The process by which the data for one month have been derived is given below as an illustration in full detail in table 60 which sets forth, step by step, the different operations leading up to the final result.

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* In all days the aperiodic change is largely made up of the instrumental contribution which though small is comparatively much larger than the secular change of force, and the larger instrumental contribution is not subject to any periodic variations such as the sun-spot fluctuations of the 11-year period or any other period of shorter duration (*vide* Chapter XII, Part II). While the aperiodic change in quiet days is mostly made up of magnetic secular change which is large and which is subject to the fluctuations of the sun-spot effect. Hence the average result in the former will practically hold good for any month or year or any period small or large, but in the latter it will not. Hence the derivation of the *average* aperiodic change in quiet days on this account necessitates the adoption of data covering a complete cycle of the periods involved.

TABLE 60.—*Calculations for the reduction of the daily means of Horizontal Force, August 1904.*

Date.	Daily mean Ordinate of Tabulation.	Ordinate in column 2 corrected for progressive change $\frac{1}{48}$ $(a_{\cdot 0} - a_{\cdot 0})$.	Ordinate in column 3 converted into force, Unity = 0·1γ.	Daily mean temperature of H. F. magnetograph enclosure.	Ordinate in column 4 corrected to temperature 90° F.	Ordinate in column 6 + mean monthly value of zero at 90° F. given in column 10, Table 13, or observed daily mean.	Daily means in column 7 corrected for instrumental change.
1	2	3	4	5	6	7	8
	c. m.	c. m.		°		37	37
1	6·133	6·125	2934	91·8	2992	4028	4007
2	5·955	5·954	2852	91·8	2910	3946	3926
3	5·675	5·666	2714	91·8	2772	3808	3789
4	5·234	5·233	2507	91·7	2561	3597	3580
5	5·751	5·764	2761	91·4	2806	3842	3826
6	5·975	5·981	2865	91·4	2910	3946	3932
7	6·027	6·026	2886	91·6	2937	3973	3960
8	6·004	6·002	2875	91·5	2923	3959	3948
9	6·124	6·128	2935	91·4	2980	4016	4006
10	6·095	6·086	2915	91·5	2963	3999	3990
11	6·073	6·085	2915	91·6	2966	4002	3995
12	6·156	6·150	2946	91·5	2994	4030	4024
13	5·983	5·981	2865	91·6	2916	3952	3948
14	5·993	5·989	2869	91·7	2923	3959	3956
15	6·135	6·134	2938	91·7	2992	4028	4027

Date.	Daily mean Ordinate of Tabulation.	Ordinate in column 2 corrected for progressive change $\frac{1}{48}$ $(a_{10} - a_{10})$.	Ordinate in column 3 converted into force Unity = 0·1γ.	Daily mean temperature of H. F. magnetograph enclosure.	Ordinate in column 4 corrected to temperature 90° F.	Ordinate in column 6 + mean monthly value of zero at 90° F. given in column 10, Table 13, or observed daily mean.	Daily means in column 7 corrected for instrumental change.
1	2	3	4	5	6	7	8
	c. m.	c. m.		°		37	37
16	5·852	5·846	2800	91·7	2854	3890	3890
17	5·886	5·893	2823	91·7	2877	3913	3914
18	5·858	5·849	2802	91·7	2856	3892	3895
19	5·841	5·851	2803	91·7	2857	3893	3897
20	6·176	6·184	2962	91·7	3016	4052	4058
21	6·025	6·015	2881	91·6	2932	3968	3975
22	5·760	5·748	2753	91·6	2804	3840	3849
23	5·746	5·751	2755	91·7	2809	3845	3855
24	5·859	5·864	2809	91·7	2863	3899	3910
25	5·922	5·932	2841	91·6	2892	3928	3941
26	6·076	6·067	2906	91·8	2964	4000	4014
27	6·093	6·102	2923	91·9	2984	4020	4036
28	6·140	6·140	2941	91·7	2995	4031	4048
29	6·061	6·052	2899	91·8	2957	3993	4012
30	5·505	5·490	2630	91·7	2684	3720	3740
31	5·671	5·682	2722	91·6	2773	3809	3830
Monthly means ...	5·928	5·928	2840	91·7	2982	3928	3928

Column 2 gives the crude daily mean as derived from tabulations ; in column 3 the crude means are corrected for progressive change $= \frac{1}{48}(a_{1},-a_{10})$, due to difference between the initial and terminal hourly ordinates of the inequality for the day. The ordinates in column 3 reappear as converted into C. G. S. units in column 4 ; column 5 gives the daily temperature in the magnetograph enclosure from which the ordinates in column 4 are corrected to a mean temperature of 90°F. These appear in column 6. To the corrected mean ordinate in column 6, the value in C. G. S. unit of the observed zero shown in column 10, table 13, is added and the results – the first values of the daily mean (uncorrected for instrumental change)—are given in column 7. In column 8, the daily means then finally appear corrected for the instrumental change derived from the differences* of the monthly zeros calculated by formula which appear in column 11 of table 13. It will be seen that the instrumental change is more or less insignificant for the later years, but in the early years of the instrument's life this progressive change is considerable ;—for example the year 1873 indicates a difference of as many as 85γ between the daily mean of the first and the last day of the month. This in the year 1882 is reduced to about 15γ; in 1894, the first year from which the daily means have been published, it is reduced to 7γ, and in 1905, the last year, it stands at only about 4γ.

127. As the publication of the daily means with full details as in the table above is obviously impracticable, in tables 61 to 72 have been collected the final results only as shown in the last two columns of table 60. The first part of the tables gives the means corrected for temperature, but without being corrected for instrumental change, while the second part gives the means fully corrected for the instrumental change also.

It must be noted that after the above corrections have been applied the daily means are comparable from day to day, but are not strictly so from month to month as a small dislocation in their value must remain between the last day of any month and the first day of the succeeding month as the calculated and the observed monthly mean zeros are not closely accordant. This is due partly of course to probable errors of observation of every month which are not the same ; partly to defect of the variation instrument and to other causes referred to in the discussion of the creep of the zero of the instrument. These dislocations are derivable from column 14 or 16 of table 13, and if desirable they may be applied by increasing or decreasing, by the constant thus indicated, the daily means of each month.

* These differences should be really corrected for the annual variation of zero indicated in the last row of figures in table 15. But further refinement has not been attempted beyond indicating the correction.

TABLE 61.—*Daily means of Horizontal Force (Magnetograph).*

(1894.)

·37000+ Uncorrected for instrumental change.

1894. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	408	420	350	386	407	435	432	421	417	423	431	425
2 ...	409	404	379	414	433	425	407	426	414	427	436	429
3 ...	374	397	388	418	441	416	396	431	420	432	439	430
4 ...	367	414	384	424	430	414	413	435	418	443	443	433
5 ...	385	421	402	420	439	425	411	427	412	409	454	428
6 ...	394	405	409	406	443	432	426	422	418	431	448	415
7 ...	395	404	410	411	457	439	437	426	404	428	440	417
8 ...	401	415	412	416	439	439	409	435	407	436	413	417
9 ...	415	405	396	428	442	406	407	425	415	427	430	415
10 ...	397	409	404	429	451	351	423	435	407	432	433	421
11 ...	408	420	416	436	448	391	426	426	404	435	431	435
12 ...	392	420	422	423	448	409	423	424	404	440	433	422
13 ...	399	417	435	392	442	416	416	424	417	440	337	411
14 ...	400	426	417	412	414	419	426	396	348	423	351	414
15 ...	411	414	406	425	407	424	428	398	338	427	392	390
16 ...	418	398	404	428	417	423	426	410	381	393	386	394
17 ...	420	419	405	384	422	419	404	419	394	403	400	418
18 ...	416	422	403	366	427	417	394	423	396	412	385	422
19 ...	424	403	410	397	431	418	389	411	361	412	390	421
20 ...	423	409	418	405	424	422	253	168	354	422	412	431
21 ...	417	330	394	401	424	396	311	329	375	423	428	417
22 ...	407	366	371	401	426	390	358	369	363	430	429	415
23 ...	409	314	390	410	427	406	375	383	382	428	397	422
24 ...	404	327	405	411	433	424	382	375	384	430	393	420
25 ...	417	268	403	415	430	424	371	387	386	428	412	424
26 ...	393	340	403	416	438	429	373	372	392	411	419	431
27 ...	402	384	408	424	450	428	387	392	393	418	424	438
28 ...	405	324	416	430	419	418	388	393	400	427	413	435
29 ...	402	...	420	441	421	420	391	396	409	429	412	429
30 ...	400	...	344	414	422	424	395	399	387	426	421	431
31 ...	398	...	311	...	395	...	399	402	...	421	...	431
Monthly Mean ...	403	389	398	413	431	417	396	399	393	425	414	422

·37000+ Corrected for instrumental change.

1894. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	404	416	347	382	404	432	429	418	414	420	428	422
2 ...	406	401	376	410	429	422	404	422	411	424	433	426
3 ...	371	394	385	416	438	413	394	428	417	429	436	427
4 ...	365	412	381	421	427	411	410	432	415	441	441	430
5 ...	383	419	399	417	437	423	408	424	409	407	452	426
6 ...	391	403	407	404	440	430	423	420	416	429	445	413
7 ...	393	403	408	409	455	437	435	424	402	426	438	415
8 ...	399	414	410	414	437	437	407	433	405	434	411	415
9 ...	413	404	395	426	440	404	406	423	414	425	428	413
10 ...	396	408	402	427	450	350	422	433	406	430	431	420
11 ...	407	419	415	435	447	390	425	425	403	434	430	434
12 ...	391	419	422	422	447	408	423	423	403	439	433	421
13 ...	398	417	435	391	441	415	416	423	416	440	336	410
14 ...	399	426	416	412	413	418	425	396	348	422	351	413
15 ...	411	414	405	425	407	424	428	398	338	426	392	390
16 ...	418	398	404	428	417	423	426	410	381	393	386	394
17 ...	420	419	405	384	422	419	404	419	394	403	401	418
18 ...	417	423	404	367	428	417	395	423	397	413	385	422
19 ...	425	404	410	397	432	419	389	412	362	413	391	422
20 ...	424	411	419	406	425	423	254	169	355	423	413	431
21 ...	418	332	396	402	425	398	312	330	376	424	429	418
22 ...	408	368	373	402	428	391	360	370	365	431	431	417
23 ...	410	316	392	412	429	408	377	384	383	429	398	423
24 ...	406	329	407	413	435	426	383	376	386	431	394	421
25 ...	419	270	405	417	432	426	373	389	388	430	414	426
26 ...	395	343	405	419	440	431	376	375	395	413	421	434
27 ...	405	387	410	426	453	431	390	395	396	420	426	440
28 ...	407	327	418	433	422	421	391	396	403	429	416	438
29 ...	405	...	423	444	424	423	394	399	413	432	415	432
30 ...	403	...	348	417	425	427	398	402	390	430	425	434
31 ...	401	...	314	...	398	...	403	405	...	424	...	434
Monthly Mean ...	403	389	398	413	431	417	396	399	393	425	414	422

TABLE 62.—*Daily means of Horizontal Force (Magnetograph).*

(1895.)

·37000 + Uncorrected for instrumental change.

1895. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	410	410	435	425	452	422	412	444	450	423	442	453
2 ...	387	387	424	431	446	408	416	441	462	436	433	457
3 ...	400	414	421	430	443	402	422	443	469	438	445	460
4 ...	408	435	426	438	453	404	429	445	399	428	441	461
5 ...	425	424	426	420	445	414	434	450	401	433	441	465
6 ...	400	399	422	425	448	416	388	436	404	440	453	475
7 ...	418	411	431	428	428	408	427	439	414	448	460	464
8 ...	418	404	422	440	432	427	423	443	420	442	445	428
9 ...	407	394	405	426	437	418	434	419	425	447	408	443
10 ...	406	391	421	430	427	428	431	378	424	460	401	445
11 ...	411	410	429	380	431	417	444	393	431	468	418	442
12 ...	416	420	439	396	445	425	424	399	430	440	427	449
13 ...	416	417	396	415	432	433	405	416	442	407	425	456
14 ...	418	407	378	414	425	431	404	417	446	430	434	458
15 ...	424	392	402	416	433	453	411	418	413	436	435	453
16 ...	410	380	407	407	445	449	417	419	416	443	438	455
17 ...	395	394	402	411	434	421	415	432	426	416	448	451
18 ...	408	402	408	410	431	425	418	407	430	439	447	458
19 ...	394	406	410	419	448	431	421	421	424	446	451	457
20 ...	397	406	406	413	447	432	420	441	418	452	458	467
21 ...	399	413	410	423	447	447	421	435	427	452	454	462
22 ...	405	419	414	437	445	434	423	439	426	456	462	443
23 ...	413	425	411	429	451	426	424	445	432	456	419	443
24 ...	407	379	429	419	455	423	427	430	431	458	401	427
25 ...	417	399	428	428	450	432	443	430	422	464	429	437
26 ...	427	424	412	416	454	441	424	428	428	463	439	444
27 ...	425	435	410	416	459	451	416	433	432	409	440	449
28 ...	428	402	425	424	451	443	415	436	433	411	428	453
29 ...	405	...	433	427	428	428	413	431	439	412	431	457
30 ...	417	...	420	437	425	417	419	441	368	420	437	456
31 ...	421	...	416	...	424	...	434	435	...	425	...	461
Monthly Mean ...	411	407	417	421	441	427	421	429	426	439	436	453

·37000 + Corrected for instrumental change.

1895. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	407	407	431	422	449	419	409	440	447	419	439	450
2 ...	384	384	421	428	443	405	413	438	459	433	430	454
3 ...	398	411	419	427	441	399	419	440	466	436	442	457
4 ...	405	433	423	435	450	402	426	442	396	425	438	458
5 ...	423	422	424	417	442	412	432	448	398	431	439	463
6 ...	397	397	420	422	446	414	386	434	402	438	451	473
7 ...	416	409	429	427	426	406	425	437	412	446	458	462
8 ...	416	402	420	439	431	426	422	441	418	440	443	426
9 ...	406	393	404	425	436	416	432	418	424	445	407	442
10 ...	405	390	420	429	425	427	430	376	422	459	399	444
11 ...	409	409	428	379	430	416	443	392	430	467	417	441
12 ...	415	419	438	395	444	424	423	398	429	439	426	448
13 ...	415	417	395	414	432	432	404	416	442	406	424	455
14 ...	418	407	377	414	425	431	403	417	445	429	434	458
15 ...	424	392	402	416	433	453	411	418	413	436	435	452
16 ...	410	380	407	407	445	449	417	419	416	443	438	455
17 ...	395	395	402	412	434	421	415	433	426	416	449	451
18 ...	408	403	409	411	431	426	419	407	431	440	448	458
19 ...	394	407	410	420	448	432	421	422	424	447	452	458
20 ...	398	407	407	414	448	433	421	442	419	453	459	468
21 ...	400	414	411	424	448	448	422	436	428	453	455	463
22 ...	406	421	416	439	446	435	425	440	428	457	463	444
23 ...	415	427	413	430	452	427	425	446	434	458	421	444
24 ...	409	382	431	421	457	424	429	432	433	460	403	428
25 ...	419	401	429	430	452	434	445	432	424	465	431	438
26 ...	430	427	414	419	456	444	426	430	430	465	441	447
27 ...	427	438	412	419	462	453	418	436	435	411	442	451
28 ...	431	405	428	426	453	446	418	438	436	413	431	455
29 ...	408	...	436	430	431	431	416	434	442	415	434	460
30 ...	420	...	423	441	428	420	422	444	371	423	440	459
31 ...	424	...	419	...	427	...	437	438	...	429	...	464
Monthly Mean ...	411	407	417	421	441	427	421	429	426	439	436	453

TABLE 63.--*Daily means of Horizontal Force (Magnetograph).*

(1896.)

·37000 + Uncorrected for instrumental change.

1896. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	472	415	431	448	459	458	449	455	444	461	469	468
2 ...	466	409	447	446	466	468	452	431	449	453	472	470
3 ...	438	418	444	442	343	470	452	438	453	451	472	453
4 ...	436	406	405	434	411	462	441	444	447	457	461	409
5 ...	437	407	414	423	438	458	441	455	446	462	464	429
6 ...	440	421	432	433	449	458	443	459	444	464	422	438
7 ...	437	428	421	449	435	462	449	431	449	469	411	441
8 ...	446	421	432	454	448	471	439	445	459	459	415	448
9 ...	429	426	443	440	456	448	446	445	462	444	430	448
10 ...	434	430	449	455	452	450	458	442	457	447	436	454
11 ...	443	428	459	455	459	456	438	448	458	435	446	454
12 ...	448	430	420	458	451	458	415	448	447	393	454	467
13 ...	442	440	437	459	456	467	435	453	440	422	448	446
14 ...	448	418	432	464	458	460	440	461	454	433	447	440
15 ...	454	425	441	454	453	447	440	454	452	437	447	445
16 ...	461	433	446	464	460	441	439	457	435	429	462	450
17 ...	438	428	449	454	443	440	443	468	436	436	469	460
18 ...	446	434	458	444	410	442	449	444	355	444	443	467
19 ...	434	432	459	455	415	449	449	454	404	439	451	466
20 ...	433	435	444	464	426	452	453	449	383	449	465	470
21 ...	444	436	457	440	430	451	452	393	407	449	457	471
22 ...	444	433	467	414	430	454	451	424	426	455	460	478
23 ...	451	437	463	413	431	460	462	424	421	449	464	456
24 ...	448	451	470	419	434	466	440	436	417	457	466	465
25 ...	446	446	446	422	433	466	427	434	434	461	472	468
26 ...	451	443	415	427	443	466	434	441	443	464	476	472
27 ...	449	411	421	436	439	451	435	441	437	460	468	464
28 ...	463	406	421	438	456	452	439	446	454	466	463	460
29 ...	482	407	434	436	463	470	449	453	448	472	460	464
30 ...	436	...	446	448	453	461	440	445	449	453	466	463
31 ...	440	...	435	...	448	...	450	447	...	448	...	463
Monthly Mean ...	446	426	440	443	437	457	444	444	437	449	454	456

·37000 + Corrected for instrumental change.

1896. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	469	412	428	445	456	455	446	452	441	458	466	465
2 ...	463	406	444	443	464	465	449	428	446	451	470	467
3 ...	435	415	442	439	441	467	450	435	450	449	469	450
4 ...	434	403	403	431	409	460	438	441	444	455	459	407
5 ...	435	405	411	421	436	456	439	453	444	460	462	427
6 ...	438	419	430	431	447	456	441	457	442	462	410	436
7 ...	435	427	420	447	433	460	447	430	447	467	409	439
8 ...	444	419	430	452	446	469	437	443	457	457	414	446
9 ...	428	425	441	439	454	447	444	444	461	443	429	446
10 ...	433	429	448	453	451	448	456	441	456	445	435	453
11 ...	442	427	458	454	458	455	437	447	457	434	445	453
12 ...	447	429	419	458	450	458	414	448	447	392	453	466
13 ...	442	440	436	458	455	467	434	452	439	421	447	445
14 ...	447	418	432	463	457	460	439	460	453	433	446	439
15 ...	453	425	440	454	453	447	440	454	452	437	447	445
16 ...	461	433	446	464	460	441	439	457	436	429	462	450
17 ...	439	428	449	454	443	440	443	468	436	437	469	460
18 ...	447	435	459	445	410	443	450	444	355	444	443	467
19 ...	434	433	460	456	415	450	450	455	405	440	452	467
20 ...	433	436	444	465	426	453	454	450	384	450	466	471
21 ...	445	437	458	441	431	452	453	394	408	450	458	472
22 ...	446	435	468	416	431	456	452	425	428	456	461	479
23 ...	452	439	464	414	433	461	464	426	423	451	466	458
24 ...	450	453	472	421	435	467	442	437	419	459	467	466
25 ...	448	449	447	424	435	468	429	436	436	463	474	470
26 ...	453	445	417	429	445	468	436	443	445	466	478	474
27 ...	451	414	423	439	441	453	437	443	440	462	470	467
28 ...	466	409	423	441	459	455	442	448	457	468	466	463
29 ...	485	410	437	439	465	473	452	455	451	474	463	467
30 ...	439	...	448	451	455	464	443	448	452	456	469	466
31 ...	443	...	438	...	451	...	453	450	...	451	...	466
Monthly Mean ...	446	426	440	443	437	457	444	444	437	449	454	456

TABLE 64.—*Daily means of Horizontal Force (Magnetograph).*

(1897.)

·37000+ Uncorrected for instrumental change.

1897. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	464	455	462	431	457	459	477	425	462	455	451	452
2 ...	351	461	457	422	448	464	480	439	464	442	444	454
3 ...	407	441	445	456	451	435	471	448	468	448	451	463
4 ...	430	430	423	445	452	445	470	448	460	452	460	460
5 ...	442	442	427	440	458	456	472	453	446	452	456	456
6 ...	447	452	442	435	449	461	478	458	454	448	447	456
7 ...	460	433	451	437	454	459	471	464	460	448	455	460
8 ...	453	443	428	446	458	463	468	463	462	453	454	464
9 ...	462	450	437	447	463	468	476	456	451	463	448	468
10 ...	461	449	448	429	467	471	484	452	461	444	456	444
11 ...	438	452	445	448	454	465	467	453	435	436	457	389
12 ...	440	453	452	453	463	473	469	452	441	438	458	408
13 ...	437	451	442	440	475	477	466	447	457	445	461	426
14 ...	451	444	452	429	440	467	472	439	439	450	443	435
15 ...	439	447	455	445	440	468	462	450	450	453	444	439
16 ...	450	454	461	440	448	450	461	447	453	450	449	444
17 ...	447	453	462	436	416	423	461	444	462	448	422	442
18 ...	459	457	459	438	446	438	467	437	466	424	436	438
19 ...	459	460	461	449	439	443	471	445	465	439	440	449
20 ...	459	466	461	384	439	448	466	433	455	446	437	390
21 ...	463	451	463	416	416	452	463	442	456	456	444	411
22 ...	467	453	461	441	430	448	446	450	454	459	441	421
23 ...	466	447	447	415	432	451	457	450	444	452	453	433
24 ...	457	455	456	418	434	453	462	445	440	454	446	431
25 ...	451	464	455	422	437	458	464	445	449	452	443	431
26 ...	457	437	463	424	442	462	468	439	452	451	445	438
27 ...	457	421	463	429	449	457	462	444	454	454	447	443
28 ...	463	443	461	434	457	456	463	446	465	443	446	453
29 ...	453	...	444	438	457	455	467	454	460	435	451	417
30 ...	451	...	443	437	423	459	463	451	457	434	455	430
31 ...	450	...	444	...	436	...	404	453	...	445	...	421
Monthly Mean ...	448	449	451	434	446	456	465	448	455	447	448	438

·37000+ Corrected for instrumental change.

1897. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	461	452	459	428	454	456	474	422	459	452	448	450
2 ...	348	458	454	419	446	461	478	436	462	439	441	452
3 ...	404	439	443	453	448	433	469	446	465	446	449	461
4 ...	428	428	421	442	449	443	468	446	458	450	458	458
5 ...	439	440	425	438	456	454	470	451	444	450	454	454
6 ...	445	450	440	433	447	459	476	456	452	446	445	455
7 ...	458	432	450	435	452	458	469	463	458	447	454	458
8 ...	451	441	426	444	456	461	467	461	460	452	452	463
9 ...	460	449	436	446	462	467	475	455	450	462	446	466
10 ...	460	448	447	428	466	470	482	450	460	442	455	443
11 ...	437	452	444	447	453	464	466	452	434	435	456	388
12 ...	439	452	451	452	463	472	468	451	440	437	457	407
13 ...	436	451	441	440	474	476	465	446	456	445	460	425
14 ...	450	444	452	429	440	467	472	439	439	450	443	435
15 ...	438	447	455	444	440	468	462	450	450	452	444	439
16 ...	450	454	461	441	448	450	461	447	453	450	449	444
17 ...	447	453	462	436	416	424	462	445	463	448	422	443
18 ...	459	458	459	438	446	439	467	438	466	425	437	439
19 ...	460	461	461	450	440	443	471	445	465	440	441	450
20 ...	460	468	462	385	440	448	467	434	456	447	438	391
21 ...	464	452	464	417	417	453	464	443	457	457	445	411
22 ...	469	455	462	442	431	449	447	451	456	460	442	422
23 ...	467	448	448	416	434	452	458	452	446	453	455	435
24 ...	458	457	458	419	435	455	463	447	442	456	448	433
25 ...	452	467	457	424	439	460	466	447	451	454	445	432
26 ...	459	439	465	426	444	464	469	441	454	453	447	440
27 ...	459	423	465	431	451	459	464	446	456	456	449	445
28 ...	465	446	464	437	459	459	465	449	467	446	449	456
29 ...	455	...	446	440	460	458	470	456	463	438	454	419
30 ...	453	...	446	440	426	462	466	453	460	437	458	433
31 ...	453	...	447	...	439	...	407	456	...	448	...	424
Monthly Mean ...	448	449	451	434	446	456	465	448	455	447	448	438

TABLE 65.—*Daily means of Horizontal Force (Magnetograph).*

(1898)

·37000 + Uncorrected for instrumental change.

1898. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	429	463	466	438	439	431	435	453	439	423	441	463
2 ...	439	462	422	442	434	428	441	441	434	429	443	465
3 ...	440	457	443	447	441	436	443	426	408	435	438	457
4 ...	444	467	455	424	408	438	444	439	424	440	432	458
5 ...	448	458	451	430	420	443	435	440	424	441	439	473
6 ...	448	445	439	426	429	450	433	438	431	453	443	475
7 ...	450	454	452	395	427	435	432	443	450	434	438	452
8 ...	453	460	454	414	429	434	432	445	451	435	445	463
9 ...	452	460	459	421	433	440	434	449	351	436	427	454
10 ...	441	471	457	425	439	444	442	450	316	430	436	457
11 ...	427	433	429	427	439	438	444	453	363	439	437	463
12 ...	441	428	438	384	427	439	442	447	387	441	446	473
13 ...	441	440	445	414	434	441	439	434	401	437	443	472
14 ...	450	425	449	412	441	444	438	446	387	435	444	437
15 ...	448	431	371	424	429	444	438	454	408	444	446	447
16 ...	433	432	366	426	433	440	442	435	425	437	451	438
17 ...	431	436	408	426	437	446	440	417	421	440	429	440
18 ...	432	441	421	430	445	451	446	429	414	440	423	454
19 ...	434	450	419	435	446	448	456	434	418	450	437	451
20 ...	438	453	421	432	444	448	424	433	425	424	443	448
21 ...	435	441	428	438	442	449	434	431	422	426	426	455
22 ...	439	440	432	440	453	461	430	432	434	418	398	450
23 ...	444	450	434	438	447	437	427	434	422	425	417	453
24 ...	451	448	435	444	446	445	425	438	414	433	429	457
25 ...	451	450	432	435	449	448	421	438	417	412	429	459
26 ...	445	457	443	438	453	426	427	444	427	414	425	464
27 ...	445	457	445	446	450	424	436	436	429	421	424	466
28 ...	437	457	446	437	433	439	429	423	401	417	435	455
29 ...	442	...	440	443	434	433	432	433	398	394	433	460
30 ...	451	...	436	441	414	431	443	433	412	407	437	459
31 ...	450	...	449	...	421	...	437	445	...	415	...	456
Monthly Mean ...	442	449	435	429	436	440	436	438	412	430	435	457

·37000 + Corrected for instrumental change.

1898. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	426	460	463	435	436	428	433	450	437	420	438	460
2 ...	437	460	419	439	432	426	438	438	431	427	440	462
3 ...	438	454	441	444	438	433	440	424	·406	433	435	455
4 ...	442	465	452	422	406	436	442	437	422	438	430	456
5 ...	446	456	449	428	418	441	433	438	422	439	437	471
6 ...	446	443	438	424	427	449	432	436	430	451	441	474
7 ...	449	453	451	393	426	433	430	441	449	432	437	451
8 ...	452	459	452	413	428	432	430	443	449	433	444	462
9 ...	451	459	457	420	432	439	433	448	350	435	426	453
10 ...	440	470	456	424	438	443	441	449	315	428	435	456
11 ...	426	433	428	426	438	437	443	452	362	438	436	462
12 ...	440	428	438	383	426	438	441	447	387	440	445	472
13 ...	440	440	444	413	433	440	439	434	401	437	443	472
14 ...	450	425	449	412	440	444	438	446	387	434	443	437
15 ...	448	431	371	424	429	443	438	454	408	444	446	447
16 ...	433	433	366	426	433	441	442	435	425	437	451	438
17 ...	431	437	408	427	437	446	440	417	421	440	430	440
18 ...	433	442	421	431	445	452	446	429	415	440	424	454
19 ...	434	451	419	436	447	449	456	434	419	451	438	452
20 ...	439	454	422	433	444	449	425	434	426	425	444	449
21 ...	436	443	429	439	443	450	435	432	423	427	427	455
22 ...	440	441	433	442	454	462	431	433	435	419	400	451
23 ...	445	452	435	439	448	439	428	436	424	426	418	455
24 ...	452	450	436	446	447	446	426	439	415	434	431	459
25 ...	453	452	433	437	451	450	423	440	418	413	431	461
26 ...	447	460	445	440	455	428	429	446	429	416	427	466
27 ...	447	460	447	449	452	426	438	438	431	423	427	468
28 ...	439	460	448	440	435	442	431	425	403	419	438	457
29 ...	445		442	445	437	435	434	435	400	396	436	462
30 ...	454	...	439	444	416	433	445	436	415	410	440	461
31 ...	453	...	451	...	424	...	440	448	...	418	...	459
Monthly Mean ...	442	449	435	429	436	440	436	438	412	430	435	457

TABLE 66.—*Daily means of Horizontal Force (Magnetograph).*

(1899.)

·37000 + Uncorrected for instrumental change.

1899. Date.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	464	435	429	450	441	441	413	455	436	436	451	455
2 ..	462	433	439	452	428	440	419	458	435	438	455	447
3 ...	452	435	434	453	447	439	410	449	436	438	454	452
4 ...	446	440	439	446	420	443	418	435	436	442	437	455
5 ...	445	445	441	444	410	445	426	443	436	445	441	456
6 ...	453	452	446	451	434	451	433	444	433	433	443	463
7 ...	457	455	432	445	443	452	438	435	436	436	450	449
8 ...	462	446	442	448	450	457	432	437	443	440	450	440
9 ...	463	438	442	445	450	460	436	443	440	442	450	445
10 ...	463	450	433	443	455	456	442	435	432	444	456	453
11 ...	462	455	429	440	453	449	434	439	441	443	448	461
12 ...	456	358	431	441	444	449	432	445	440	447	447	455
13 ...	457	409	424	445	456	439	430	436	434	449	442	452
14 ...	465	415	434	449	460	444	438	442	445	447	449	457
15 ...	456	421	433	453	442	444	444	445	432	423	446	460
16 ...	451	425	437	449	424	450	445	442	432	428	450	468
17 ...	453	430	439	445	431	451	446	439	430	427	454	457
18 ...	448	436	440	407	439	451	444	443	420	429	464	460
19 ...	451	441	441	412	442	453	445	452	430	439	456	444
20 ...	446	435	444	418	435	448	446	427	433	440	449	446
21 ...	449	425	434	425	448	451	447	424	432	448	448	445
22 ...	455	434	396	427	445	458	442	430	443	439	437	445
23 ...	436	428	378	434	457	452	443	431	440	426	437	447
24 ...	449	417	396	437	459	447	447	435	444	425	439	452
25 ...	450	417	410	428	456	448	435	435	449	428	440	452
26 ...	448	424	411	437	453	456	436	437	421	429	444	451
27 ...	455	437	421	442	451	441	434	440	417	429	445	445
28 ...	443	431	426	440	453	435	444	454	424	432	448	443
29 ...	422	...	434	445	455	420	444	453	420	439	445	441
30 ...	437	...	437	431	460	394	438	431	428	445	445	445
31 ...	439	...	439	...	449	...	445	428	...	439	..	445
Monthly Mean ...	451	431	429	439	445	445	436	440	434	437	447	451

·37000 + Corrected for instrumental change.

1899. Date.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	461	432	426	447	438	438	411	453	434	433	448	452
2 ...	459	430	436	449	425	437	417	455	432	435	452	445
3 ...	449	433	432	451	445	436	407	446	434	435	452	450
4 ...	444	438	436	444	418	441	416	432	434	440	434	452
5 ...	443	443	439	442	408	443	424	441	434	443	439	454
6 ...	451	450	444	450	433	449	431	442	432	431	441	461
7 ...	455	454	430	444	442	451	436	434	435	434	448	448
8 ...	460	445	440	447	448	456	431	436	441	438	449	439
9 ...	462	437	441	444	448	458	435	441	439	441	449	444
10 ...	462	449	432	442	454	455	441	433	431	443	455	452
11 ...	461	454	428	439	452	448	433	438	440	442	448	460
12 ...	455	357	431	441	444	449	432	445	439	447	447	455
13 ...	457	408	424	445	455	438	429	436	433	448	441	451
14 ...	465	415	433	449	459	444	437	441	445	446	448	457
15 ..	456	421	433	453	442	444	444	445	432	422	446	460
16 ...	451	425	437	449	424	450	445	442	432	428	450	468
17 ...	453	431	440	445	431	451	447	439	430	427	455	457
18 ...	448	437	440	407	440	451	444	443	421	429	465	460
19 ...	452	442	441	413	443	454	445	453	430	439	457	444
20 ...	447	436	445	419	436	448	446	428	434	440	450	447
21 ...	450	427	435	426	449	452	448	425	433	449	449	446
22 ...	456	435	397	428	446	459	444	431	444	440	438	446
23 ...	437	430	380	436	458	454	445	432	442	427	438	448
24 ..	450	419	398	439	460	449	448	437	446	426	440	453
25 ...	451	419	411	430	457	450	436	437	451	430	442	454
26 ...	450	426	413	439	454	458	437	439	423	431	446	453
27 ...	457	439	423	444	453	443	436	442	419	431	447	447
28 ...	445	433	428	442	455	437	446	456	427	434	450	446
29 ...	425	...	436	447	457	422	446	456	422	441	447	444
30 ...	439	...	440	433	463	397	441	434	431	447	447	448
31 ...	442	...	442	...	451	...	448	430	...	442	...	447
Monthly Mean ...	451	431	429	439	445	445	436	440	434	437	447	451

TABLE 67.—*Daily means of Horizontal Force (Magnetograph).*

(1900.)

·37000 + Uncorrected for instrumental change.

1900. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	450	440	452	451	400	443	442	443	456	450	451	451
2 ...	453	441	448	450	425	440	434	445	459	449	450	440
3 ...	456	438	448	456	431	434	441	450	453	456	448	442
4 ...	461	432	450	455	438	438	445	448	459	453	458	443
5 ...	425	415	457	442	331	445	448	441	452	439	462	442
6 ...	436	427	461	449	378	447	451	446	456	451	458	447
7 ...	439	434	453	446	394	446	445	448	453	449	458	444
8 ...	444	445	434	441	410	447	444	429	457	447	457	439
9 ...	456	433	405	451	417	445	448	435	459	443	457	448
10 ...	450	430	425	435	422	442	442	442	451	451	460	429
11 ...	452	426	435	440	423	445	445	451	451	452	458	438
12 ...	442	434	440	440	428	447	446	451	456	456	456	441
13 ...	440	439	345	439	416	450	440	445	461	456	452	441
14 ...	440	437	406	445	412	450	445	438	454	453	453	446
15 ...	429	424	423	455	427	448	449	451	454	454	454	445
16 ...	435	426	428	453	426	445	442	446	447	454	455	443
17 ...	437	434	437	453	428	449	445	447	452	455	454	443
18 ...	442	438	444	442	435	450	438	440	449	454	450	446
19 ...	433	446	443	446	424	451	440	445	453	457	453	444
20 ...	424	449	448	449	431	447	433	443	455	454	458	442
21 ...	416	431	449	447	430	448	439	439	455	446	458	446
22 ...	441	437	447	449	427	450	439	444	450	448	456	446
23 ...	440	448	442	446	433	444	449	440	445	453	461	445
24 ...	445	431	444	436	432	443	439	445	449	457	452	450
25 ...	443	434	450	447	431	445	432	438	451	412	447	434
26 ...	431	435	446	452	427	443	431	439	456	433	447	442
27 ...	430	439	447	448	432	453	434	441	454	429	449	433
28 ...	440	436	458	448	437	436	435	433	433	432	459	427
29 ...	442	...	450	455	432	438	435	435	444	435	452	427
30 ...	447	...	441	449	421	432	434	440	443	431	455	431
31 ...	435	...	443	...	421	...	437	445	...	436	...	430
Monthly Mean ...	440	435	439	447	420	445	441	443	452	447	455	441

·37000 + Corrected for instrumental change.

1900. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	447	438	450	449	397	440	439	440	454	448	449	448
2 ...	451	438	446	448	423	437	431	442	456	446	448	438
3 ...	453	436	446	454	429	431	438	448	451	454	446	439
4 ...	459	430	448	453	436	436	443	446	457	451	456	441
5 ...	423	414	455	440	329	443	446	439	450	437	460	440
6 ...	435	425	460	447	376	445	449	444	454	449	456	446
7 ...	437	433	451	445	392	445	444	447	452	447	457	442
8 ...	443	444	432	440	409	446	443	428	456	446	456	438
9 ...	454	432	404	450	415	444	447	434	458	442	456	446
10 ...	449	429	424	434	421	441	441	441	450	450	459	428
11 ...	451	426	435	439	422	444	445	450	450	451	457	437
12 ...	441	433	439	440	428	446	446	451	456	455	456	440
13 ...	440	438	345	438	416	449	440	444	461	456	452	441
14 ...	440	437	405	445	412	449	445	437	453	453	452	446
15 ...	429	424	423	455	427	448	448	451	454	453	454	445
16 ...	435	426	428	453	426	445	442	446	447	454	455	443
17 ...	437	435	437	453	429	449	445	448	452	455	455	443
18 ...	442	439	444	442	436	451	439	440	450	454	450	447
19 ...	434	447	444	446	424	451	440	445	454	457	453	444
20 ...	424	450	449	450	432	448	433	444	456	455	459	443
21 ...	417	432	450	448	431	449	440	439	456	447	459	447
22 ...	442	439	448	450	428	451	440	445	451	449	457	447
23 ...	442	449	443	447	434	446	450	441	447	454	462	446
24 ...	446	433	445	438	433	444	440	446	451	458	453	451
25 ...	445	436	451	449	432	446	434	440	452	414	449	436
26 ...	433	438	447	454	429	445	433	441	458	434	449	443
27 ...	432	441	448	450	434	455	436	443	456	431	451	435
28 ...	442	438	460	450	439	438	437	435	435	434	462	429
29 ...	444	...	453	458	435	440	437	437	446	438	454	430
30 ...	449	...	444	451	424	434	436	442	445	433	457	433
31 ...	438	...	445	...	424	...	440	447	...	438	...	432
Monthly Mean ...	440	435	439	447	420	445	441	443	452	447	455	441

TABLE 68.—*Daily means of Horizontal Force (Magnetograph).*

(1901.)

·37000 + Uncorrected for instrumental change.

1901. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	455	443	444	448	452	455	439	451	441	432	450	449
2 ...	444	425	450	439	451	446	443	455	442	435	452	417
3 ...	444	432	446	446	446	451	449	451	441	434	453	423
4 ...	457	436	443	446	445	452	447	439	437	439	421	427
5 ...	444	439	445	449	449	454	441	436	439	433	442	418
6 ...	441	438	446	457	454	461	441	449	441	438	439	426
7 ...	447	439	441	446	452	450	439	459	440	439	442	431
8 ...	448	439	443	442	454	451	447	440	441	428	440	436
9 ...	451	440	440	443	450	448	450	448	449	415	439	431
10 ...	444	438	448	450	438	448	443	447	426	422	443	427
11 ...	443	445	444	449	429	449	451	444	419	424	441	432
12 ...	442	432	443	448	433	453	422	448	420	428	440	433
13 ...	447	433	432	449	435	458	436	451	428	428	443	432
14 ...	452	436	440	440	437	443	440	431	429	428	445	433
15 ...	451	441	450	443	437	433	442	424	437	430	444	431
16 ...	449	447	451	439	441	438	435	428	445	427	443	436
17 ...	452	447	443	438	447	444	427	434	429	429	440	433
18 ...	451	445	439	446	446	447	435	435	432	428	444	435
19 ...	454	427	435	447	436	453	438	440	436	435	434	432
20 ...	453	426	437	447	436	454	439	442	435	433	434	427
21 ...	446	428	441	448	438	451	438	438	435	427	439	429
22 ...	444	428	441	445	445	449	434	437	439	428	439	431
23 ...	431	437	445	432	450	449	441	439	440	429	444	432
24 ...	432	430	397	432	439	448	446	445	435	433	443	435
25 ...	438	428	409	446	440	448	444	447	437	423	447	430
26 ...	440	435	422	447	441	446	443	440	441	416	442	431
27 ...	445	439	430	446	437	456	439	432	435	429	442	433
28 ...	444	438	433	436	439	461	440	437	434	427	439	399
29 ...	445	...	434	438	439	457	439	444	436	426	437	410
30 ...	437	...	427	446	440	443	442	438	437	427	441	412
31 ...	442	...	434	...	446	...	445	443	...	431	...	415
Monthly Mean ...	446	436	438	444	443	450	440	442	436	429	441	428

·37000 + Corrected for instrumental change.

1901. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	453	440	441	446	449	452	436	449	438	430	448	447
2 ...	442	423	447	437	448	444	440	453	440	433	450	414
3 ...	442	430	443	444	444	449	447	448	439	432	451	421
4 ...	455	434	441	444	443	451	445	437	435	437	420	425
5 ...	442	437	443	447	447	452	439	435	438	431	440	417
6 ...	440	436	444	456	452	459	440	447	440	436	437	424
7 ...	445	437	439	444	450	449	438	458	438	438	440	429
8 ...	446	438	442	440	453	450	445	438	439	427	438	435
9 ...	450	439	439	442	449	447	449	447	448	414	437	430
10 ...	443	437	447	449	437	447	442	446	426	421	442	426
11 ...	443	444	443	448	429	448	450	444	419	423	440	431
12 ...	441	432	443	447	432	453	421	448	420	427	440	432
13 ...	·447	433	431	448	435	458	435	451	428	428	442	432
14 ...	452	436	440	440	437	442	440	430	429	428	445	433
15 ...	451	441	450	442	437	433	442	424	437	430	444	430
16 ...	449	447	451	439	441	438	435	428	445	427	443	436
17 ...	452	447	443	439	447	444	427	434	430	429	440	433
18 ...	451	445	439	447	447	447	436	435	432	429	444	435
19 ...	455	427	435	448	436	453	439	440	437	435	434	433
20 ...	454	427	438	448	436	455	439	443	435	434	435	428
21 ...	446	429	442	449	439	452	439	438	436	428	439	430
22 ...	445	429	442	446	446	450	435	438	440	429	440	432
23 ...	432	439	446	433	451	451	443	440	441	430	445	433
24 ...	434	431	398	434	440	449	447	446	436	435	444	437
25 ...	440	429	410	448	442	449	445	449	438	425	449	431
26 ...	441	437	424	448	443	448	445	441	443	418	444	433
27 ...	449	442	432	448	439	458	441	433	437	431	444	435
28 ...	446	440	435	438	441	463	442	439	436	429	442	401
29 ...	448	...	436	440	441	459	441	446	438	428	439	412
30 ...	439	...	430	448	443	445	444	440	439	429	443	415
31 ...	445	...	436	...	449	...	447	445	...	434	...	418
Monthly Mean ...	446	436	438	444	443	450	440	442	436	429	441	428

TABLE 69.—*Daily means of Horizontal Force (Magnetograph).*

(1902.)

·37000 + Uncorrected for instrumental change.

1902. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	428	445	441	436	429	432	432	431	423	418	410	425
2 ...	431	443	434	437	423	436	435	434	412	430	417	424
3 ...	427	437	439	431	431	436	440	437	416	427	427	429
4 ...	429	439	440	430	429	439	431	430	413	426	429	424
5 ...	432	439	444	434	430	440	436	433	420	428	433	429
6 ...	434	445	436	432	430	434	438	435	422	431	435	424
7 ...	433	427	441	439	427	440	440	432	421	433	431	429
8 ...	431	424	428	447	431	436	437	432	421	429	433	428
9 ...	430	430	432	436	407	442	436	433	423	426	437	430
10 ...	428	434	435	435	416	445	437	434	416	429	435	424
11 ...	426	439	444	379	421	443	440	421	412	421	439	432
12 ...	434	437	431	411	427	434	425	426	411	421	439	429
13 ...	433	439	435	421	435	435	431	426	413	425	435	425
14 ...	436	436	435	420	425	431	439	429	421	424	439	426
15 ...	420	438	443	430	427	437	440	430	420	424	435	428
16 ...	404	432	431	433	430	432	431	434	416	428	436	426
17 ...	411	434	433	430	432	437	436	431	418	430	438	424
18 ...	416	440	434	428	428	436	442	424	423	430	439	430
19 ...	422	436	439	429	428	436	430	432	415	423	436	430
20 ...	426	433	442	426	426	435	438	432	408	432	436	425
21 ...	427	425	438	420	427	439	437	418	407	427	432	428
22 ...	428	433	435	425	427	424	438	401	413	428	428	425
23 ...	428	434	440	429	434	432	438	413	406	429	420	407
24 ...	425	438	424	427	435	437	421	419	414	422	386	411
25 ...	428	430	425	431	429	435	416	428	414	407	400	418
26 ...	428	429	426	435	422	433	419	421	414	414	409	417
27 ...	428	434	429	432	428	431	424	427	416	413	425	419
28 ...	433	439	433	437	433	435	426	429	416	417	424	417
29 ...	431	...	434	438	427	425	428	429	419	423	427	418
30 ...	432	...	432	434	417	420	423	429	413	410	425	423
31 ...	432	...	437	...	423	...	429	426	...	363	...	426
Monthly Mean ...	427	435	435	429	427	435	433	428	416	422	428	424

·37000 + Corrected for instrumental change.

1902. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	425	443	438	433	427	430	430	428	421	416	407	422
2 ...	429	441	432	434	421	434	433	432	410	427	415	422
3 ...	425	435	436	429	429	434	438	435	414	425	425	427
4 ...	427	438	438	429	427	437	429	428	411	424	428	422
5 ...	430	437	442	432	428	438	434	431	418	426	431	428
6 ...	432	443	434	431	428	432	437	433	421	429	433	423
7 ...	432	425	439	437	426	438	438	430	420	431	429	428
8 ...	429	422	427	446	429	435	435	430	419	428	432	427
9 ...	429	429	431	435	406	441	435	432	422	425	436	428
10 ...	427	433	434	434	415	445	436	433	415	428	434	423
11 ...	425	439	444	378	420	442	439	421	411	420	439	431
12 ...	434	437	430	410	426	434	425	425	411	420	439	428
13 ...	433	439	434	421	434	435	431	425	413	424	435	424
14 ...	436	436	434	420	424	431	439	429	421	424	439	425
15 ...	420	438	442	430	427	437	440	430	419	424	435	427
16 ...	404	432	431	433	430	432	431	434	416	428	436	426
17 ...	412	435	433	430	433	437	437	431	418	430	439	425
18 ...	416	441	434	428	429	437	443	424	423	431	439	431
19 ...	423	437	440	430	429	437	431	432	415	424	436	430
20 ...	426	434	443	426	426	436	438	433	409	433	437	425
21 ...	428	426	439	421	428	440	438	418	408	428	433	429
22 ...	429	435	436	426	427	425	439	402	414	429	429	426
23 ...	429	436	441	430	435	433	439	414	407	430	421	408
24 ...	426	440	425	428	437	438	423	421	415	423	387	412
25 ...	430	432	427	432	431	436	418	429	416	408	401	419
26 ...	429	431	428	437	423	435	421	423	416	416	411	418
27 ...	430	436	431	434	430	433	425	429	418	415	427	421
28 ...	435	441	435	439	434	437	428	430	418	419	426	419
29 ...	433	...	436	440	429	427	430	431	422	425	429	420
30 ...	435	...	434	436	420	423	425	431	416	412	427	425
31 ...	434	...	440	...	425	...	431	428	...	365	...	428
Monthly Mean ...	427	435	435	429	427	435	433	428	416	422	428	424

TABLE 70.—*Daily means of Horizontal Force (Magnetograph).*

(1903.)

·37000 + Uncorrected for instrumental change.

1903. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	435	433	430	420	414	419	423	413	415	420	321	399
2 ...	438	436	419	418	418	416	424	422	412	407	352	375
3 ...	436	432	420	417	423	420	428	422	415	417	365	383
4 ...	436	437	430	427	417	424	431	422	415	424	378	390
5 ...	423	434	418	415	407	427	434	409	405	420	388	385
6 ...	424	432	424	336	399	428	421	416	410	420	391	390
7 ...	425	436	413	373	405	431	427	423	412	416	400	387
8 ...	433	415	411	401	411	431	432	418	408	408	394	390
9 ...	431	419	411	392	411	434	430	413	408	422	403	394
10 ...	428	427	418	396	414	431	419	425	414	429	384	398
11 ...	424	419	422	404	414	435	417	413	409	425	388	395
12 ...	426	433	423	407	416	432	424	409	402	385	394	403
13 ...	430	432	417	409	420	443	437	413	402	368	396	326
14 ...	431	430	417	413	411	442	434	413	404	375	400	342
15 ...	426	431	420	404	414	427	425	412	406	397	404	363
16 ...	426	428	421	417	421	437	429	414	406	403	397	376
17 ...	424	425	422	415	413	430	430	413	418	406	392	382
18 ...	429	428	428	408	415	425	434	414	415	406	394	396
19 ...	424	435	424	411	412	429	421	420	381	407	385	403
20 ...	423	435	424	414	419	429	427	414	386	416	395	381
21 ...	421	429	423	415	419	428	428	404	394	419	400	383
22 ...	426	412	425	418	417	419	428	376	395	408	389	389
23 ...	422	424	423	417	397	420	425	391	385	409	391	391
24 ...	426	427	424	418	409	415	436	399	383	408	398	398
25 ...	426	420	425	427	405	423	434	404	393	417	403	408
26 ...	428	430	422	420	405	426	412	374	398	385	409	412
27 ...	413	431	423	410	407	433	416	392	411	402	415	402
28 ...	422	435	426	417	401	431	417	397	413	408	421	402
29 ...	425	...	416	417	403	412	415	407	387	418	403	412
30 ...	421	...	422	419	406	411	415	403	399	422	410	371
31 ...	419	...	418	...	411	...	416	404	...	126	...	354
Monthly Mean ...	426	429	421	409	411	427	425	409	403	400	392	386

·37000 + Corrected for instrumental change.

1903. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	433	431	428	418	412	417	421	411	413	418	318	397
2 ...	436	434	417	415	416	414	422	419	410	405	350	373
3 ...	434	430	418	415	421	418	426	420	414	415	364	381
4 ...	434	435	428	425	415	422	429	421	413	422	376	388
5 ...	422	433	416	413	405	425	432	407	403	418	387	383
6 ...	422	431	423	334	398	427	419	414	408	418	389	389
7 ...	424	434	412	372	404	430	426	422	411	415	398	386
8 ...	432	414	409	400	410	430	430	417	407	407	393	388
9 ...	430	418	410	391	410	433	429	412	407	421	402	393
10 ...	427	427	417	395	413	430	419	424	413	428	383	397
11 ...	423	419	421	403	414	434	416	412	408	424	388	395
12 ...	425	432	422	406	415	432	424	409	401	384	394	402
13 ...	430	431	416	409	419	443	436	413	401	368	396	326
14 ...	431	430	416	413	411	442	434	413	403	375	399	341
15 ...	426	431	420	404	414	427	425	412	406	397	404	363
16 ...	426	429	421	417	421	438	429	414	406	403	397	376
17 ...	424	426	422	415	413	430	430	413	418	406	392	382
18 ...	429	429	429	408	415	425	434	414	416	407	395	396
19 ...	424	436	425	412	412	430	421	420	382	407	386	403
20 ...	424	436	424	415	420	430	428	414	387	417	396	382
21 ...	422	430	424	416	420	429	429	405	394	419	401	384
22 ...	427	413	426	419	418	420	429	377	396	408	390	390
23 ...	423	425	424	419	398	421	426	392	386	410	392	392
24 ...	427	428	425	420	410	417	437	400	384	409	399	399
25 ...	428	422	427	428	407	424	435	406	395	419	405	409
26 ...	430	432	423	422	406	428	414	376	400	386	411	413
27 ...	415	433	424	412	409	435	418	394	413	404	416	403
28 ...	424	438	428	419	403	433	419	399	415	409	422	404
29 ...	427	...	418	419	405	414	417	409	390	420	405	414
30 ...	423	...	424	421	408	413	417	405	401	424	412	373
31 ...	421	...	420	...	413	...	418	406	...	128	...	356
Monthly Mean ...	426	429	421	409	411	427	425	409	403	400	392	386

TABLE 71.—*Daily means of Horizontal Force (Magnetograph).*

(1904.)

·37000 + Uncorrected for Instrumental change.

1904. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	392	394	396	339	380	387	408	403	393	384	383	390
2 ...	406	388	401	355	391	388	397	395	394	383	384	404
3 ...	405	398	400	368	390	392	392	381	395	384	395	387
4 ...	403	406	380	375	397	403	397	360	399	386	357	390
5 ...	404	398	380	382	404	404	392	384	402	378	365	384
6 ...	408	395	386	383	402	405	391	395	393	383	374	392
7 ...	416	398	390	370	403	381	367	397	396	353	381	393
8 ...	424	396	392	374	405	393	378	396	394	357	384	400
9 ...	423	390	393	385	411	401	380	402	389	363	386	393
10 ...	408	393	399	385	408	403	373	400	389	376	389	392
11 ...	401	398	404	382	402	394	387	400	385	383	392	398
12 ...	405	400	391	387	381	394	390	403	392	379	394	401
13 ...	412	403	402	384	326	404	395	395	392	375	394	405
14 ...	416	403	401	390	364	406	389	396	397	372	396	402
15 ...	422	407	403	392	382	366	382	403	404	375	395	389
16 ...	382	399	405	390	395	334	388	389	396	380	358	386
17 ...	409	404	406	395	393	369	389	391	391	384	367	393
18 ...	414	402	406	370	395	375	392	389	392	389	364	392
19 ...	426	406	409	336	383	382	399	389	393	389	377	395
20 ...	424	404	398	377	386	382	402	405	402	390	385	393
21 ...	419	409	398	387	391	381	397	397	402	348	394	380
22 ...	406	408	406	386	396	392	399	384	402	357	387	392
23 ...	415	411	408	391	396	399	394	384	389	367	387	400
24 ...	419	413	404	387	378	396	395	390	388	376	392	398
25 ...	425	416	410	388	388	396	396	393	342	389	356	409
26 ...	427	410	388	370	396	406	397	400	366	381	366	391
27 ...	431	413	393	383	395	382	382	402	377	376	374	395
28 ...	400	412	400	387	360	382	386	403	381	370	383	393
29 ...	396	406	400	389	381	389	390	399	396	376	395	393
30 ...	404	...	403	379	382	400	386	372	393	370	392	390
31 ...	411	...	404	...	388	...	389	381	...	364	...	397
Monthly Mean ...	411	403	399	379	389	390	390	393	391	375	381	394

·37000 + Corrected for Instrumental change.

1904. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	390	392	394	337	378	385	406	401	391	382	380	388
2 ...	404	386	399	353	388	386	395	393	392	381	382	402
3 ...	403	397	398	366	388	390	391	379	393	382	393	385
4 ...	402	404	379	374	395	401	395	358	397	385	355	388
5 ...	402	396	379	380	402	402	390	383	400	377	364	382
6 ...	407	393	389	381	400	404	389	393	392	382	372	391
7 ...	415	397	389	369	401	380	365	396	395	352	380	391
8 ...	422	395	391	372	403	392	377	395	393	356	383	399
9 ...	422	390	392	384	410	400	379	401	388	362	385	392
10 ...	407	392	398	384	408	403	372	399	388	375	388	391
11 ...	401	397	403	381	401	394	386	399	385	382	391	397
12 ...	405	400	391	387	381	394	389	402	392	378	393	400
13 ...	412	403	401	383	326	403	394	395	391	374	394	404
14 ...	415	403	401	390	364	406	389	396	396	372	395	402
15 ...	422	407	403	392	382	366	382	403	404	375	395	389
16 ...	382	400	405	390	395	334	388	389	396	380	358	386
17 ...	409	404	406	395	393	369	389	391	391	384	367	393
18 ...	419	402	407	370	395	375	393	389	393	390	364	392
19 ...	422	406	409	336	383	382	400	390	394	389	378	396
20 ...	424	405	398	378	387	383	402	406	403	391	386	393
21 ...	419	410	399	388	392	381	398	397	403	348	394	381
22 ...	407	409	408	387	397	393	400	385	403	358	388	393
23 ...	416	412	409	392	397	401	395	385	391	368	388	401
24 ...	420	415	405	389	379	398	396	391	390	377	393	400
25 ...	427	418	412	389	389	397	398	394	344	390	357	411
26 ...	429	412	389	371	398	407	398	401	367	382	368	393
27 ...	433	415	395	385	396	383	383	404	379	377	376	397
28 ...	401	414	402	389	361	384	388	405	383	372	385	395
29 ...	397	409	402	391	383	391	392	401	398	378	397	395
30 ...	406	...	405	381	384	403	388	374	395	372	394	392
31 ...	413	...	406	...	390	...	391	383	...	366	...	399
Monthly Mean ...	411	403	399	379	389	390	390	393	391	375	381	394

TABLE 72.—*Daily means of Horizontal Force (Magnetograph).*

(1905.)

·37000 + C. G. S. Uncorrected for Instrumental change.

1905. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	394	398	394	345	372	393	393	413	383	366	401	403
2 ...	392	386	326	337	379	395	393	333	385	378	409	405
3 ...	394	322	343	360	380	398	396	356	349	384	404	403
4 ...	384	345	358	362	385	401	405	366	372	385	377	372
5 ...	373	359	376	358	381	374	398	378	369	386	373	385
6 ...	361	372	390	365	389	389	374	380	376	351	389	388
7 ...	377	370	352	366	387	389	377	359	384	372	393	395
8 ...	383	377	367	367	386	400	376	367	393	373	397	393
9 ...	393	380	375	374	387	396	380	385	399	379	401	407
10 ...	389	384	386	374	488	359	383	393	386	382	397	405
11 ...	370	392	388	380	389	373	388	389	384	382	403	409
12 ...	381	386	384	381	398	376	390	402	390	386	321	400
13 ...	385	377	382	376	389	390	389	388	391	380	353	363
14 ...	375	373	382	380	389	393	387	375	394	381	364	384
15 ...	371	381	378	372	389	386	395	379	395	390	326	391
16 ...	378	381	371	376	396	391	401	380	394	387	294	399
17 ...	371	379	384	379	390	394	400	389	402	381	347	391
18 ...	383	380	398	381	394	395	395	394	383	382	360	394
19 ...	377	384	394	387	379	400	396	395	333	389	370	394
20 ...	384	396	395	383	380	401	393	391	365	393	375	369
21 ...	388	385	394	376	384	391	389	390	372	381	363	386
22 ...	369	386	407	379	397	378	383	395	381	383	371	394
23 ...	387	368	402	382	398	359	401	390	383	386	364	395
24 ...	391	393	393	389	386	376	363	383	387	385	373	401
25 ...	381	388	397	390	383	382	376	381	388	377	384	399
26 ...	382	383	399	379	386	388	385	396	366	371	371	396
27 ...	387	374	393	379	376	390	383	392	354	387	371	402
28 ...	387	395	401	384	378	398	384	383	376	359	375	398
29 ...	380	...	414	374	374	396	380	373	381	363	380	390
30 ...	379	...	404	380	380	396	384	366	376	374	388	388
31 ...	383	...	410	...	382	...	392	373	...	377	...	401
Monthly Mean ...	382	378	385	374	385	388	388	382	380	379	373	393

·37000 + Corrected for Instrumental change.

1905. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	392	396	391	343	370	391	391	411	381	364	399	401
2 ...	390	384	324	335	377	393	391	331	383	376	407	403
3 ...	393	320	341	358	378	396	394	354	347	382	402	401
4 ...	382	344	356	360	383	399	403	364	370	383	375	370
5 ...	371	357	375	356	379	373	396	377	367	385	371	383
6 ...	359	371	389	364	387	387	372	378	375	349	388	387
7 ...	376	369	351	364	386	387	376	357	383	371	392	394
8 ...	382	376	366	366	385	399	375	366	392	372	396	392
9 ...	392	379	374	373	386	396	379	384	399	378	400	406
10 ...	388	383	385	373	387	358	382	392	386	381	396	404
11 ...	370	392	388	379	389	372	387	388	383	382	402	408
12 ...	381	386	383	381	398	376	389	402	389	385	321	399
13 ...	384	377	381	376	388	390	389	388	390	380	353	362
14 ...	375	373	382	380	388	392	387	374	394	381	364	384
15 ...	371	381	378	372	389	386	395	379	395	390	326	391
16 ...	378	381	371	377	396	391	401	380	394	387	294	399
17 ...	371	380	385	379	390	394	400	389	402	381	348	391
18 ...	384	380	398	382	394	396	395	394	383	382	360	394
19 ...	378	385	395	388	380	401	396	395	334	389	371	394
20 ...	385	397	395	383	380	402	393	392	366	394	376	369
21 ...	389	386	395	377	385	392	390	391	373	382	364	387
22 ...	370	387	408	379	398	378	384	396	382	384	372	395
23 ...	388	369	403	383	399	360	402	391	384	387	365	396
24 ...	392	394	394	390	387	377	364	384	389	386	374	402
25 ...	382	390	399	392	384	384	377	383	389	378	386	400
26 ...	383	385	400	380	388	390	386	398	367	372	372	397
27 ...	389	376	395	380	378	392	384	394	356	388	373	403
28 ...	389	397	403	386	379	399	386	385	377	361	377	400
29 ...	382	...	415	376	376	398	382	375	383	365	382	392
30 ...	381	...	405	382	382	398	386	368	378	376	390	390
31 ...	385	...	412	...	384	...	394	375	...	379	...	403
Monthly Mean ...	382	378	385	374	385	388	388	382	380	379	373	393

CHAPTER III.

HORIZONTAL FORCE.

Differential Instruments.

Grubb's Force Magnetometer.

128. This instrument by Grubb of Dublin was mounted in 1840 and the record has been systematically secured from the year 1846 up to date without any interruption. A description of the instrument with its various constants and their derivation from time to time has been fully given in detail in appendix III of the volume for 1879—1882 to which reference may be made for minor details.

129. The most important of the interruptions or breaks in the continuity of record occurred in December 1850 when the suspension wire broke and had to be renewed. In December 1855 and in January 1873 similar re-adjustments of the instruments caused a break in the value of the scale co-efficient.

130. Hourly eye-observations of this instrument were made continuously on all days of the week except on Sundays and holidays during the period 1847—1872. The magnetographs were introduced late in 1871 and for the year 1872 both these differential instruments worked simultaneously; the double record so secured has been made use of in linking up the variations of the two periods before and after 1872 given by the two sets of instruments.

After the year 1872 the hourly observations by Grubb's magnetometer were discontinued and eye-readings five times in the day, *viz.* at 6, 10, 14, 16 and 22 hours, were alone kept up. These, as also the eye-readings of the instrument taken simultaneously at times of the absolute determinations, were continued to the date of the close of the Colaba record.

131. The correction which has been applied to the scale-readings to reduce them to an uniform temperature of 82° F., was 0·20 (t° − 82°) from 1847 to 1850; 0·21 (t° − 82°) from 1851 to 1855 and 0·15 (t° − 82°) from 1856 to 1905. The scale-readings have been increased by the above amounts when the observed temperature t° was above, and decreased when it was below 82° F. The question of the temperature co-efficient and the process of its derivation will be referred to later.

132. In table 73 are collected the mean monthly scale-readings of the instrument corrected for temperature. For the period 1847—1872 they have been derived from 24 hourly readings; while for the later period 1873—1905 the monthly means are derived from 5 hourly readings only, after being corrected for the mean of the 24 hours.

2. Scale Co-efficient.

133. The scale co-efficient of this instrument has been derived from the following formula already discussed elsewhere.

$$H \,.\, a \,.\, \frac{1}{\delta\mu} \frac{\delta H}{H} = H \,.\, a \left\{ \cot \mu + \cot (\theta - \mu) \right\} \qquad (68)$$

where a the value of the unit of scale division = sin 10′·8; other notations remain as before.

For the derivation of the co-efficients, the whole period has been, for convenience of discussion, divided into three periods from 1847 to 1855, from 1856 to 1872, and 1873 to 1905.

134. From 1847 to 1855 they have been derived from purely experimental data, as no deflection experiments are available for the period.

TABLE 73.—*Mean monthly Scale Readings of Grubb's Horizontal Force Magnetometer Corrected to 82°.0 F.*

Years.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual means.	Differences of consecutive annual means converted in C. G. S. unit Unit = 1 γ	Annual change corrected for instrumental change shown in columns 18 and 22 of table 77.	Absolute values derived by adding annual changes to values of force for 1903 from 1873 to 1905, for 1872 from 1856 to 1872 and for 1853 from 1847-1856.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1847 ...	18.50	18.16	18.27	18.43	18.77	19.04	19.09	19.22	18.80	19.07	19.11	18.99	18.79			.36000*
1848 ...	19.50	19.89	20.35	20.69	21.04	21.36	21.08	21.39	22.32	21.11	20.93	21.39	20.92	+ 77	+ 69	557
1849 ...	21.79	22.06	22.61	22.92	23.15	22.95	23.05	23.23	23.20	23.34	23.39	23.85	22.96	+ 73	+ 65	622
													24.91			
1850 ...	23.98	24.25	24.66	24.89	25.07	25.05	24.87	25.07	25.07	25.14	25.46	14.42	20.57	+ 70	+ 64	686
1851 ...	17.37	19.11	20.48	21.46	22.11	22.45	22.53	22.63	22.27	22.60	23.40	23.19	21.63	+ 38	+ 32	718
1852 ...	23.47	23.06	23.85	23.87	24.44	24.56	24.63	24.77	24.48	24.86	24.99	25.04	24.33	+ 97	+ 92	810
													25.30			
1853 ...	13.23	13.38	13.70	13.93	13.89	13.98	13.92	14.28	13.77	14.57	14.54	14.51	13.97	+ 35	+ 30	[840]
1854 ...	14.80	14.92	15.05	14.86	15.32	15.57	15.29	15.41	15.33	15.57	15.88	16.03	15.34	+ 50	+ 45	885
1855 ...	16.36	16.34	16.54	16.62	16.73	16.79	16.53	16.63	16.78	16.77	17.09	17.39	16.71	+ 50	+ 45	930
1856 ...	18.31	19.18	19.05	19.08	19.18	18.86	18.80	18.66	18.63	18.72	19.04	19.16	18.89	...	...	953
1857 ...	19.21	19.36	19.33	19.33	19.08	19.26	18.95	18.84	18.51	18.66	18.52	18.56	18.97	+ 5	+ 1	954
1858 ...	18.68	18.81	18.58	18.51	18.85	18.65	18.46	18.50	18.38	18.42	18.94	18.81	18.63	− 19	− 23	931
1859 ...	19.14	18.96	19.11	19.08	19.21	19.05	19.16	19.44	18.76	18.68	19.22	19.19	19.08	+ 25	+ 21	952
1860 ...	19.62	19.95	19.45	19.27	19.44	19.56	19.37	19.17	19.34	19.68	20.17	20.18	19.60	+ 29	+ 25	977
1861 ...	20.34	20.35	20.35	20.51	20.58	20.05	20.26	20.15	20.05	20.14	20.33	20.33	20.29	+ 39	+ 35	1,012
1862 ...	20.71	20.88	20.90	20.88	20.89	20.99	20.60	20.29	20.42	20.12	20.69	20.87	20.69	+ 22	+ 19	1,031
1863 ...	21.11	21.23	21.49	21.33	21.49	21.32	21.14	21.00	20.90	21.09	21.38	21.43	21.24	+ 31	+ 27	1,058
1864 ...	21.89	21.91	21.80	21.71	21.60	21.46	21.44	21.38	21.39	21.88	22.24	22.36	21.75	+ 28	+ 25	1,083
1865 ...	22.35	22.54	22.75	22.70	22.73	22.58	22.47	21.69	22.16	22.07	22.48	22.97	22.46	+ 39	+ 36	1,119
	22.97	22.82	22.95	23.17	23.32	23.02							22.77			
1866 ...	23.20	23.05	23.18	23.40	23.55	23.25	22.64	22.38	22.41	22.47	23.02	23.43	23.00	+ 17	+ 14	1,133
1867 ...	23.65	23.75	23.58	23.63	23.63	23.56	23.41	23.25	23.08	23.13	23.79	24.03	23.54	+ 30	+ 26	1,159
1868 ...	24.17	24.07	24.10	23.88	24.02	23.99	23.79	23.77	23.47	23.57	24.12	24.14	23.92	+ 21	+ 18	1,177
1869 ...	24.03	24.00	24.07	23.81	23.90	24.08	24.16	23.81	23.55	23.87	24.32	24.38	24.00	+ 4	+ 2	1,179
1870 ...	24.15	24.22	24.39	24.32	24.70	24.70	24.76	24.35	23.87	23.87	24.31	24.74	24.36	+ 20	+ 17	1,196
1871 ...	24.79	24.69	24.80	24.39	25.10	25.67	24.84	24.63	24.68	24.72	24.54	25.19	24.79	+ 24	+ 21	1,217
1872 ...	25.40	25.09	25.08	25.24	25.58	25.30	25.01	24.70	24.74	24.54	25.01	24.90	25.05	+ 14	+ 11	[1,228]
1873 ...	[9.73]	9.77	9.89	10.19	10.40	10.34	10.46	10.51	10.52	10.62	10.95	11.32	10.39	...	...	1,188
1874 ...	11.35	11.18	11.47	11.31	11.59	11.61	11.54	11.52	11.50	11.34	11.67	11.98	11.51	+ 64	+ 61	1,249
1875 ...	12.23	12.23	12.00	12.22	12.33	12.45	12.25	12.29	12.09	12.27	12.55	12.75	12.31	+ 46	+ 44	1,293
1876 ...	12.95	12.93	12.91	13.00	13.07	13.11	12.95	12.89	12.81	12.84	13.05	13.19	12.97	+ 38	+ 36	1,329
1877 ...	13.32	13.45	13.37	13.34	13.25	13.29	13.30	13.30	13.27	13.26	13.36	13.54	13.34	+ 21	+ 18	1,347
1878 ...	13.69	13.70	13.78	13.74	13.70	13.62	13.68	13.52	13.40	13.41	13.55	13.73	13.63	+ 17	+ 14	1,361
1879 ...	14.04	14.20	13.97	13.95	13.80	13.71	13.66	13.60	13.45	13.61	13.82	13.97	13.82	+ 11	+ 8	1,369
1880 ...	14.00	14.24	14.01	14.08	13.99	14.03	13.84	13.37	13.55	13.62	13.65	13.75	13.85	+ 2	0	1,369
1881 ...	14.02	13.81	14.03	14.00	14.08	14.02	13.87	13.89	13.55	13.73	13.79	14.02	13.90	+ 3	+ 1	1,370
1882 ...	14.14	14.08	14.18	13.64	13.77	13.70	13.71	13.44	13.73	13.37	13.21	13.54	13.71	− 11	− 14	1,356
1883 ...	13.95	14.02	13.99	13.98	14.14	14.08	13.83	13.91	13.60	13.80	14.00	13.42	13.98	+ 15	+ 13	1,369
1884 ...	14.61	14.59	14.46	14.47	14.52	14.59	14.38	14.46	14.37	14.31	14.50	14.79	14.50	+ 30	+ 28	1,397
1885 ...	14.69	14.98	14.91	14.89	14.64	14.69	14.82	14.59	14.46	14.70	15.01	15.33	14.81	+ 18	+ 15	1,412
1886 ...	15.10	15.35	15.23	14.98	14.94	14.97	14.73	14.68	14.73	14.61	14.76	14.96	14.92	+ 6	+ 4	1,416
1887 ...	15.01	15.16	15.12	15.02	15.10	15.10	14.98	14.84	14.70	14.82	15.06	15.24	15.01	+ 5	+ 2	1,418
1888 ...	15.07	15.25	15.25	15.24	15.25	15.25	15.16	15.06	14.99	15.10	15.23	15.55	15.20	+ 11	+ 9	1,427
1889 ...	15.68	15.72	15.52	15.55	15.46	15.43	15.23	15.15	15.06	15.14	15.26	15.49	15.39	+ 11	+ 9	1,436
1890 ...	15.65	15.82	15.72	15.65	15.61	15.60	15.44	15.28	15.20	15.16	15.34	15.59	15.50	+ 6	+ 4	1,440
1891 ...	15.75	15.77	15.61	15.35	15.19	15.44	15.32	15.15	14.87	15.07	15.42	15.66	15.39	− 6	− 8	1,432
1892 ...	15.51	15.17	15.04	15.27	15.09	15.20	14.80	14.78	14.89	14.74	15.27	15.19	15.08	− 18	− 20	1,412
1893 ...	15.41	15.46	15.47	15.48	15.59	15.39	15.16	14.95	14.95	15.01	15.19	15.48	15.29	+ 12	+ 10	1,422
1894 ...	15.51	15.28	15.35	15.28	15.54	15.30	14.87	14.79	14.69	15.04	15.05	15.44	15.18	− 6	− 9	1,413
1895 ...	15.54	15.45	15.52	15.47	15.62	15.56	15.37	15.34	15.26	15.12	15.31	15.74	15.44	+ 15	+ 13	1,426
1896 ...	15.67	15.61	15.59	15.66	15.50	15.70	15.46	15.17	15.17	15.31	15.61	15.75	15.52	+ 5	+ 3	1,429
1897 ...	15.72	15.88	15.79	15.46	15.59	15.85	15.88	15.66	15.69	15.73	16.00	16.01	15.77	+ 15	+ 13	1,442
1898 ...	16.20	16.18	15.88	15.93	15.97	15.87	15.73	15.52	15.03	15.46	15.78	15.92	15.79	+ 1	− 1	1,441
1899 ...	15.99	15.85	15.78	15.77	15.72	15.74	15.47	15.61	15.56	15.57	15.75	15.95	15.72	− 4	− 6	1,435
1900 ...	16.09	16.17	15.88	15.94	15.86	16.07	15.92	15.75	15.70	15.77	16.06	16.23	15.95	+ 13	+ 11	1,446
1901 ...	16.21	16.35	16.17	16.12	16.18	16.03	15.81	15.67	15.59	15.62	15.89	16.10	15.98	+ 2	0	1,446
1902 ...	16.06	16.10	16.00	15.84	15.97	15.91	15.74	15.66	15.52	15.58	15.74	15.84	15.83	− 9	− 11	1,435
1903 ...	15.94	16.07	15.95	15.80	15.75	15.59	15.37	15.18	15.10	15.02	14.75	15.08	15.48	− 21	− 23	[1,412]
1904 ...	15.23	15.44	15.56	15.29	15.27	15.27	15.20	15.16	15.11	15.06	15.27	15.48	15.28	− 12	− 14	1,398
1905 ...	15.31	15.41	15.34	15.28	15.34	15.32	15.15	14.92	14.83	15.03	14.89	15.32	15.18	− 6	− 8	1,390

* For absolute values of the years 1853, 1872 and 1903 used for data of column 17 see table 239, column 11, and paragraph 142.

The observational data are as follows :—

TABLE 74.

Date.	West torsion reading.	Adjustment torsion reading.	Angle of torsion μ_0.	West scale-reading.	Remarks.
	° ′	° ′	° ′		
May 1, 1846 ...	336 38	264 17	72 21	15·71	Collimator moved and cobweb removed.
May 30, 1846 ...	......	......	......	......	Cobweb removed.
December 30, 1850 ..	334 58	262 37	72 21	12·20	Magnet and fittings cleaned; silver suspension wire broken and renewed.
January 25, 1853 ...	.....	......	......	......	Wires brought closer together at top.
December 31, 1855...	......	269 58	......	.... ..	Turned torsion arm and altered distance apart of wires at top.

For this period the excat value of θ in the above formula is also not known but as the change in declination is not very large, being only about $+6'$, its effect on the value of θ in the formula may be neglected. The small changes in θ hence being excluded from consideration, putting in (68) $\mu=\mu_0+\Delta\,\mu$, and as $\theta-\mu_0=\frac{\pi}{2}$ we have $\theta-\mu=\frac{\pi}{2}-\Delta\,\mu$ (*vide* paragraph 62).

The equation may hence be written—

$$Ha\,\frac{1}{\delta\mu}\,\frac{\delta H}{H}=Ha\left\{\cot\;(\mu_0+\Delta\mu)+\tan\,\Delta\mu\right\} \tag{69}$$

Substituting in the above equation the known values of μ_0 and $\Delta\mu$, and $10'.8$ being the value in arc of a scale-division, we have—

$$Ha\,\frac{1}{\delta\mu}\,\frac{\delta H}{H}=Ha\left\{\cot\,[(72^\circ\,21')+(s-15{\cdot}71)\;10'.8]+\tan\,(s-15{\cdot}71)\;10'.8\right\} \tag{70}$$

The zero of the scale-readings which up to the year 1850 was 15·71, was thereafter changed to 12·20.

The values of H and s used in the above equations have been taken from columns 17 and 14 respectively of table 73 which are sufficiently accurate for the requirements.

The co-efficients derived from the above data are—

	sc. coefft.		sc. coefft.		sc. coefft.
1847 ...	·000364	1850 ..	·000364	1853 ...	·000368
1848 ...	·000364	1851 ...	·000364	1854 ...	·000368
1849 ...	·000364	1852 ...	·000364	1855 ...	·000368

From the magnitude of the co-efficient, and considering that the accuracy required is not greater than $\frac{1}{200}$ of the whole, the value of H and the zero of the scale-reading need not be very accurately known. In the present instance if H is out by 100γ, it affects the co-efficient just by $0{\cdot}1\gamma$. A corresponding limit of error in the zero of the scale-readings is also admissible; any refinement hence in regard to correcting the scale-readings or the values of H for instrumental or other defects has not been attempted. For even if the scale values as corrected by errors in column 10 and the smoothed values of H in column 5 or in column 11 in table 239 are used, the results are the same.

The values of the co-efficients adopted in the early years and given in the volume for 1879—1882, are ·000360 for 1847 to 1852, and ·000365 from 1853 to 1855.

The differences of 4 and 3 in the last place in the co-efficients of the respective periods are due to the adoption, in the early discussion, of a seriously faulty value of H. A reference to appendix III of the volume (1879—1882, page 148, article 203), will show that the adopted value of H expressed as fraction of the force at the epoch 1870·0 works out at ·36319 C. G. S. for the period 1846 to 1851. This value compared even with the rough absolute values of force given in column 2 or column 5 or column 11 of table 239 shows a difference of over 300γ. This, it will be seen at once, accounts for the difference of about 0·3γ between the co-efficients which is almost the whole difference under examination. There seems little doubt that the value of H adopted then was incorrect because the value of H (·36367) used in the same discussion (see page 151, article 210, of the volume) for the earlier year 1846 is higher than ·36319, the value of H for the subsequent epoch 1849·0, which is not possible as the force then was rapidly rising.

Side by side are given below for comparison the values of H used in the determinations of the co-efficients, which will make clear the cause of the slight discrepancy in the results :—

Values of H adopted in the volume of 1879—1882.		Values of H used for the co-efficients for the Colaba data.					
1846—1851, epoch 1849·0 = ...	·36319	1847 ...	·36488	1850 ...	·36686	1853 ...	·36840
1851—1853 „ 1852·25= ...	·36558	1848 ...	·36557	1851 ...	·36718	1854 ...	·36885
1853—1856 „ 1854·50= ...	·36689	1849 ...	·36622	1852 ..	·36810	1855 ...	·36930

135. From the year 1856 to 1872 not only are the observational data available, but also the results of deflection experiments taken in May and June 1866 and in October 1872.

On the occasion of the re-adjustment of the instrument in December 1855 neither the west torsion reading nor the west scale-reading were re-determined. However, as the collimator was not apparently disturbed, if the change in the declination in five years which was not considerable, be excluded, the figures of the preceding adjustment for the west torsion reading 334° 58′ and the scale reading for true west 12·20 given in table 74 may be accepted provisionally as correct. And as the torsion reading of the new adjustment was found to be 269° 58′ this would give for the period 1856 to 1872, $\mu_0+\Delta\mu =$ 65° 0′+(s − 12·20) 10′·80.

It must be noted that the value of μ so obtained must involve errors due to any change of declination. Hence no use is made of the data beyond seeing how far the results obtained from them agree with those derived from the deflection experiments which have alone been utilised and extended backward for the derivation of the co-efficients from 1866 to 1856 as shown below.

The results of the deflection experiment (d' being the deflections corrected for distributions, of the declination magnetometer and d those of the force magnetometer and a' and a the arc values of the divisions of the scales of the instruments respectively) are as follows :—

For May and June 1866 $\dfrac{a'\Sigma d'}{a\Sigma d} = {}$·47886

„ October 1872 $\dfrac{a'\Sigma d'}{a\Sigma d} = {}$·47563

As $\dfrac{a'\Sigma d'}{a\Sigma d} = \dfrac{1}{\delta\mu}\cdot\dfrac{\delta H}{H}$, the value of co-efficient $H\,.\,a\dfrac{1}{\delta u}\cdot\dfrac{\delta H}{H}$ equals $H\,.\,a\,.\dfrac{a'\Sigma d'}{a\Sigma d}$ and substituting the known values of H and a we have—

Scale co-efficients, May and June 1866 = ·37133×·00314×·47886 = ·000558 C. G. S.

„ October 1872 = ·37228×·00314×·47563 = ·000556 C. G. S.

To derive the co-efficients for every year, the equation $\dfrac{1}{\delta\mu}\,\dfrac{\delta H}{H} = \cot\mu+\cot(\theta-\mu)$ (71)
has been used and the value of $\cot\mu$ derived as follows.

θ the direction of the line of the collimation of the reading telescope was N 91° 1′ 41″ W. Also the scale-reading corresponding to the magnetic axis of the magnet was determined to be 10·90 and therefore $\theta-\mu$ would be 91° 1′ 41″+D − (s − 10·90) 10′·8, D being the declination of the year.

During the deflection experiments the values of $\theta-\mu$ so derived, were 89° 38′ 16″ and 89° 34′ 13″ and substituting these in the equation (71) we get—

$$\cdot 47886 = \cot \mu + \cot 89^\circ\ 38'\ 16'' \qquad (72)$$

$$\cdot 47563 = \cot \mu + \cot 89^\circ\ 34'\ 13'' \qquad (73)$$

whence μ equals 64° 42′ 26″ for the first and 64° 54′ 51″ for the second epoch corresponding to the mean scale-readings 22·64 and 24·27 respectively for the two sets of experiments. The co-efficients are then finally derived for the period 1856 to 1866 from the equation.

$$H \cdot a \frac{1}{\delta\mu} \cdot \frac{\delta H}{H} = H \sin 10'\cdot 8 \left\{ \cot \left[(64^\circ\ 42') + (s - 22\cdot 64)\ 10'\cdot 8 \right] + \cot\ (\theta - \mu) \right\} \qquad (74)$$

and for the period 1867 to 1872 from the equation

$$H \cdot a \frac{1}{\delta\mu} \cdot \frac{\delta H}{H} = H \sin 10'\cdot 8 \left\{ \cot \left[(64^\circ\ 55') + (s - 24\cdot 27)\ 10'\cdot 8 \right] + \cot\ (\theta - \mu) \right\} \qquad (75)$$

The values of $\theta - \mu$ used in the equations as also the co-efficients derived have all been collected in table below:—

TABLE 75.

Year.	Absolute easterly declination D.	Mean scale-reading of Grubb's H. F. magnetometer s.	91° 1′ 41″ + D − s (s − 10·90) 10′·8 or $\theta - \mu$.	$H \cdot a \frac{1}{\delta\mu} \cdot \frac{\delta H}{H}$ or scale co-efficient Colaba data.	Scale co-efficients published in the old volumes.	Scale co-efficients (corrected) published in the old volumes.
1	2	3	4	5	6	7
	′ ″		° ′ ″	C. G. S.	C. G. S.	C. G. S.
1856	19 21	18·89	89 54 44	·000567	·000570	·000567
1857	19 41	18·97	89 54 13	567	567	567
1858	20 14	18·63	89 58 26	567	563	565
1859	21 54	19·08	89 55 14	566	561	565
1860	24 24	19·60	89 52 7	565	561	566
1861	27 23	20·29	89 47 39	564	559	564
1862	30 23	20·69	89 46 20	563	557	562
1863	33 48	21·24	89 43 49	562	556	562
1864	36 17	21·75	89 40 47	561	555	560
1865	39 52	22·46	89 36 42	560	554	559
1866	43 55	23·00	89 34 55	559	553	558
1867	46 28	23·54	89 31 38	559	553	558
1868	48 56	23·92	89 30 0	558	552	557
1869	50 40	24·00	89 30 52	558	550	556
1870	52 58	24·36	89 29 17	557	550	556
1871	54 56	24·79	89 26 36	556	550	555
1872	56 20	25·05	89 25 12	556	549	554

The derivation of the old values of the co-efficients for this period has also been fully discussed in appendix III of the volume for 1879—82 and the corrections to the co-efficients, which had initially been recognised as slightly faulty, have also been derived and given in the volume. The following was the remark made at that time at the conclusion of the discussion :—

" The time may come when it will be worth while to take account of the small error shown in the last column repeating the conversions into force for the whole period................."

The old co-efficients duly corrected as then derived (see article 224, page 153, of the appendix) have been reproduced in columns 6 and 7 of the above table for ready reference, and it will be seen that the revised final co-efficients as given in column 5 are practically the same as the corrected values indicated in the old discussion.

136. For the period 1873 to 1905 the use of the instrument, as already referred to, was restricted. The readings were taken 5 times a day and auxiliary eye-readings corresponding to the times of the absolute determinations* for securing small corrections due to change of force were alone taken with this instrument. The co-efficients derived as under have hence been used for these purposes alone and it will be seen from the small magnitude of the ordinates so corrected that the limit of accuracy (1/200 of the whole) for the co-efficient is. more than ample for the requirements. The co-efficients were initially derived from the formula

$$H\, a \frac{1}{\delta\mu}\ \frac{\delta H}{H} = H \sin 10'\cdot 8 \Big[\cot \Big\{ 64^\circ\ 1' + (s - 13\cdot45)\ 10'\cdot 8 \Big\}$$

$$+ \tan \Big\{ (s - 1\cdot 87)\ 10'\cdot 8 + 89^\circ\ 6' - (90^\circ + D) \Big\} \Big] \quad (76)$$

The value of $\mu_0 = 64^\circ\ 1'$ was derived from deflection experiments made in 1875 and 1878 ; and the various other constants were re-determined after the fresh adjustment of January 1873 ; 89° 6′ being the inclination of the line of collimation to the magnetic meridian, 1·87 being the scale-reading corresponding to the magnetic axis of the magnet and 13·45 being the scale-reading corresponding to the adopted value, 64° 1′ of μ_0. In the adopted co-efficients, however, small corrections for μ, etc., have been introduced.

The mean result of the deflection experiments of August 1875 and September and October 1878, after the necessary corrections, gave $\frac{a'\Sigma d'}{a\Sigma d} = \cdot 49051$. The value of force being ·37338 C. G. S. and the value of the scale division being ·00314 (sin 10′·8), the product of the three gave the co-efficient equal to ·000575 C. G. S. ; and from the equation $\cdot 49051 = \cot\mu + \tan\{(s - 1\cdot 87)\ 10'\cdot 8 + 89^\circ\ 6' - (90^\circ + D)\}$ where s is equal to 13·45 and D = 1° E., the value of μ_0 was found to be 64° 1′.

Deflection experiments repeated in October and November 1893 showed similarly that the co-efficient for that year was ·000584, the data being $\frac{a'\Sigma d'}{a\Sigma d} = \cdot 49656$, and the force = ·37419 C. G. S.

The co-efficients derived from formula (76) which were initially adopted and which are given in columns 2, 5 and 8 of table 76, however show that the value for the year 1893 is ·000580 which is about 1/146 less than the value given by the above deflection experiments. There can be little doubt that the value of the co-efficient by the deflection method, the theory of which is comprehensive and takes into account all possible factors which influence the co-efficient, whether due to magnetic or instrumental causes, is the correct one. The difference hence between the co-efficient derived by the use of the formula and that of the deflection experiment must be regarded as being due to the omission of some factor not considered in equation (76).

The formula, it will be seen, assumes that μ_0 has a constant value for a certain reading of the scale, which, undoubtedly, would be the case if the instrument was perfect and the changes were all due to magnetic variations for which, of course, the formula fully provides. It does not however take into consideration the creep of the zero due to instrumental defects, to loss of moment of the magnet or to change in the torsion owing to stretching of the wires of the bifilar suspension. These causes would affect μ_0. From year to year the change would be insignificant at least for the purposes of the co-efficient, especially in an instrument like Grubb's in long use as at Colaba ; but as the effect is cumulative, only after several years will its effects become appreciable† and sensibly affect the co-efficient.

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* For regular absolute observations the corrections were initially derived from Grubb's. But as, after investigation it was found that the readings of the instrument were affected by temperature errors all corrections were rederived from the magnetograph tabulations, for the Colaba Observatory.

† This change vitiates the co-efficient of 1856 derived from one constant, by less than 1/200 of the whole quite a negligible quantity.

The formula hence may be written in the form

$$Ha . \frac{1}{\delta\mu} . \frac{\delta H}{H} = H . a \Big[\cot \Big\{ 64^\circ 1' + (s - z)\ 10'8 \Big\} + \tan \Big\{ (s - 1{\cdot}87)\ 10'{\cdot}8 + 89^\circ 6' - (90^\circ + D) \Big\} \Big] \quad (77)$$

where z is initially the scale-reading corresponding to 64° 1′ but which changes slowly in value due to the creep of the zero. It will presently be seen, when the question of this shift of zero is discussed (see next section) that the creep due to the stretching of the wires or some other instrumental defect is, for all practical purposes, uniform and amounts to an *increase* of force of about 2γ per year (equal to 0·04 in scale division). Hence, if in 1877 (the mean epoch of the deflection experiments of 1875 and 1878) the scale-reading corresponding to 64° 1′ was 13·45, sixteen years later, that is in 1893, it would obviously become 14·09, provided, of course, that this rate of creep has been correctly measured. When this value of scale-reading 14·09 is hence used for z in formula (77) for the determination of the co-efficient for the year 1893 the derived co-efficient exactly coincides with the value given by the deflection experiments, namely 0·000584. Such revised co-efficients have been calculated from formula (77) and given in columns 3, 6, 9 of the following table side by side with the old adopted co-efficients in columns 2, 5 and 8.

TABLE 76.

Year.	Scale co-efficient derived and initially adopted.	Scale co-efficient derived from formula (77).
1	2	3
	C. G. S.	C. G. S.
1873 ...	·000571	·000573*
1874 ...	573	574*
1875 ...	574	576
1876 ...	575	576
1877 ...	575	576
1878 ...	574	576
1879 ...	574	576
1880 ...	575	576
1881 ...	574	577
1882 ...	574	577
1883 ...	575	577

Year.	Scale co-efficient derived and initially adopted.	Scale co-efficient derived from formula (77).
4	5	6
	C. G. S.	C. G. S.
1884 ...	·000575	·000578
1885 ...	575	578
1886 ...	575	578
1887 ...	576	579
1888 ...	576	579
1889 ...	577	580
1890 ...	578	581
1891 ...	578	582
1892 ...	578	582
1893 ...	580	584
1894 ...	580	585

Year.	Scale co-efficient derived and initially adopted.	Scale co-efficient derived from formula. (77)
7	8	9
	C. G. S.	C. G. S.
1895 ...	·000581	·000586
1896 ...	582	587
1897 ...	582	587
1898 ...	583	589
1899 ...	584	590
1900 ...	584	590
1901 ...	585	591
1902 ...	586	592
1903 ...	587	593
1904 ...	587	593
1905 ...	588	594

* For the years 1873 and 1874, the instrumental change due to the disturbing effect of the adjustment in 1873 is more than the average and has been allowed for.

For the purposes of correcting the absolute determinations, referred to above, for which the old instrument has been made use of, the refinement of using the corrected co-efficients instead of the old ones has not been found essential, as their employment does not appreciably affect the actual result to the unit chosen ; nevertheless they have been shown here, and used wherever necessary so as to present the series as fully complete in all its details as practicable.

3. Grubb's Magnetometer as a recorder of secular changes.

The creep of the Zero.

137. As already remarked elsewhere constant adjustments of instruments are fatal to the accurate registration by them of fine secular changes. It is essential hence for the purpose of any successful examination of such movements that the period during which the instrument has remained undisturbed by adjustment or by interruptions of any other kind should be sufficiently large. In the fairly long life of 60 years of this instrument which commenced its record about 1845, it was disturbed first in December 1850, then in January 1853, again in December 1855, and January 1856 and finally in January 1873. Thus the only useful periods which fall to be considered for purposes of investigation are 1856 to 1872 and 1873 to 1905. Unfortunately however for the former period reliable absolute observations are not available and an indirect procedure has to be adopted to secure the necessary data. The latter period for which full data are available is therefore taken in hand first. In table 78 are collected the observed scale readings of the instrument (uncorrected for temperature) and in table 79 are collected the mean values of observed temperature as given by the attached thermometer, both having been taken simultaneously at the time of the absolute observations of force, the usual mean time of which falls at about 14 hours. The observed values of force have already been given in table 6. From these are derived in table 77 the values of absolute force corresponding to 15·00 scale reading of Grubb's magnetometer which may be called the Grubb's zero series, all figures in which, are reduced to an uniform temperature of 82° F. The mean annual values given in column 14 may now be made available for examination.

138. It will be seen that they clearly show a steady progressive fall in the zero indicating a *rise* in force. The magnet of the instrument is an old one whose moment therefore cannot vary much and may be expected to remain fairly constant. This progression may be due either to a faulty co-efficient or to some defect in the bifilar suspension such as, perhaps the stretching and torsion of the silver wires under the constant weight of the magnet and its carrier, resulting in the introduction of a slowly growing torsional force. The scale co-efficient as already referred to, is fairly accurate and the progression may hence be presumably due to the latter cause. Whatever be the cause, this slow rise in force to which the instrumental readings are clearly subject, should be eliminated, and if found to be regular and uniform, formulated, if possible, into a law. After examination it was seen that the formula which best fitted the curve was $\zeta = a + b\sqrt{t}$ where a and b are some constants, and t is the time in years reckoned from some convenient year, 1844-5 as the starting point. The constants derived are $a = \cdot 37607$, $b = -\cdot 000295$. The calculated annual means appear in column 15, table 77, while the departures of the theoretical from the observed annual means are given in column 16. The observed instrumental changes—differences of the observed annual means from year to year—and those of the theoretical annual means are given respectively in columns 17 and 18. The departures of figures in column 17 from those in 18 are given in column 19 which together with the series in column 16 have been charted for ready reference in figures IV and VII of plate 2.

139. The parallelism of the curves in figures III and IV, and in VI and VII in plate 2, as already referred to elsewhere, shows that this phenomenon of residual secular change of zero having a corresponding closely parallel movement in another instrument of altogether different type, cannot at least wholly be ascribed to instrumental defects.

140. We have seen that it is improbable that two instruments differing in type and construction, and also in location should behave similarly almost to precision in their irregular movements for a period of more than 25 years, and the conclusion is unavoidable that the major portion at least of the movements must be of common origin, possibly due to some defect in the absolute determination, or due to some magnetic cause, which affects the two instruments near the ground almost equally but which has no influence on the magnetic field at the electrometer tower above where the absolute determinations are made.

So far the principal movements may be explained, but it is difficult to go further. While agreeing in the main features, the minor differences charted in figure V, plate 2, of the secular growths as given by the magnetograph in column 17 of table 15 and by Grubb's instrument in column 19 of table 77 indicate that the two instrumental zeros do by no means run in close agreement. In this connection it may be noted that the magnetograph has been adjusted far too often in the short periods under discussion to keep it absolutely free from irregularities, while the Grubb's instrument, though free from this disturbing influence, suffers from another much more serious source of error, *viz.* small uncompensated temperature effects, the actual changes of temperature of the magnet being not exactly recorded by the thermometer attached to the instrument. We shall refer to this again presently, but it is sufficient meanwhile for our purpose here to see that apart from accidental irregularities, the cumulative effect at least in the creep of the annual values of the zero of Grubb's due to instrumental causes has been almost wholly eliminated (*vide* column 16, table 77).

TABLE 77.—*Mean monthly and yearly values of Zero of Grubb's H. F. Magnetometer (corresponding to scale reading 15·00) and Annual Inequality.*

Unity = 1γ = ·00001 C. G. S. Unit.

Years.	Month.													Calculated value of zero derived from Formula a + b √t	Differences, column 14 − column 15.	Consecutive differences of observed zeros.	Consecutive differances of calculated zeros.	Differences, column 17 − column 18.	Calculated values of zeros by formula a + b √t from 1846—1872.		
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.						Years.	Calculated value of zero:	Consecutive differenc. of col. 21.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1876 ...	37421	37434	37436	37446	37453	37449	37456	37464	37471	37468	37449	37434	37448	37441	+ 7				1846	...	
1877 ...	432	433	438	442	435	423	440	442	439	444	443	431	437	438	− 1	− 11	− 3	− 8	1847	...	...
1878 ...	425	422	431	423	414	424	439	449	448	447	445	439	434	435	− 1	− 3	− 3	0	1848	...	...
1879 ...	417	416	426	437	434	447	455	453	450	451	425	415	435	432	+ 3	+ 1	− 3	+ 4	1849	...	...
1880 ...	431	431	429	444	431	426	440	434	433	423	422	428	431	430	+ 1	− 4	− 2	− 2	1850	...	...
1881 ...	416	424	411	402	416	419	434	431	434	433	417	401	420	428	− 8	− 11	− 2	− 9	1851	37529	...
1882 ...	396	402	407	404	400	419	423	431	428	437	415	410	414	425	− 11	− 6	− 3	− 3	1852	524	− 5
1883 ...	409	405	403	422	425	430	436	449	466	463	461	428	433	423	+ 10	+ 19	− 2	+ 21	1853	519	− 5
1834 ...	429	418	427	449	456	451	459	456	450	444	435	426	442	421	+ 21	+ 9	− 2	+ 11	1854	514	− 5
1385 ...	429	402	417	414	431	430	427	429	439	430	415	393	421	418	+ 3	− 21	− 3	− 18	1855	509	− 5
1886 ...	394	393	412	417	412	423	425	432	422	422	400	385	411	416	− 5	− 10	− 2	− 8	1856	505	− 4
1887 ...	405	409	399	398	407	403	409	419	428	444	414	398	411	413	− 2	0	− 3	+ 3	1857	501	− 4
1888 ...	405	408	407	410	408	410	416	413	423	418	395	393	409	411	− 2	− 2	− 2	0	1858	497	− 4
1889 ...	383	381	389	394	401	400	421	425	427	426	413	400	405	409	− 4	− 4	− 2	− 2	1859	493	− 4
1890 ...	392	383	393	396	399	404	417	429	416	414	409	398	404	407	− 3	− 1	− 2	+ 1	1860	489	− 4
1891 ...	395	385	384	394	402	398	408	417	422	410	399	390	400	405	− 5	− 4	− 2	− 2	1861	485	− 4
1892 ...	370	381	386	396	383	381	394	404	419	431	418	422	399	403	− 4	− 1	− 2	+ 1	1862	482	− 3
1893 ...	394	396	393	393	399	401	405	408	419	418	398	385	401	401	0	+ 2	− 2	+ 4	1863	478	− 4
1894 ...	374	376	377	395	398	397	405	413	411	420	407	396	397	398	− 1	− 4	− 3	− 1	1864	475	− 3
1895 ...	379	377	382	394	405	397	397	410	410	429	415	408	400	396	+ 4	+ 3	− 2	+ 5	1865	472	− 3
1896 ...	408	390	405	402	408	416	417	432	427	430	414	411	413	394	+ 19	+ 13	− 2	+ 15	1866	469	− 3
1897 ...	405	395	403	405	413	405	414	409	413	403	388	374	402	392	+ 10	− 11	− 2	− 9	1867	465	− 4
1898 ...	368	376	381	372	377	387	394	405	406	402	385	401	388	390	− 2	− 14	− 2	− 12	1868	462	− 3
1899 ...	389	377	379	392	399	404	406	401	401	401	398	389	395	388	+ 7	+ 7	− 2	+ 9	1869	460	− 2
1900 ...	374	363	384	391	372	378	383	396	410	400	389	365	384	386	− 2	− 11	− 2	− 9	1870	457	− 3
1901 ...	372	354	364	375	370	387	390	400	398	388	381	358	378	384	− 6	− 6	− 2	− 4	1871	454	− 3
1902 ...	363	369	374	375	368	381	387	386	385	386	378	369	377	382	− 5	− 1	− 2	+ 1	1872	451	− 3
1903 ...	365	364	364	362	363	389	404	399	396	395	396	378	381	380	+ 1	+ 4	− 2	+ 6	1873	448	− 3
1604 ...	391	375	370	361	373	378	382	383	386	368	360	365	374	378	− 4	− 7	− 2	− 5	1874	445	− 3
1905 ...	362	350	362	358	363	366	379	387	391	377	376	370	370	376	− 6	− 4	− 2	− 2	1875	443	− 2
Annual Inequality, 1876-1905.	− 11·7	− 14·9	− 10·0	− 5·5	− 3·6	+ 0·1	+ 8·3	+ 13·2	+ 15·5	+ 14·1	+ 2·2	− 7·6	...	...	...	...	...	...	...	...	...

TABLE 78.—*Scale Readings of Grubb's Horizontal Force Magnetometer at times of Absolute Observations.*

Years.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1876 ...	13·53	13·34	13·20	12·82	12·27	12·44	13·02	13·02	12·69	12·68	13·30	13·39	12·97
1877 ...	13·89	13·88	13·64	13·00	12·66	12·66	12·89	12·79	12·71	13·06	12·83	13·67	13·14
1878 ...	14·48	13·91	13·76	13·20	12·69	12·53	13·90	13·53	13·50	12·94	13·36	14·22	13·50
1879 ...	13·74	14·62	14·41	13·83	13·27	13·26	13·52	13·91	13·65	13·70	14·08	14·92	13·91
1880 ...	15·06	15·31	14·03	13·73	13·22	13·31	13·92	13·90	13·26	13·40	13·24	13·82	13·85
1881 ...	14·47	14·04	14·16	13·83	13·37	13·55	13·94	14·09	13·55	13·62	13·47	14·30	13·87
1882 ...	14·42	14·63	14·26	13·46	13·29	13·40	14·04	13·52	13·56	13·13	13·62	14·02	13·78
1883 ...	14·53	14·73	14·17	13·26	13·47	13·86	14·11	13·95	13·86	13·82	13·83	15·39	14·08
1884 ...	15·74	15·35	15·03	14·75	14·08	14·31	14·49	14·67	14·47	14·32	14·74	15·38	14·78
1885 ...	15·10	15·87	15·23	14·60	13·78	14·07	14·59	14·72	13·94	14·13	14·47	15·25	14·65
1886 ...	15·48	15·96	14·97	14·16	13·81	14·17	14·52	14·60	14·56	14·24	14·34	14·76	14·63
1887 ...	15·56	15·89	15·27	14·77	14·20	15·00	15·20	15·03	14·86	14·72	14·97	15·38	15·07
1888 ...	15·89	15·80	15·36	14·63	14·49	14·77	15·05	15·26	14·84	14·70	14·78	15·55	15·09
1889 ...	15·86	16·28	15·37	15·41	14·42	15·15	14·98	15·06	14·59	14·94	15·47	16·12	15.30
1890 ...	15·90	15·95	15·70	15·19	14·94	15·39	15·67	15·50	15·16	15·11	15·15	15·68	15·44
1891 ...	16·19	16·62	15·74	15·02	14·87	14·67	15·44	15·09	14·85	14·80	15·33	15·99	15·38
1892 ...	15·73	15·61	15·11	14·61	14·12	14·93	14·42	15·35	15·36	14·51	15·49	15·49	15·06
1893 ...	16·10	16·48	15·80	15·08	15·17	15·44	15·42	15·28	14·92	14·71	15·16	15·84	15·45
1894 ...	16·02	15·47	15·84	14·92	14·78	15·13	15·14	14·82	14·96	15·02	14·81	15·93	15·24
1895 ...	16·24	16·39	15·56	15·23	14·88	15·27	15·46	15·56	15·26	14·65	15·13	15·87	15·46
1896 ...	16·10	16·09	16·05	15·03	14·68	15·29	15·50	15·39	14·94	14·68	15·26	15·60	15·38
1897 ...	16·27	16·68	16·10	14·85	14·90	15·25	15·84	15·59	15·63	15·40	15·89	16·31	15·73
1898 ...	16·57	16·68	15·44	15·40	15·23	15·41	15·73	15·37	15.11	14·94	15·28	15·74	15·57
1899 ...	16·87	16·33	15·59	15·28	14·95	15·31	15·25	15·39	15·13	14·98	15·55	15·95	15·55
1900 ...	17·12	17·75	15·95	15·67	15·14	15·34	15·53	15·82	15·61	15·38	15·76	16·06	15·93
1901 ...	16·71	17·11	16·01	15·59	15·24	15·47	15·72	15·71	15·20	15·21	15·54	16·00	15·79
1902 ...	16·21	16·32	15·68	15·36	14·93	15·25	15·35	15·28	15·66	15·10	15·47	16·05	15·55
1903 ...	16·49	16·53	16·49	15·74	15·18	15·10	15·36	15·16	14·72	14·73	14·61	15·26	15·45
1904 ...	15·81	15·63	15·69	14·97	14·72	14·86	15·35	15·07	15·10	14·74	15·13	15·65	15·23
1905 ...	16·06	16·90	16·17	15·45	14·77	14·64	15·07	14·66	14·41	14·63	14·83	15·19	15·23
Means ...	15·60	15·71	15·19	14·63	14·25	14·51	14·81	14·77	14·53	14·40	14·70	15·29	14·87
Inequality, 1877—1905	+0·73	+0·84	+0·32	−0·24	−0·62	−0·36	−0·06	−0·10	−0·34	−0·47	−0·17	+0·12	

TABLE 79.—*Temperature of Grubb's H. F. Magnetometer at Times of Absolute Observations.*

Years.	Month.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1876 ...	80·4	80·0	82.9	86·0	88·9	87·9	84·2	83·4	83·2	83·9	82·4	81·8	83·88
1877 ...	79·8	80·4	81·9	85·4	88·0	87·9	86·3	86·0	85·9	85·8	86·8	82·6	84·77
1878 ...	78·6	80·8	83·9	86·4	89·9	89·5	82·8	83·1	83·8	86·7	85·0	80·7	84·29
1879 ...	84·7	80·1	81·6	85·3	87·1	85·5	84·8	81·8	82·6	83·4	81·0	78·1	83·03
1880 ...	77·7	76·6	84·3	87·6	88·7	87·5	83·0	83·5	83·0	85·7	85·1	82·2	83·77
1881 ...	80·7	82·0	83·8	86·3	89·0	87·5	84·0	83·1	84·0	84·7	84·0	81·9	84·28
1882 ...	82·2	80·7	83·7	86·4	88·0	85·4	81·9	83·9	83·6	84·7	82·6	81·0	83·69
1883 ...	80·1	79·4	81·6	86·0	88·1	85·5	83·3	83·7	81·7	83·7	85·3	77·6	83.02
1884 ...	76·0	78·9	83·0	85·1	87·4	87·6	84·4	84·0	83·4	83·9	82·2	79·6	82·98
1885 ...	81·2	79·0	82·7	85·3	89·0	88·9	85·6	83·6	85·9	88·2	87·6	83·3	85·06
1886 ...	80·9	79·6	84·3	87·9	90·9	87·6	83·9	84·4	84·3	85·8	85·9	83·0	84·91
1887 ...	79·0	77·9	82·2	85·4	88·0	84·6	82·5	81·6	82·1	84·9	84·1	81·6	82·85
1888 ...	78·5	81·0	85·1	87·0	88·3	87·1	84·1	82·8	84·7	87·1	85·7	83·2	84·58
1889 ...	81·7	80·5	84·3	85·2	89·4	85·9	84·6	83·6	85·1	84·5	81·7	79·5	83·85
1890 ...	81·3	81·9	83·7	86·3	87·9	84·7	82·4	81·8	83·1	84·6	84·5	82·4	83·73
1891 ...	80·5	78·6	82·7	85·0	87·5	89·3	83·9	83·7	83·3	86·5	85·1	80·8	84·10
1892 ...	82·1	83·1	83·9	88·9	89·7	86·2	85·0	81·9	82·5	85·7	83·3	81·6	84.52
1893 ...	78·8	76·8	81·8	87·1	87·4	84·6	84·0	82·7	83·0	85·1	84·7	81·6	83·15
1894 ...	80·1	82·3	83·4	86·2	88·9	86·3	83·1	83·5	82·2	84·0	83·0	81·3	83·74
1895 ...	78·7	79·8	84·1	86.0	88·3	86·0	84·1	82·5	83·0	86·5	86·2	82·0	83·96
1896 ...	82·1	80·9	83·5	88·4	90·1	86·4	83·6	82·6	85·6	88·5	86·5	83·9	85·20
1897 ...	79·8	79·9	82·2	86·8	88·5	88·0	84·3	83·8	84·8	85·7	83·6	81·3	84·08
1898 ...	80·6	81·1	83·6	87·1	88·8	86·9	83·5	83·6	83·7	87·6	86·8	83·0	84·71
1899 ...	77·3	80·1	84·2	86·4	89·1	85·6	84·8	85·0	84·5	87·5	85·1	83·4	84·43
1900 ...	77·3	79·6	83·3	85·4	88·5	89·2	86·3	83·1	84·3	85·9	85·6	84·2	84·41
1901 ...	79·3	78·4	84·9	86·9	90·3	87·1	84·3	83·3	85·1	85·5	85·7	83·9	84·58
1902 ...	82·6	82·0	85·6	87·9	90·7	88·2	86·1	85·9	82·7	87·0	85·8	82·1	85·58
1903 ...	79·5	79·9	80·9	84·9	87·8	86·7	83·5	83·1	84·7	86·1	84·2	81·7	83·60
1904 ...	81·0	81·9	84·2	86·5	88·8	86·5	84·5	84·4	84·5	87·2	84·5	82·0	84·70
1905 ...	79·0	75·3	80·0	83·4	88·6	89·3	85·1	84·7	84·5	87·3	85·5	82·4	83·78
Inequality, 1877-1905.	−4·03	−4·13	−0·84	+2·20	+4·64	+2·90	+0·05	−0·61	−0·25	+1·71	+0·58	−2·22	84·08

For a short time after each adjustment it is well known that the behaviour of such instruments becomes unsteady and the zero curves always indicate this disturbing effect, which is in all probability due to the introduction of some kind of strain in the wires. The instrument soon, however, settles down to stable conditions and reverts quickly to the uniform and fairly regular creep typical of the particular magnet and its suspension system. The magnet of the Grubb's instrument with the same appendages has been carried by the *same* silver wire from the year 1850 to 1905 and hence it would presumably appear that the law of the instrumental change derived as above, may be extended to the earlier period also for the elimination of at least the major portion of the accumulated effect of the creep. The result of the examination of the zero series of the earlier period from 1856 to 1872 which follows, supports the view that, except about the year of adjustment, the instrumental change so derived may with fair justification be made applicable also to the earlier period.

141. The zero series of the period from 1856 to 1872 unfortunately suffers from the fact already referred to, that no reliable simultaneous absolute observations are available. The following method of procedure has therefore been adopted to secure the necessary data.

The theoretical curve (thick curve in figure 1, plate 9) may be assumed in the first instance to give fairly rough approximate values of force, the curve derived from the data of 1872—1905 being also depended upon to supply the data for the period of 16 years prior to 1872. It has been noted in the discussion of the absolute values of force from 1872—1905, Chapter I, Part II, that the absolute curve (thin curve in figure 1, plate 9) can be fairly approximately reproduced from the theoretical curve by superposing upon the latter, the disturbance fluctuations of the 11-year cycle to which, it will be seen later, the absolute values of force are undoubtedly subject. We have 3 such cycles from which the average corrections for any year depending upon its position reckoned from either the year of maximum or of minimum disturbance, can be roughly derived. If the average corrections are accepted as a measure of the departure of the true absolute force of any year from the theoretical thick curve, the former can be derived from the latter by the average corrections. In column 2, table 80, are given the values of force indicated by the thick curve. In column 3 are given the smoothed average corrections for the year and in column 4 appear the corrected values of force. Having thus secured workable values of force, the subsequent process is similar to that described above. In column 5 the annual means of the scale readings of Grubb's are entered and in column 6 are given the reduced values of force corresponding to one common scale division of the instrument, namely, 20·00. Omitting the years of adjustment, 1856 and 1857, this series is then dealt with and rederived from the simple equation of a straight line, the calculated series being given in column 7. The instrumental change so obtained, in view of the uncertainty of the value of force, may be regarded as satisfactory; a change of 4γ per year is made out for the period while the previous average value shown in column 22, table 77, is 3·4γ.

TABLE 80.

Year.	Absolute value of force given by theoretical curve.	Average corrections for 11 yearly disturbance.	Corrected absolute Force.	* Annual means of scale readings of Grubb's.	Values of force corresponding to 20·00 scale reading of Grubb's.	Calculated zero series from $f = a + bt$.	Differences of Col. 6 and Col. 7.
1	2	3	4	5	6	7	8
1856	·36906	+·00014	·36920	19·12	·36970	·37025	−·00055
1857	·36933	+ 13	·36946	19·20	·36991	·37021	− 30
1858	·36959	+ 5	·36964	18·86	·37028	·37017	+ 11
1859	·36985	− 12	·36973	19·31	·37012	·37012	0
1860	·37010	− 22	·36988	19·83	·36998	·37008	− 10
1861	·37034	− 20	·37014	20·52	·36984	·37004	− 20
1862	·37058	− 8	·37050	20·92	·36998	·37000	− 2
1863	·37080	+ 4	·37084	21·47	·37001	·36995	+ 6
1864	·37102	+ 7	·37109	21·98	·36998	·36991	+ 7
1865	·37124	+ 9	·37133	22·69	·36983	·36987	− 4
1866	·37144	+ 11	·37155	23·00	·36988	·36982	+ 6
1867	·37164	+ 14	·37178	23·54	·36980	·36978	+ 2
1868	·37184	+ 13	·37197	23·92	·36979	·36974	+ 5
1869	·37202	+ 5	·27207	24·00	·36985	·36969	+ 16
1870	·37220	− 12	·37208	24·36	·36966	·36965	+ 1
1871	·37237	− 22	·37215	24·79	·36949	·36961	− 12
1872	·37254	.....	·37228	25·05	·36948	·36957	− 9

* Scale readings from 1856 to 1865 are corrected for the constant difference, 0·23 scale division due to the renewal of the reading wire of the telescope, to make the series comparable.

It will be seen from tables 80, 73 and 239 that the years of adjustment 1856 and 1873 and the years immediately following them 1857 and 1874 respectively are marked by large departures. It will also be noticed that the instrument thereafter rapidly reverts to normal conditions after the passing away of the disturbing effects, whatever they be, of the adjustments. Hence in the treatment adopted, which is strictly a differential process as shown below, the use and application of the instrumental differences *begin* from the later year backwards, the differences of the years of the adjustment coming last, so that the values of these years alone may remain affected, leaving the values of other years unvitiated by the erratic movements of the years of adjustment.

Grubb's variation instrument as recorder of secular change.

142. To resume the consideration of the absolute values of force, as we have to anticipate some of the results in Part II of the volume, it may perhaps be convenient to read this in connection with Chapter I, Part II, where in table 239, the differences of mean annual scale readings of Grubb's converted into force which appear in column 9, have been corrected for the instrumental change given in table 77, columns 18 and 22, throughout the period from 1847 to 1905. These corrected annual changes are given in column 10. These operations have also been indicated in columns 14 to 17 of table 73. The last operation then consists in the selection of the absolute value of force of any particular year and by summing up successive corrected annual differences the absolute series as given by the Grubb's instrument is built up. The value of 1903 has been selected as the starting value for the period 1872 to 1905; for the period 1856 to 1872 the absolute value for the year 1872 has been selected, and for the earlier period that of 1853. Whatever be the values of force selected for these three periods, it is obvious that the character of the secular fluctuations shown in column 12 from year to year will not be affected, except for the years 1872-73 and 1855-56, and yet the absolute values of the particular years selected have been adopted after consideration. The value of the year 1903 lying midway between the minimum and maximum solar spot epoch, is least affected by the disturbing effect of the 11-year period, it being nearest to the theoretical thick curve, figure I, plate 9. That of 1872 was selected for the simple reason that correct absolute observations by the Kew unifilar commenced in 1868 and of the five available annual values of force, the absolute value of 1872 was the only one corrected by the magnetograph for the mean of the day. The selection of the year 1853 was influenced by the fact that the rough absolute determinations of force by the old magnetometer, the results of which are given in column 2 of table 239, Part II, when corrected for the mean of the day by Grubb's and for the difference in the sites* (about 58γ) gave the least departure from the theoretical curve. Thus has been built up integrally in three parts the series of absolute values by Grubb's which appears in column 11, table 239, and is charted as thin curve, figure III, plate 9. In column 12 of the same table are given its departures from the theoretical curve which are also charted in figure III*a*, plate 9. In column 13 are given the departures of the absolute values by Grubb's from the observed absolute values of force corrected for the mean of the day which are given in column 4. These errors or departures are obviously made up of (1) the residual errors of zero, specially marked for the years of adjustment such as 1873, 1874, (2) any secular magnetic change not affecting the absolute, but influencing the variation instrument only, and (3) errors due to other instrumental causes such as uncompensated effects of temperature. The first two have been referred to and discussed already, while the last defect—the uncompensated effects of temperature as they run through all the indications of the instrument,—diurnal, annual and secular—is of such importance as to claim a separate section for itself.

4. *Temperature Corrections of Grubb's.*

143. In the application of temperature corrections to readings of an instrument like Grubb's, which is located above ground and has a large temperature variation, it is not sufficient merely to derive the value of the co-efficient. It is necessary besides to ascertain how far the scale of the attached thermometer is open enough to allow of the corrections to be applied with certainty. It is also essential to make sure that the thermometer can be relied upon to measure the actual changes of the temperature of the magnet. Only on the fulfilment of these requirements is it possible to expect the complete elimination of the vitiating effects of temperature on the readings of such a magnetometer.

144. The scale of the attached thermometer of Grubb's measures about ·08 inch only for 1° F.; and as the co-efficient happens at the same time to be large (as will be presently seen) 8·4γ per 1° F., it is obvious that the limit of accuracy of any single reading can scarcely be less than 1·7γ, assuming that two-tenths of a degree can always be accurately judged which is doubtful.

* The absolute observations were, prior to 1867, made on the ground-floor, while after that year they were transferred to the electrometer tower and the difference in force at the two places has been ascertained and found to be about 58γ.

145. The value of the temperature co-efficient of this instrument had been initially derived by two methods, (1) by the usual experimental method of heating and cooling the room of the magnetometer and (2) by the comparison, extended over a long period, of the average change of the daily temperature with the average simultaneous change in the scale readings of the instrument, *viz.*, $\frac{\Sigma\Delta s}{\Sigma\Delta t}$.

Method 1, the heating and cooling experiment on the magnetometer, showed that a change of ·1486 scale division occurred in the instrument for a change of temperature of 1° F., or taking into consideration the scale coefficient at the time, a change of 8·53γ was indicated for 1° F. The application of the second method by taking the results of the years 1856 to 1864 and subsequently of the periods 1847 to 1850, and 1850 to 1855, gave the average co-efficient $\frac{\Sigma\Delta s}{\Sigma\Delta t}$ = ·1506 scale division or 8·43γ for 1° F. It was, however, noticed that the co-efficient derived from the winter months, November to April, was ·1551, while that given by the summer months, May to October, was ·1461 (*vide* Appendix III, Vol. 1879—1882, paragraph 216, page 154).

146. This small discrepancy, which was then inexplicable, will in light of what follows be clearly seen to be due to causes present in the instrument itself. As it was absolutely essential to remove all doubts about the exact value of the co-efficient although the mean values by both the above methods gave fairly identical results, advantage was taken of the opportunity, when the instrument was dismounted in May 1906, of detaching the magnet from its carrier, and experiments referred to in paragraph 74 as method (1) were performed by noting the deflections on the standard magnetometer, caused by the above magnet being immersed in water at different temperatures. Six such experiments were made and correcting the result for change of force and declination, and applying the necessary correction for the suspension wires, pulley, etc., the temperature co-efficient* for 1° F. was found to be [6·97γ], 7·57γ, 9·07γ, 9·21γ, 8·29γ and 7·92γ, and rejecting the first value, the final mean, result was found to be 8·41γ. Assuming this value as correct and dividing it by the scale co-efficient of any year or period, the values of the co-efficient in scale division of the instrument work out as follows :—

·231 for the period 1847 to 1850; ·230 for 1851 to 1855; ·150 for 1856 to 1872; and ·145 for 1873 to 1905.

147. The temperature co-efficients in scale value which can be read only up to the limit of ·01, actually used in the reductions are respectively for the above periods ·20, ·21, ·15 and ·15, and as from the magnitude of the corrections the errors are within admissible limits, no further modifications in the corrections have been attempted.

148. Having so far verified the value of the co-efficient, the question which next suggested itself for inquiry was—did the thermometer correctly register the variations of the temperature of the magnet itself? Certain discrepancies noticed were long suspected to be due to this fault; but as it was not practicable without dismounting the instrument and disturbing the magnet to provide ways and means to verify the suspicion by actual observations of the march of the temperature of the suspended magnet, simultaneously with that of the thermometer, the final investigation on this point had to be deferred. A careful examination of the diurnal variation as recorded by the two differential instruments, however, gave definite evidence as to the character of the discrepancy, whatever its cause. From the year 1873 to 1905 the magnetograph was running and recording along with Grubb's the diurnal march of the horizontal force. The temperature in the magnetograph underground room was, as already referred to elsewhere, kept absolutely uniform, and hence at least for one day the zero of that instrument could be relied upon safely to remain constant, and thus to supply the necessary data for the examination and comparison of the hourly march of the zero of Grubb's daily at 6, 10, 14, 16 and 22 hours at which simultaneous observations were secured. The process adopted was as follows.

149. The ordinates of the magnetograph curve taken at these hours of observation were duly entered side by side with the simultaneous readings of Grubb's (variation over the five ordinates duly corrected for temperature, and for the mean of five over that of 24 hours). It is obvious that if the two instruments recorded the magnetic phenomenon correctly, the ordinates at the same hour must necessarily be equal. But they showed systematic differences. The excesses hence at each of these hours for the average day of every month for the 33 years available from 1873 to 1905 were tabulated for examination, and the

* Not determined for higher powers of t.

table below gives the results at each of the five hours for each average month derived from the whole period 1873 to 1905.

TABLE 81.

Unity = 1γ = ·00001 C. G. S.

Hours.		6.	10.	14.	16.	22.
January	...	− 4·0	+ 0·3	+ 4·0	+ 3·6	− 3·9
February	...	− 3·7	+ 0·6	+ 3·7	+ 3·1	− 3·5
March	..	− 3·6	+ 1·5	+ 2·6	+ 1·9	− 2·6
April	...	− 3·3	+ 1·7	+ 2·2	+ 1·7	− 2·3
May	...	− 3·0	+ 1·1	+ 2·4	+ 1·7	− 2·3
June	...	− 2·1	+ 0·9	+ 1·7	+ 1·4	− 2·0
July	...	− 1·1	+ 1·3	+ 1·1	+ 0·5	− 1·8
August	...	− 1·3	+ 1·1	+ 1·2	+ 1·0	− 2·1
September	...	− 1·5	+ 1·6	+ 1·3	+ 0·9	− 2·3
October	...	− 3·2	+ 1·8	+ 2·7	+ 1·9	− 3·2
November	...	− 4·0	+ 1·2	+ 4·0	+ 2·8	− 4·0
December	...	− 4·1	+ 0·3	+ 4·4	+ 3·8	− 4·4
Means	...	− 2·9	+ 1·1	+ 2·6	+ 2·0	− 2·8

A glance at the table will show that the zero persistently stands lower during the afternoon hours, while in the morning, when the temperature is low, it stands higher. It will also be noticed that the excesses become markedly small during the wet months of the year, while they are decidedly larger during the drier months. As the magnetograph is located in the underground room, having practically no diurnal fluctuation of temperature, while the Grubb's instrument is mounted in the magnetometer office overground where the daily temperature variation is comparatively markedly great, the excesses may be ascribed to more than one likely cause (1) to the march of the magnetic variation itself being different at the two places, or (2) to the adoption of a faulty temperature co-efficient, or (3) to the faulty record by the attached thermometer of the actual changes of the temperature of the magnet, or to all these causes combined. We have already seen that the correctness of the temperature co-efficient can hardly be doubted after the verification of the value by three independent methods. The causes then reduce themselves to two and the investigation of these acquires additional importance from the fact that its satisfactory solution alone could ensure the accurate comparison of the diurnal variations of force registered by the Grubb's instrument for the earlier period 1846 to 1872 with those recorded by the magnetograph for the later period 1872 to 1905. For this purpose unfortunately however only one single year's simultaneous record of continuous 24 hourly registration of the two differential instruments, is available for comparison and as this year happens to be near the epoch of the greatest disturbance of magnetic energy, the difficulties of comparison are much accentuated. In the volume for 1879—1882 (page 236, appendix V), this comparison has been made and, as must be anticipated from what has been said above, a residual variation was obtained as the result of the comparison. This was then ascribed to the difference of magnetic conditions in the underground and the overground rooms. The excess magnetic variation together with the original Grubb's inequality then derived are given below for ready reference in tables 82 and 82*a*. In light, however, of fresh evidence collected later, this view was abandoned and the cause was rightly shown (*vide* volume for 1886, appendix III) to be due to the thermometer failing to record the actual temperature of the magnet itself. As at that time the experiment could not be conducted upon the instrument itself or upon its magnet but had to be performed in another improvised enclosure it was extremely difficult to evolve the correct temperature series to which the magnet was really subject in its own enclosure. Hence the investigation which was based on assumed experimental data while correctly tracing the cause of the errors, was not successful in securing reliable and satisfactory data for corrections. For, after the elimination of the supposed errors derived from the discussion, there was still left over a residual excess variation, the amplitude of which was much too large to be neglected (*vide* volume for 1886, appendix III, page 54, table 42).

150. The stoppage of the Colaba magnetic record afforded the long sought for opportunity for a direct investigation. The instrument was opened up in January 1907 and the magnet was supported on the Ys of a small wooden support placed in the box, just relieving the tension in the bifilar wires. A thin shallow cup of copper about an inch and a half in diameter was then filled with mercury and placed upon the large magnet of the instrument, a good metallic contact being thus secured. A thermometer was then introduced into the mercury, the stem passing out through a small hole made in the top of the box. The instrument was then closed as before with the single quilt cover in position as in the year 1872.

TABLE 82.—*Grubb's Horizontal Force Magnetometer—Showing the mean diurnal inequality of Horizontal Force for each month of the year 1872 and for the whole year.*

Unity = 0·1γ = ·000001 C. G. S.

1872. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 14	−225	−450	−225	−274	−231	−181	−198	−203	−236	−143	−203	−220	−232
1 14	−192	−428	−209	−269	−231	−148	−225	−209	−214	−115	−181	−220	−220
2 14	−198	−412	−214	−247	−225	−170	−214	−214	−187	− 93	−181	−154	−209
3 14	−192	−318	−176	−236	−203	−192	−236	−209	−170	− 66	−181	−165	−195
4 14	−165	−242	−170	−236	−203	−192	−209	−209	−165	− 11	−176	−148	−177
5 14	−176	−242	−143	−214	−187	−187	−176	−198	−176	− 60	−159	−137	−171
6 14	−132	−170	−154	−165	−148	−137	−115	−159	−181	− 88	−132	−104	−140
7 14	− 49	− 49	− 93	−110	− 22	− 22	+ 11	− 60	−165	− 49	− 38	− 49	− 58
8 14	+ 55	+137	+ 77	+ 93	+176	+115	+198	+ 82	− 16	+ 82	+ 82	+ 38	+ 93
9 14	+192	+313	+291	+357	+401	+258	+384	+242	+225	+258	+280	+209	+284
10 14	+346	+445	+483	+565	+544	+412	+450	+423	+423	+428	+423	+368	+442
11 14	+439	+500	+582	+626	+576	+461	+456	+478	+511	+483	+516	+423	+504
12 14	+439	+516	+533	+549	+516	+445	+439	+467	+500	+417	+467	+401	+474
13 14	+362	+428	+445	+461	+395	+368	+335	+384	+439	+225	+357	+307	+375
14 14	+264	+280	+296	+280	+247	+231	+220	+264	+302	+ 55	+253	+242	+244
15 14	+170	+181	+137	+121	+ 93	+110	+115	+126	+159	− 44	+148	+165	+123
16 14	+ 88	+104	+ 44	− 5	− 16	− 16	− 11	+ 16	+ 66	− 71	+ 16	+ 66	+ 23
17 14	+ 33	+ 38	− 82	− 66	− 82	−104	− 99	− 55	− 16	−159	− 49	+ 11	− 52
18 14	− 27	− 22	−176	−110	−154	−137	−159	− 99	− 99	−143	− 88	− 33	−104
19 14	− 66	− 77	−220	−159	−187	−132	−198	−154	−176	−165	−159	− 77	−147
20 14	−165	−104	−253	−220	−236	−159	−209	−170	−181	−203	−242	−148	−191
21 14	−236	−137	−253	−225	−274	−176	−209	−187	−198	−220	−269	−214	−216
22 14	−264	−159	−274	−242	−285	−198	−181	−170	−236	−176	−253	−247	−224
23 14	−242	−154	−258	−274	−280	−192	−176	−148	−242	−165	−231	−253	−218

TABLE 82*a*.—*Excesses of the hourly inequalities of Horizontal Force as shown by Grubb's Horizontal Force Magnetometer over the same as shown by the Horizontal Force Magnetograph for the year 1872.*

Unity = 0·1γ = ·000001 C. G. S.

1872. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	March to October.	November to January.
0 14	− 73	−105	− 37	− 23	−20	−20	−31	−55	−37	−54	− 69	− 35	−34	− 69
1 14	− 68	−112	− 30	− 45	−34	−23	−40	−42	−51	−52	− 82	− 59	−39	− 70
2 14	− 86	−139	− 39	− 42	−22	−22	−52	−58	−43	−58	− 70	− 41	−42	− 66
3 14	− 90	−141	− 35	− 45	−31	−42	−46	−32	−53	−61	− 75	− 44	−43	− 70
4 14	− 83	−102	− 39	− 48	−28	−37	−34	−60	−41	−45	− 88	− 62	−42	− 77
5 14	−105	−143	− 42	− 41	−26	−29	−32	−55	−54	−16	− 81	− 70	−36	− 85
6 14	−115	−113	− 48	− 23	−48	−41	−50	−38	−61	−36	−110	− 68	−43	− 97
7 14	−104	− 77	− 55	− 40	−52	−32	−52	−30	−55	−33	−107	− 74	−43	− 95
8 14	− 67	− 61	− 43	− 55	−23	−36	−27	− 3	−42	−43	− 98	− 70	−34	− 78
9 14	− 30	+ 1	− 11	− 25	+22	0	−11	+21	−11	+ 3	− 16	− 11	− 2	− 19
10 14	+ 52	− 17	+ 5	+ 24	+42	+26	+ 9	+37	+46	+29	+ 21	+ 29	+27	+ 34
11 14	+ 81	+ 5	+ 45	+ 54	+68	+44	+38	+45	+72	+57	+ 96	+ 62	+53	+ 79
12 14	+101	+ 62	+ 57	+ 69	+85	+63	+53	+66	+82	+83	+132	+ 80	+70	+105
13 14	+122	+ 98	+100	+103	+83	+67	+60	+57	+90	+67	+144	+ 75	+78	+113
14 14	+136	+ 99	+ 96	+ 98	+74	+65	+47	+66	+78	+70	+154	+107	+74	+132
15 14	+127	+ 91	+ 76	+ 62	+55	+63	+70	+57	+60	+54	+145	+ 92	+62	+121
16 14	+139	+ 69	+ 65	+ 40	+37	+51	+56	+50	+51	+47	+106	+ 82	+50	+109
17 14	+117	+ 25	+ 37	+ 18	+23	+20	+50	+46	+26	− 3	+ 78	+ 81	+27	+ 92
18 14	+ 67	+ 18	− 12	+ 6	+ 3	+10	+34	+17	+ 4	+23	+ 38	+ 40	+10	+ 48
19 14	+ 61	− 35	− 16	− 12	−16	+ 4	− 8	−15	− 3	+13	+ 17	+ 37	− 7	+ 38
20 14	0	− 19	− 29	− 23	−21	− 5	− 9	− 7	− 9	−10	− 16	+ 12	−14	− 1
21 14	− 25	+ 62	− 30	− 38	−36	−12	−27	− 9	−15	−11	− 44	− 21	−22	− 30
22 14	− 55	+231	− 47	− 15	−53	−19	−31	−19	−34	−28	− 62	− 65	−31	− 61
23 14	− 70	+281	− 24	− 33	−50	− 4	−15	− 3	−42	−40	− 62	− 63	−27	− 65

This afforded the best arrangement it was possible to devise without disturbing other conditions of the instrument. The new thermometer introduced could register the actual temperature of the magnet with which it was in good metallic contact, while the other two* thermometers attached to the instrument could whilst remaining in their original position, continue to record the temperatures as before under the same conditions which prevailed in the magnetometer box. For two months the three thermometers were read simultaneously throughout the 24 hours of the day. For the first month the magnetometer box was covered with one quilt which was the condition of the instrument between 1866 and 1872; and for the second month the quilt was removed altogether which was the condition obtaining between 1846 and 1866. These hourly observations entailed heavy labour, and for obvious reasons they could not be continued longer. It would be well hence at the outset to remark that a single month's experimental data, depending as they must be on the accidental meteorological conditions for that month, could hardly be utilised for the purposes of generalisation. It will be seen however that the evidence afforded is such as fully to justify certain conclusions allowing of the corrections so derived to be applied generally to the data by certain methods of reductions based upon the elucidated facts and justifiable deductions derived therefrom.

TABLE 83.—*Comparison of Old Thermometer and Thermometer No. 1 in the Grubb's H. F. Magnetometer Enclosure.*

Years.		MONTHS.											
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1884	Old Thermometer.	...	...	...	...	...	86°·77	83°·78	83°·40	82°·34	83°·19	81°·67	79°·25
	Thermometer No. 1.	...	...	...	...	...	85·89	82·96	82·61	81·61	82·40	80·79	78·39
	Difference ...	...	...	...	...	...	·88	·82	·79	·73	·79	·88	·88
1885	Old Thermometer.	79°·17	77°·61	82°·30	84°·11	87°·29	87·85	84·50	83·01	84·31	86·20	85·40	81·05
	Thermometer No. 1.	78·12	76·52	81·26	83·14	86·39	86·96	83·60	82·12	83·39	85·25	84·30	79·78
	Difference ...	1·05	1·09	1·04	·97	·90	·89	·90	·89	·92	·95	1·10	1·27
1886	Old Thermometer.	79·08	78·96	83·50	85·82	89·13	86·65	82·97	83·41	83·73	84·61	84·44	81·19
	Thermometer No. 1.	77·89	77·75	82·40	84·80	88·13	85·70	82·13	82·51	82·82	83·69	83·46	80·07
	Difference ...	1·19	1·21	1·10	1·02	1·00	·95	·84	·90	·91	·92	·98	1·12
1887	Old Thermometer.	77·86	78·42	81·87	84·91	87·76	84·14	81·97	81·86	81·69	84·53	83·88	81·15
	Thermometer No. 1.	76·77	77·30	80·88	83·93	86·80	83·25	81·16	81·02	80·83	93·58	82·78	80·00
	Difference ...	1·09	1·12	·99	·98	·96	·89	·81	·84	·86	·95	1·10	1·15

151. In table 84 are set forth the results of the experiments in full details. It is clear that as the magnetometer readings have been previously corrected for temperature given by the attached thermometer for a variation of the type given in row 4, and if the actual march of temperature of the magnet was of the type given in row 2, the errors introduced or the residual magnetic variation due to the faulty correction would run closely parallel to the difference of the two temperature variations. This difference temperature variation given in row 7 is hence what we have to deal with in the present investigation when examining the excess magnetic variation due to faulty temperature corrections.

152. The daily charts of the magnetic inequalties of the year 1872 were carefully examined and, seeing that the year was greatly disturbed (it being very near the maximum epoch of 1871), such of the days as were markedly disturbed were rigidly excluded from consideration. At the same time, the average diurnal inequality of the month was made up of as many days—quiet and slightly disturbed—as it was possible to include; all Sundays, however, irrespective of the fact, whether they were quiet or disturbed, were omitted as no eye observations by Grubb's instrument were available for those days.

* Besides the old attached thermometer initially belonging to the instrument, the readings of which have been used throughout in the reductions another thermometer No. 1 was introduced in 1884 in the magnetometer box, exactly on the opposite side of the magnet and equally distant from it as the old thermometer. The readings of this thermometer were registered five times every day, but no monthly means were systematically derived. Such means of a few years have, however, been obtained for examination and given in table 83 which show that even in the small air space of the magnetometer box it is not unusual to have a difference of $\frac{1}{2}$° in temperature of the two thermometers themselves which stand about 10 inches apart in the enclosure. This means a difference of more than 4γ in the measurement of force by the differential instrument.

TABLE 84.—*Showing the comparison of the diurnal inequality of temperature in the Grubb's H. F. Magnetometer enclosure as given by the three attached thermometers.**

		Colaba Civil Hour (at 19 minutes past the full hour).	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Monthly Means.
			°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Enclosure covered with a Cotton quilt cushion. 1907 January 16th to February 15th.	1	Hourly Means (No. 3).	78·05	77·90	77·75	77·59	77·40	77·17	76·93	76·70	76·58	76·63	76·84	77·17	77·54	77·94	78·40	78·84	79·14	79·25	79·20	79·05	78·87	78·67	78·46	78·25	77·93
	2	Diurnal Inequality No. 3).	+0·12	−0·03	−0·18	−0·34	−0·53	−0·76	−1·00	−1·23	−1·35	−1·30	−1·09	−0·76	−0·39	+0·01	+0·47	+0·91	+1·21	+1·32	+1·27	+1·12	+0·94	+0·74	+0·53	+0·32	...
	3	Hourly Means (Old Thermometer).	79·03	78·85	78·68	78·50	78·29	78·03	77·77	77·53	77·53	77·74	78·08	78·57	79·09	79·61	80·14	80·58	80·79	80·72	80·43	80·14	79·89	79·66	79·46	79·24	79·10
	4	Diurnal Inequality (Old Thermometer).	−0·07	−0·25	−0·42	−0·60	−0·81	−1·07	−1·33	−1·57	−1·57	−1·36	−1·02	−0·53	−0·01	+0·51	+1·04	+1·48	+1·69	+1·62	+1·33	+1·04	+0·79	+0·56	+0·36	+0·14	...
	5	Hourly Means (No. 1).	78·02	77·86	77·70	77·54	77·35	77·08	76·82	76·62	76·65	76·84	77·15	77·56	78·00	78·46	78·92	79·33	79·52	79·52	79·36	79·13	78·93	78·72	78·48	78·23	78·07
	6	Diurnal Inequality (No. 1).	−0·05	−0·21	−0·37	−0·53	−0·72	−0·99	−1·25	−1·45	−1·42	−1·23	−0·92	−0·51	−0·07	+0·39	+0·85	+1·26	+1·45	+1·45	+1·29	+1·06	+0·86	+0·65	+0·41	+0·16	...
	7	Excess Diurnal Inequality Old—No. 3.	−0·19	−0·22	−0·24	−0·26	−0·28	−0·31	−0·33	−0·34	−0·22	−0·06	+0·07	+0·23	+0·38	+0·50	+0·57	+0·57	+0·48	+0·30	+0·06	−0·08	−0·15	−0·18	−0·17	−0·18	...
	8	Excess Diurnal Inequality Old—No. 1.	−0·02	−0·04	−0·05	−0·07	−0·09	−0·08	−0·08	−0·12	−0·15	−0·13	−0·10	−0·02	+0·06	+0·12	+0·19	+0·22	+0·24	+0·17	+0·04	−0·02	−0·07	−0·09	−0·05	−0·02	...
	9	Excess Diurnal Inequality No. 1—No. 3.	−0·17	−0·18	−0·19	−0·19	−0·19	−0·23	−0·25	−0·22	−0·07	+0·07	+0·17	+0·25	+0·32	+0·38	+0·38	+0·35	+0·24	+0·13	+0·02	−0·06	−0·08	−0·09	−0·12	−0·16	...
Enclosure without any covering 1907 February 17th to March 18th.	1	Hourly Means (No. 3).	79·11	78·84	78·60	78·37	78·13	77·92	77·66	77·45	77·67	78·28	79·08	79·94	80·63	81·27	81·80	82·12	82·10	81·74	81·13	80·60	80·21	79·91	79·65	79·39	79·65
	2	Diurnal Inequality (No. 3).	−0·54	−0·81	−1·05	−1·28	−1·52	−1·73	−1·99	−2·20	−1·98	−1·37	−0·57	+0·29	+0·98	+1·62	+2·15	+2·47	+2·45	+2·09	+1·48	+0·95	+0·56	+0·26	0·0	−0·26	...
	3	Hourly Means (Old Thermometer).	80·05	79·80	79·54	79·29	79·04	78·84	78·59	78·44	78·79	79·60	80·53	81·45	82·22	82·89	83·39	83·64	83·51	82·98	82·20	81·66	81·25	80·88	80·61	80·34	80·81
	4	Diurnal Inequality (Old Thermometer).	−0·76	−1·01	−1·27	−1·52	−1·77	−1·97	−2·22	−2·37	−2·02	−1·21	−0·28	+0·64	+1·41	+2·08	+2·58	+2·83	+2·70	+2·17	+1·39	+0·85	+0·44	+0·07	−0·20	−0·47	...
	5	Hourly Means (No. 1).	79·17	78·90	78·65	78·40	78·17	77·96	77·70	77·63	78·06	78·79	79·67	80·46	81·10	81·70	82·16	82·38	82·25	81·79	81·12	80·61	80·25	79·96	79·71	79·45	79·83
	6	Diurnal Inequality (No. 1).	−0·66	−0·93	−1·18	−1·43	−1·66	−1·87	−2·13	−2·20	−1·77	−1·04	−0·16	+0·63	+1·27	+1·87	+2·33	+2·55	+2·42	+1·96	+1·29	+0·78	+0·42	+0·13	−0·12	−0·38	...
	7	Excess Diurnal Inequality Old—No. 3.	−0·22	−0·20	−0·22	−0·24	−0·25	−0·24	−0·23	−0·17	−0·04	+0·16	+0·29	+0·35	+0·43	+0·46	+0·43	+0·36	+0·25	+0·08	0·09	−0·10	−0·12	−0·19	−0·20	−0·21	...
	8	Excess Diurnal Inequality Old—No. 1.	−0·10	−0·08	−0·09	−0·09	−0·11	−0·10	−0·09	−0·17	−0·25	−0·17	−0·12	+0·01	+0·14	+0·21	+0·25	+0·28	+0·28	+0·21	+0·10	+0·07	+0·02	−0·06	−0·08	−0·09	...
	9	Excess Diurnal Inequality No. 1—No. 3.	−0·12	−0·12	−0·13	−0·15	−0·14	−0·14	−0·14	0·0	+0·21	+0·33	+0·41	+0·34	+0·29	+0·25	+0·18	+0·08	−0·03	−0·13	−0·19	−0·17	−0·14	−0·13	−0·12	−0·12	...

* Thermometer No. 3 is the one placed in contact with the magnet, measuring the actual temperature of the Magnet.
Old thermometer is the one attached to the instrument and used for reduction throughout the period.
Thermometer No. 1 is another attached thermometer introduced in 1884.

Colaba Observatory.

Comparison of the Diurnal Inequalities of Horizontal Force as registered by the Grubb's. H.F. Magnetometer & H.F. Magnetograph for the Year 1872.

Plate 3.

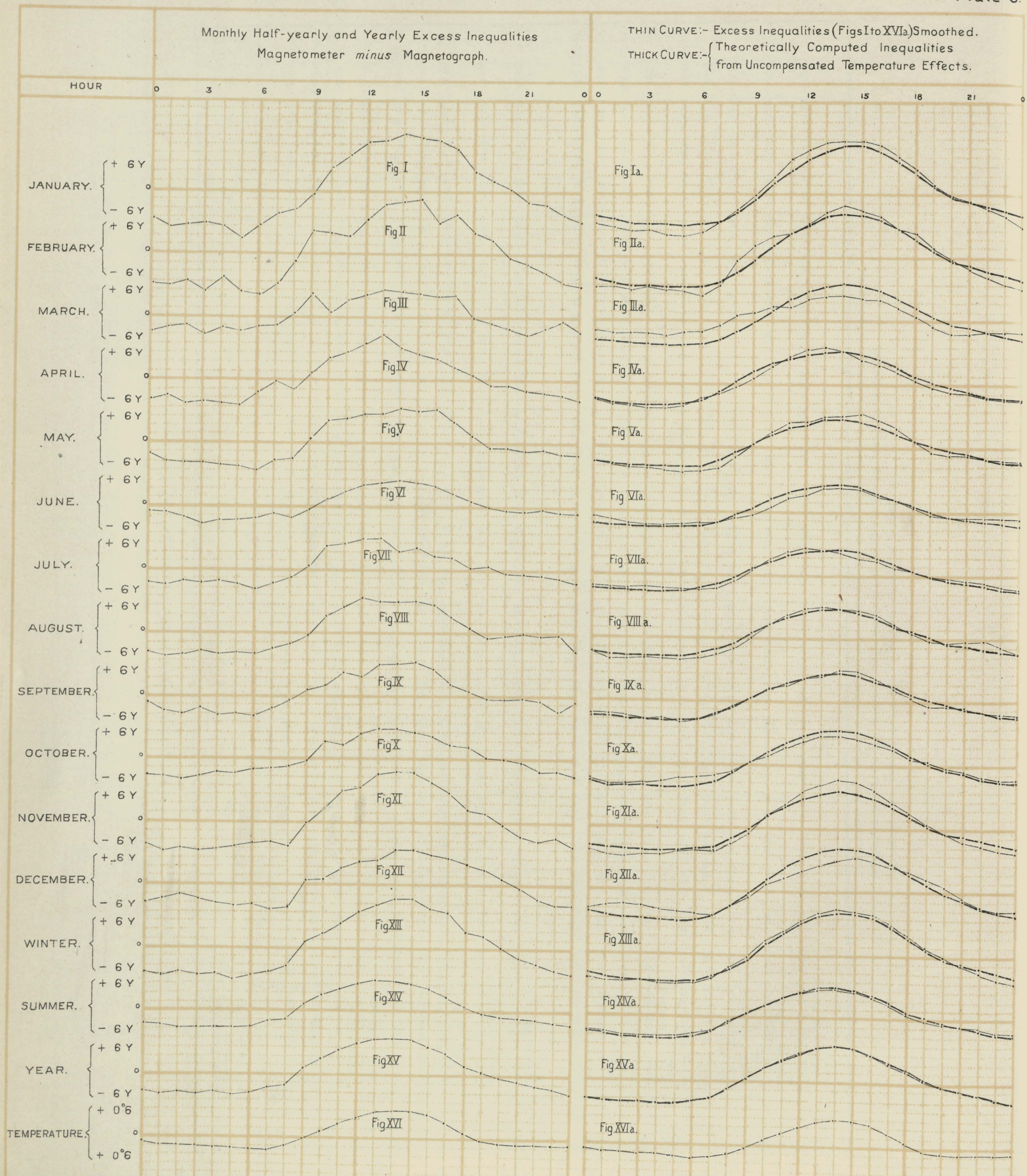


Fig. XVI:- Excess Temperature Inequality Derived from Experiment Referred to in the Text from Differences of the Actual Temperature of the Magnet and the Temperature as Recorded by the Thermometer.

Fig. XVIa:- Excess Temperature Inequality in Fig XVI Smoothed.

TABLE 85.

1872.	SELECTED DAYS.																
January	2	3	4	5	6	8	10	11	15	17	22	23	30				
February	2	3	7	9	13	14	17	19									
March	6	8	9	11	12	14	18	22	27	28	30						
April	2	5	6	8	13	22	23	24	25	26	27						
May	6	8	11	16	17	21	27	29	30	31							
June	1	5	7	8	12	13	14	17	18	19	20	27	28	29			
July	1	5	13	15	17	22	23	24	25	26	27						
August	1	2	7	8	10	12	13	17	19	21	22	23	24	28	29	30	
September	10	12	13	14	16	17	23	25	26	7							
October	1	3	4	5	10	12	14	21	22	23	24	25	26				
November	5	6	7	8	9	18	19	20	21	22	23	25	26	27	28	29	30
December	2	5	7	11	12	13	19	20	27								

153. After selecting the days, a list of which is given above, the inequalities were derived respectively from the magnetograph tabulations and from the Grubb's eye-reading series.

154. In table 86 full details of all operations have been set forth. The first row contains the inequalities of the magnetograph. In row 2 the inequalities have been corrected for aperiodic change. In row 3 is given the inequality by Grubb's corrected for temperature as given by the *attached* thermometer; while in row 4 the same is given corrected for the aperiodic change. Then as between the time of the eye-readings of Grubb's and of the magnetograph tabulations there is a difference of five minutes — the former being read at 14 minutes and the latter tabulated at 19 minutes after the full hour—a correction is necessary, and the series in row 4 is corrected for this change and given in row 5. It would have been possible and perhaps better for the investigation to have secured fresh tabulations altogether of the 24 ordinates, coincident with the exact moment of the eye-readings; but it was thought best to deal with the very figures which have been used in the old discussions. The difference of row 2 and row 5, *i. e.*, the excess magnetic diurnal inequality is shown in row 6.

155. It is well to note here that the inequalities and the excesses for the months so derived from the *selected* days when compared with the inequalities and excesses from *all* days used in the old discussion and given in the Volume for 1879—1882 and reprinted in tables 82 and 82*a* in paragraph 149 show that with the exception of a diminution in the amplitudes and removal of some of the accidental irregularities the character of the curves remains almost unaltered.

156. Having thus secured the excess magnetic inequalities for each month and for the summer and winter months respectively from March to October and November to February and for the year which are all charted as figs. 1 to 15 in plate 3, their comparison with the excess temperature inequality of our experiments, the results of which are indicated in row 7, table 84, and charted in fig 16, at once discloses the striking parallelism between the two. Both show that they reach their maximum at about 2 p.m. and the minimum at about 6 a.m. and the run of the curves generally is in close accordance. The temperature variation if reduced by the temperature co-efficient 8·47 would reproduce a magnetic inequality for January equal only to about half the amplitude of the excess magnetic inequality which we have to account for and explain. The curves are, it will be seen, precisely similar but differ only in amplitude. But it must be remembered that in order to get accurate and concurrent results, the meteorological conditions which obtained in 1872 should have been secured during the experiment of 1907. This was of course impossible. As a matter of fact they were not only dissimilar but as divergent as the freaks of nature could possibly make them The year 1872 was one of the most abnormal years on record. The temperature range recorded then in January-February was nearly 14° while in January-February 1907 it was less than 10°. The hygrometric conditions were correspondingly different. The temperature range of the attached thermometer in the Grubb's instrument box showed a range of 4° about 33% more than that which prevailed during the experiment

TABLE 86.—*Showing the comparison of the Diurnal Inequalities given by Grubb's determined from the Selected*

Unity = ·1γ = ·000001 C. G. S.

Month	No.		0	1	2	3	4	5	6	7	8	9
January.	1	Diurnal Inequality by Magnetograph	− 159	− 124	− 146	− 142	− 120	− 102	− 61	+ 2	+ 77	+ 177
	2	Diurnal Inequality corrected for P. change	− 129	− 96	− 121	− 119	− 100	− 84	− 46	+ 15	+ 87	+ 185
	3	Diurnal Inequality by Grubb's Magnetometer	− 245	− 223	− 240	− 234	− 212	− 229	− 157	− 69	+ 18	+ 150
	4	Diurnal Inequality corrected for P. change	− 199	− 180	− 201	− 199	− 181	− 202	− 134	− 50	+ 33	+ 162
	5	Diurnal Inequality corrected to 19 minutes past the hour ...	− 197	− 182	− 201	− 198	− 183	− 196	− 127	− 43	+ 44	+ 175
	6	Excess Diurnal Inequality ...	− 68	− 86	− 80	− 79	− 83	− 112	− 81	− 58	− 43	− 10
	7	Excess Diurnal Inequality Smoothed	− 70	− 78	− 82	− 81	− 91	− 92	− 84	− 61	− 37	− 2
	8	Temperature corrections ...	− 51	− 59	− 65	− 68	− 69	− 72	− 69	− 61	− 41	− 12
	9	Residual errors	− 19	− 19	− 17	− 13	− 22	− 20	− 15	0	+ 4	+ 10
February.	1	Diurnal Inequality by Magnetograph	− 164	− 147	− 138	− 85	− 103	− 81	− 59	− 11	+ 86	+ 230
	2	Diurnal Inequality corrected for P. change	− 162	− 145	− 136	− 84	− 102	− 80	− 58	− 10	+ 87	+ 230
	3	Diurnal Inequality by Grubb's Magnetometer	− 262	− 245	− 223	− 190	− 174	− 179	− 174	− 102	+ 40	+ 260
	4	Diurnal Inequality corrected for P. change	− 235	− 220	− 200	− 169	− 156	− 163	160	− 91	+ 49	+ 267
	5	Diurnal Inequality corrected to 19 minutes past the hour ...	− 234	− 218	− 197	− 168	− 157	− 163	− 154	− 79	+ 67	+ 279
	6	Excess Diurnal Inequality ...	− 72	− 73	− 61	− 84	− 55	− 83	− 96	− 69	− 20	+ 49
	7	Excess Diurnal Inequality Smoothed	− 69	− 69	− 73	− 67	− 74	− 78	− 83	− 62	− 13	+ 23
	8	Temperature corrections ...	− 50	− 58	− 62	− 64	− 65	− 68	− 64	− 55	− 35	− 7
	9	Residual errors	− 19	− 11	− 11	− 3	− 9	− 10	− 19	− 7	+ 22	+ 30
March.	1	Diurnal Inequality by Magnetograph	− 228	− 212	− 241	− 170	− 179	− 150	− 158	− 84	+ 82	+ 313
	2	Diurnal Inequality corrected for P change	− 201	− 187	− 219	− 150	− 161	− 134	− 145	− 73	+ 91	+ 320
	3	Diurnal Inequality by Grubb's Magnetometer	− 259	− 226	− 259	− 204	− 204	− 182	− 182	− 116	+ 65	+ 345
	4	Diurnal Inequality corrected for P. change	− 243	− 211	− 245	− 192	− 193	− 172	− 174	− 109	+ 70	+ 349
	5	Diurnal Inequality corrected to 19 minutes past the hour ...	− 240	− 214	− 241	− 192	− 191	− 172	− 169	− 94	+ 93	+ 367
	6	Excess Diurnal Inequality ...	− 39	− 27	− 22	− 42	− 30	− 38	− 24	− 21	+ 2	+ 47
	7	Excess Diurnal Inequality Smoothed	− 25	− 29	− 30	− 31	− 37	− 31	− 28	− 14	+ 9	+ 18
	8	Temperature corrections ...	− 43	− 49	− 53	− 53	− 56	− 56	− 53	− 45	− 25	− 1
	9	Residual errors	+ 18	+ 20	+ 23	+ 22	+ 19	+ 25	+ 25	+ 31	+ 34	+ 19
April.	1	Diurnal Inequality by Magnetograph	− 178	− 215	− 207	− 199	− 203	− 203	− 182	− 87	+ 137	+ 372
	2	Diurnal Inequality corrected for P. change	− 196	− 232	− 222	− 213	− 215	− 214	− 191	− 95	+ 131	+ 367
	3	Diurnal Inequality by Grubb's Magnetometer	− 243	− 275	− 286	− 270	− 275	− 281	− 237	− 122	+ 81	+ 361
	4	Diurnal Inequality corrected for P. change	− 238	− 270	− 281	− 266	− 271	− 278	− 234	− 120	+ 83	+ 362
	5	Diurnal Inequality corrected to 19 minutes past the hour ...	− 241	− 271	− 280	− 266	− 272	− 274	− 225	− 103	+ 106	+ 379
	6	Excess Diurnal Inequality ...	− 45	− 39	− 58	− 53	− 57	− 60	− 34	− 8	− 25	+ 12
	7	Excess Diurnal Inequality Smoothed	− 38	− 47	− 50	− 56	− 57	− 50	− 34	− 22	− 7	+ 10
	8	Temperature corrections ...	− 38	− 42	− 45	− 45	− 48	− 48	− 44	− 37	− 18	+ 2
	9	Residual errors	0	− 5	− 5	− 11	− 9	− 2	+ 10	+ 15	+ 11	+ 8
May.	1	Diurnal Inequality by Magnetograph	− 192	− 205	− 180	− 167	− 184	− 167	− 97	+ 36	+ 198	+ 381
	2	Diurnal Inequality corrected for P. change	− 198	− 211	− 185	− 172	− 188	− 171	− 100	+ 33	+ 196	+ 379
	3	Diurnal Inequality by Grubb's Magnetometer	− 243	− 275	− 248	− 232	− 254	− 243	− 188	− 28	+ 131	+ 367
	4	Diurnal Inequality corrected for P. change	− 224	− 257	− 232	− 217	− 241	− 232	− 178	− 20	+ 137	+ 372
	5	Diurnal Inequality corrected to 19 minutes past the hour ...	− 227	− 255	− 231	− 219	− 240	− 228	− 165	− 7	+ 157	+ 384
	6	Excess Diurnal Inequality ...	− 29	− 44	− 46	− 47	− 52	− 57	− 65	− 40	− 39	+ 5
	7	Excess Diurnal Inequality Smoothed	− 33	− 40	− 46	− 48	− 52	− 58	− 54	− 48	− 25	+ 4
	8	Temperature corrections ...	− 36	− 39	− 42	− 42	− 44	− 43	− 39	− 31	− 14	+ 5
	9	Residual errors	+ 3	− 1	− 4	− 6	− 8	− 15	− 15	− 17	− 11	− 1

Horizontal Force Magnetometer, and the Horizontal Force Magnetograph, as Quiet Days of the year 1872.

10	11	12	13	14	15	16	17	18	19	20	21	22	23
+278	+334	+300	+230	+120	+33	−28	−41	−54	−72	−129	−146	−159	−107
+283	+337	+300	+227	+115	+25	−38	−54	−69	−90	−149	−169	−184	−135
+315	+408	+408	+342	+255	+161	+90	+62	−3	−36	−113	−157	−179	−146
+323	+412	+408	+338	+247	+149	+75	+43	−26	−63	−144	−192	−218	−189
+330	+412	+402	+330	+239	+143	+72	+37	−29	−70	−148	−194	−216	−190
+47	+75	+102	+103	+124	+118	+110	+91	+40	+20	+1	−25	−32	−55
+37	+75	+93	+110	+115	+117	+106	+80	+50	+20	−1	−19	−37	−52
+21	+51	+73	+91	+101	+99	+88	+68	+41	+17	−3	−17	−29	−40
+16	+24	+20	+19	+14	+18	+18	+12	+9	+3	+2	−2	−8	−12
+371	+419	+357	+265	+134	+55	+20	−94	−134	−147	−164	−221	−208	−186
+371	+419	+357	+265	+134	+55	+19	−95	−135	−148	−165	−222	−210	−188
+403	+458	+436	+386	+260	+189	+101	+7	−75	−102	−152	−223	−229	−229
+408	+460	+436	+384	+255	+182	+92	−4	−89	−118	−170	−244	−252	−254
+412	+458	+432	+373	+249	+175	+84	−11	−91	−122	−176	−245	−252	−252
+41	+39	+75	+108	+115	+120	+65	+84	+44	+26	−11	−23	−42	−64
+43	+52	+74	+99	+114	+100	+90	+64	+51	+20	−3	−25	−43	−59
+25	+52	+72	+88	+96	+93	+81	+60	+35	+13	−5	−17	−29	−39
+18	0	+2	+11	+18	+7	+9	+4	+16	+7	+2	−8	−14	−20
+565	+618	+528	+408	+276	+119	+28	−146	−199	−249	−257	−220	−236	−241
+569	+620	+528	+406	+272	+112	+19	−157	−212	−265	−275	−240	−258	−266
+564	+658	+581	+477	+345	+175	+81	−100	−199	−270	−292	−270	−270	−265
+567	+659	+581	+476	+342	+171	+76	−107	−207	−280	−303	−282	−284	−280
+575	+653	+572	+465	+328	+163	+61	−115	−213	−282	−301	−282	−284	−277
+6	+33	+44	+59	+56	+51	+42	+42	−1	−17	−26	−42	−26	−11
+29	+28	+45	+53	+55	+50	+45	+28	+8	−15	−28	−31	−26	−25
+26	+46	+64	+75	+80	+77	+66	+46	+26	+8	−6	−17	−26	−35
+3	−18	−19	−22	−25	−27	−21	−18	−18	−23	−22	−14	0	+10
+534	+563	+480	+356	+199	+91	0	−74	−128	−182	−219	−207	−219	−215
+531	+561	+480	+358	+202	+96	+6	−66	−119	−171	−207	−193	−204	−198
+570	+625	+564	+471	+279	+158	+59	−34	−100	−177	−215	−210	−226	−226
+571	+625	+564	+471	+278	+157	+57	−36	−103	−180	−219	−214	−231	−231
+575	+620	+556	+455	+268	+149	+49	−42	−109	−183	−219	−215	−231	−231
+44	+59	+76	+97	+66	+53	+43	+24	+10	−12	−12	−22	−27	−33
+38	+60	+77	+80	+72	+54	+40	+26	+7	−5	−15	−20	−27	−34
+26	+42	+56	+65	+69	+64	+54	+37	+19	+4	−7	−16	−23	−30
+12	+18	+21	+15	+3	−10	−14	−11	−12	−9	−8	−4	−4	−4
+473	+515	+431	+336	+203	+49	−84	−163	−167	−171	−196	−209	−213	−209
+472	+514	+431	+337	+204	+51	−82	−160	−164	−167	−192	−204	−208	−203
+510	+570	+499	+411	+295	+136	+4	−105	−138	−171	−193	−210	−210	−215
+513	+572	+499	+409	+292	+131	−2	−113	−148	−182	−206	−225	−226	−233
+518	+566	+492	+399	+279	+120	−11	−116	−151	−184	−208	−225	−227	−232
+46	+52	+61	+62	+75	+69	+71	+44	+13	−17	−16	−21	−19	−29
+34	+53	+58	+66	+69	+72	+61	+43	+13	−7	−18	−19	−23	−25
+26	+41	+54	+61	+63	+58	+48	+31	+15	+2	−8	−15	−22	−29
+8	+12	+4	+5	+6	+14	+13	+12	−2	−9	−10	−4	−1	+4

TABLE 86.—*Showing the comparison of the Diurnal Inequalities given by Grubb's determined from the selected*

Unity = 0·1γ = ·000001 C. G. S.

Month			0	1	2	3	4	5	6	7	8	9
June.	1	Diurnal Inequality by Magnetograph	−174	−174	−157	−161	−165	−153	−102	+27	+165	+311
	2	Diurnal Inequality corrected for P. change	−174	−174	−157	−161	−165	−153	−102	+27	+165	+311
	3	Diurnal Inequality by Grubb's Magnetometer	−221	−221	−210	−226	−221	−210	−160	−17	+114	+279
	4	Diurnal Inequality corrected for P. change	−191	−193	−185	−203	−201	−192	−145	−4	+124	+287
	5	Diurnal Inequality corrected for 19 minutes past the hour ...	−191	−192	−186	−203	−200	−188	−133	+7	+138	+300
	6	Excess Diurnal Inequality ...	−17	−18	−29	−42	−35	−35	−31	−20	−27	−11
	7	Excess Diurnal Inequality smoothed	−17	−21	−30	−35	−37	−34	−29	−26	−19	−8
	8	Temperature corrections ...	−32	−35	−38	−38	−40	−38	−35	−25	−9	+8
	9	Residual errors	+15	+14	+8	+3	+3	+4	+6	−1	−10	−16
July.	1	Diurnal Inequality by Magnetograph	−181	−176	−185	−176	−160	−139	−71	+21	+168	+315
	2	Diurnal Inequality corrected for P. change	−179	−174	−183	−174	−158	−138	−70	+22	+169	+316
	3	Diurnal Inequality by Grubb's Magnetometer	−224	−224	−224	−219	−197	−186	−131	−32	+127	+303
	4	Diurnal Inequality corrected for P. change	−211	−212	−213	−209	−188	−178	−124	−26	+131	+306
	5	Diurnal Inequality corrected for 19 minutes past the hour ...	−211	−212	−213	−207	−187	−174	−116	−13	+146	+318
	6	Excess Diurnal Inequality ...	−32	−38	−30	−33	−29	−36	−46	−35	−23	+2
	7	Excess Diurnal Inequality smoothed	−30	−33	−34	−31	−33	−37	−39	−35	−19	+9
	8	Temperature corrections	−33	−36	−38	−38	−40	−38	−34	−23	−7	+12
	9	Residual errors	+3	+4	+4	+7	+7	+1	−5	−12	−12	−3
August.	1	Diurnal Inequality by Magnetograph	−205	−217	−213	−205	−196	−184	−158	−74	+91	+268
	2	Diurnal Inequality corrected for P. change	−163	−178	−178	−173	−168	−159	−137	−56	+105	+279
	3	Diurnal Inequality by Grubb's Magnetometer	−242	−269	−264	−247	−247	−231	−214	−126	+49	+247
	4	Diurnal Inequality corrected for P. change	−204	−234	−232	−218	−221	−209	−195	−110	+62	+257
	5	Diurnal Inequality corrected for 19 minutes past the hour ...	−206	−234	−231	−218	−220	−208	−188	−96	+78	+273
	6	Excess Diurnal Inequality ...	−43	−56	−53	−45	−52	−49	−51	−40	−27	−6
	7	Excess Diurnal Inequality smoothed	−36	−51	−51	−50	−49	−51	−47	−39	−24	0
	8	Temperature corrections ...	−36	−39	−42	−42	−44	−42	−38	−27	−10	+9
	9	Residual errors	0	−12	−9	−8	−5	9	−9	−12	−14	−9
Septemb r.	1	Diurnal Inequality by Magnetograph	−254	−203	−165	−161	−140	−156	−135	−148	−38	+156
	2	Diurnal Inequality corrected for P. change	−227	−178	−142	−140	−122	−140	−121	−137	−29	+163
	3	Diurnal Inequality by Grubb's Magnetometer	−301	−268	−230	−213	−202	−213	−197	202	−81	+144
	4	Diurnal Inequality corrected for P. change	−249	−220	−187	−174	−167	−183	−171	−180	−64	+157
	5	Diurnal Inequality corrected for 19 minutes past the hour ...	−247	−217	−186	−173	−168	−182	−172	−170	−46	+173
	6	Excess Diurnal Inequality ...	−20	−39	−44	−33	−46	−42	−51	−33	−17	+10
	7	Excess Diurnal Inequality smoothed	−32	−34	−39	−41	−40	−46	−42	−34	−13	+4
	8	Temperature corrections ...	−36	−39	−42	−42	−44	−43	−39	−31	−14	+5
	9	Residual errors	+4	+5	+3	+1	+4	−3	−3	−3	+1	−1
October.	1	Diurnal Inequality by Magnetograph	−186	−203	−173	−148	−126	−105	−114	−88	+48	+260
	2	Diurnal Inequality corrected for P. change	−161	−180	−152	−129	−109	−90	−101	−77	+56	+266
	3	Diurnal Inequality by Grubb's Magnetometer	−240	−262	−240	−207	−174	−152	−152	−130	+2	+233
	4	Diurnal Inequality corrected for P. change	−199	−224	−205	−176	−146	−128	−131	−113	+16	+243
	5	Diurnal Inequality corrected for 19 minutes past the hour ...	−201	−222	−203	−174	−145	−128	−130	−102	+35	+259
	6	Excess Diurnal Inequality ...	−40	−42	−51	−45	−36	−38	−29	−25	−21	−7
	7	Excess Diurnal Inequality smoothed	−37	−44	−46	−44	−40	−34	−31	−25	−18	+2
	8	Temperature corrections ...	−41	−46	−49	−49	−52	−52	−48	−40	−20	+2
	9	Residual errors	+4	+2	+3	+5	+12	+18	+17	+15	+2	0

Horizontal Force Magnetometer, and the Horizontal Force Magnetograph, as Quiet Days of the year 1872.

10	11	12	13	14	15	16	17	18	19	20	21	22	23
+428	+453	+416	+328	+194	+ 44	− 86	−144	−148	−165	−186	−182	−182	−178
+428	+453	+416	+328	+194	+ 44	− 86	−144	−148	−165	−186	−182	−182	−178
+433	+477	+466	+389	+268	+114	− 28	−105	−122	−149	−177	−171	−166	−166
+438	+480	+466	+386	+263	+106	− 38	−118	−137	−167	−197	−194	−191	−194
+441	+479	+459	+376	+250	+ 94	− 45	−120	−139	−169	−197	−194	−191	−194
+ 13	+ 26	+ 43	+ 48	+ 56	+ 50	+ 41	+ 24	+ 9	− 4	− 11	− 12	− 9	− 16
+ 9	+ 27	+ 39	+ 49	+ 51	+ 49	+ 38	+ 25	+ 10	− 2	− 9	− 11	− 12	− 14
+ 25	+ 38	+ 49	+ 55	+ 55	+ 50	+ 39	+ 25	+ 12	0	− 8	− 15	− 22	− 28
− 16	− 11	− 10	− 6	− 4	− 1	− 1	0	− 2	− 2	− 1	+ 4	+ 10	+ 14
+399	+399	+378	+286	+181	+ 50	− 34	− 97	−118	−160	−185	−197	−172	−160
+399	+399	+378	+286	+181	+ 49	− 35	− 98	−119	−161	−187	−199	−174	−162
+446	+451	+446	+363	+232	+105	+ 1	− 65	−109	−147	−186	−202	−180	−169
+448	+452	+446	+362	+230	+102	− 3	− 71	−116	−155	−195	−212	−191	−181
+448	+452	+439	+351	+219	+ 93	− 9	− 75	−119	−158	−196	−210	−190	−183
+ 49	+ 53	+ 61	+ 65	+ 38	+ 44	+ 26	+ 23	0	+ 3	− 9	− 11	− 16	− 21
+ 35	+ 54	+ 60	+ 55	+ 49	+ 36	+ 31	+ 16	+ 9	− 2	− 6	− 12	− 16	− 23
+ 28	+ 41	+ 51	+ 56	+ 55	+ 49	+ 38	+ 23	+ 9	− 2	− 9	− 16	− 22	− 28
+ 7	+ 13	+ 9	− 1	− 6	− 13	− 7	− 7	0	0	+ 3	+ 4	+ 6	+ 5
+419	+474	+436	+339	+213	+ 91	− 15	− 70	− 91	−124	−154	−154	−150	−154
+426	+478	+436	+335	+206	+ 80	− 29	− 88	−112	−149	−182	−186	−185	−193
+445	+527	+516	+412	+285	+165	+ 49	− 38	− 82	−137	−165	−159	−159	−165
+451	+530	+516	+409	+279	+155	+ 36	− 54	−101	−159	−191	−188	−191	−200
+458	+529	+507	+398	+269	+145	+ 29	− 58	−106	−162	−191	−188	−192	−200
+ 32	+ 51	+ 71	+ 63	+ 63	+ 65	+ 58	+ 30	+ 6	− 13	− 9	− 2	− 7	− 7
+ 26	+ 51	+ 62	+ 66	+ 64	+ 62	+ 51	+ 31	+ 8	− 5	− 8	− 6	− 5	− 19
+ 28	+ 42	+ 54	+ 61	+ 61	+ 55	+ 43	+ 28	+ 13	0	− 8	− 17	− 24	− 31
− 2	+ 9	+ 8	+ 5	+ 3	+ 7	+ 8	+ 3	− 5	− 5	0	+ 11	+ 19	+ 12
+330	+410	+427	+364	+233	+110	+ 30	+ 8	− 17	− 72	−101	−148	−173	−178
+335	+412	+427	+362	+228	+103	+ 21	− 3	− 31	− 88	−119	−169	−196	−203
+336	+457	+468	+440	+314	+199	+100	+ 45	+ 6	− 65	− 92	−136	−169	−191
+345	+461	+468	+436	+305	+186	+ 83	+ 23	− 20	− 95	−127	−175	−212	−239
+355	+462	+465	+425	+295	+177	+ 78	+ 19	− 26	− 98	−131	−178	−214	−240
+ 20	+ 50	+ 38	+ 63	+ 67	+ 74	+ 57	+ 22	+ 5	− 10	− 12	− 9	− 18	− 37
+ 27	+ 36	+ 50	+ 56	+ 68	+ 66	+ 51	+ 28	+ 6	− 6	− 10	− 13	− 21	− 25
+ 26	+ 41	+ 54	+ 61	+ 63	+ 58	+ 48	+ 31	+ 15	+ 2	− 8	− 15	− 22	− 29
+ 1	− 5	− 4	− 5	+ 5	+ 8	+ 3	− 3	− 9	− 8	− 2	+ 2	+ 1	+ 4
+404	+515	+451	+285	+128	+ 14	− 50	− 67	− 71	−114	−148	−177	−190	−173
+408	+517	+451	+283	+124	+ 8	− 58	− 78	− 84	−129	−165	−196	−211	−196
+425	+546	+518	+364	+205	+ 84	+ 7	− 31	− 36	−102	−135	−174	−207	−190
+432	+549	+518	+361	+198	+ 74	− 7	− 48	− 57	−126	−163	−205	−242	−228
+442	+546	+505	+347	+188	+ 67	− 10	− 49	− 63	−129	−166	−208	−241	−226
+ 34	+ 29	+ 54	+ 64	+ 64	+ 59	+ 48	+ 29	+ 21	0	− 1	− 12	− 30	− 30
+ 19	+ 39	+ 49	+ 61	+ 62	+ 57	+ 45	+ 33	+ 17	+ 7	− 4	− 14	− 24	− 33
+ 28	+ 46	+ 61	+ 71	+ 75	+ 70	+ 59	+ 40	+ 21	+ 4	− 8	− 17	− 25	− 33
− 9	− 7	− 12	− 10	− 13	− 13	− 14	− 7	− 4	+ 3	+ 4	+ 3	+ 1	0

TABLE 86.—*Showing the comparision of the Diurnal Inequalities given by Grubb's determined from the Selected*

Unity = 0·1γ = ·000001 C. G. S.

			0	1	2	3	4	5	6	7	8	9
November.	1	Diurnal Inequality by Magnetograph	−148	−118	−131	−127	−135	−127	−88	+1	+146	+277
	2	Diurnal Inequality corrected for P. change	−140	−110	−124	−121	−129	−122	−84	+5	+149	+279
	3	Diurnal Inequality by Grubb's Magnetometer	−209	−192	−198	−198	−203	−192	−148	−60	+71	+258
	4	Diurnal Inequality corrected for P. change	−198	−182	−189	−190	−196	−186	−143	−55	+75	+261
	5	Diurnal Inequality corrected for 19 minutes past the hour ...	−197	−183	−189	−190	−195	−182	−136	−44	+90	+274
	6	Excess Diurnal Inequality ...	−57	−73	−65	−69	−66	−60	−52	−49	−59	−5
	7	Excess Diurnal Inequality smoothed	−55	−65	−69	−67	−65	−59	−54	−53	−38	−13
	8	Temperature corrections ...	−43	−49	−53	−53	−56	−56	−53	−45	−25	−1
	9	Residual errors	−12	−16	−16	−14	−9	−3	−1	−8	−13	−12
December.	1	Diurnal Inequality by Magnetograph	−134	−130	−104	−109	−96	−87	−62	+7	+100	+207
	2	Diurnal Inequality corrected for P. change	−138	−134	−108	−112	−99	−90	−64	+5	+99	+206
	3	Diurnal Inequality by Grubb's Magnetometer	−194	−183	−145	−156	−150	−150	−123	−68	+25	+196
	4	Diurnal Inequality corrected for P. change	−183	−173	−136	−148	−143	−144	−118	−63	+29	+199
	5	Diurnal Inequality corrected for 19 minutes past the hour ...	−181	−170	−137	−148	−143	−142	−113	−55	+43	+209
	6	Excess Diurnal Inequality ...	−43	−36	−29	−36	−44	−52	−49	−60	−56	+3
	7	Excess Diurnal Inequality smoothed	−41	−36	−34	−36	−44	−48	−54	−55	−38	−16
	8	Temperature corrections ...	−50	−58	−62	−64	−65	−68	−64	−55	−35	−7
	9	Residual errors	+9	+22	+28	+28	+21	+20	+10	0	−3	−9
Winter.	6	Excess Diurnal Inequality ...	−60	−67	−59	−67	−62	−77	−69	−59	−44	+9
	7	Excess Diurnal Inequality smoothed	−59	−62	−64	−63	−69	−69	−68	−57	−31	−2
	8	Temperature corrections ...	−48	−56	−60	−62	−64	−66	−62	−54	−34	−7
	9	Residual errors	−11	−6	−4	−1	−5	−3	−6	−3	+3	+5
Summer.	6	Excess Diurnal Inequality ...	−33	−38	−42	−42	−42	−44	−41	−28	−22	+6
	7	Excess Diurnal Inequality smoothed	−31	−38	−41	−42	−43	−42	−38	−30	−15	+5
	8	Temperature corrections ...	−37	−41	−44	−44	−46	−45	−41	−32	−15	+5
	9	Residual errors	+6	+3	+3	+2	+3	+3	+3	+2	0	0
Year.	6	Excess Diurnal Inequality ...	−42	−48	−49	−51	−49	−55	−51	−38	−30	+7
	7	Excess Diurnal Inequality smoothed	−41	−46	−49	−49	−52	−52	−48	−40	−20	+2
	8	Temperature corrections ...	−41	−46	−49	−50	−52	−52	48	−40	−21	+1
	9	Residual errors	0	0	0	+1	0	0	0	0	+1	+1

Horizontal Force Magnetometer, and the Horizontal Force Magnetograph, as Quiet Days of the year 1872.

10	11	12	13	14	15	16	17	18	19	20	21	22	23
+397	+439	+375	+260	+154	+ 44	− 59	− 97	− 80	−144	−199	−237	−216	−199
+398	+440	+375	+259	+153	+ 42	− 62	−101	− 84	−149	−205	−243	−223	−207
+412	+505	+456	+373	+274	+165	+ 33	− 33	− 49	−121	−198	−269	−258	−236
+414	+506	+456	+372	+272	+162	+ 29	− 38	− 54	−127	−205	−277	−267	−246
+422	+502	+449	+364	+264	+151	+ 23	− 39	− 60	−133	−211	−276	−265	−242
+ 24	+ 62	+ 74	+105	+111	+109	+ 85	+ 62	+ 24	+ 16	− 6	− 33	− 42	− 35
+ 27	+ 53	+ 80	+ 97	+108	+102	+ 85	+ 57	+ 34	+ 11	− 8	− 27	− 37	− 45
+ 26	+ 46	+ 64	+ 75	+ 80	+ 77	+ 66	+ 46	+ 26	+ 8	− 6	− 17	− 26	− 35
+ 1	+ 7	+ 66	+ 22	+ 28	+ 25	+ 19	+ 11	+ 8	+ 3	− 2	− 10	− 11	− 10
+318	+343	+305	+198	+105	+ 45	− 6	− 62	− 66	−117	−138	−181	−164	−168
+317	+343	+305	+198	+106	+ 46	− 5	− 60	− 64	−114	−135	−178	−160	−164
+316	+377	+360	+256	+190	+130	+ 69	+ 3	− 13	− 73	−112	−178	−183	−200
+318	+378	+360	+255	+188	+127	+ 65	− 2	− 18	− 79	−119	−186	−192	−210
+323	+377	+351	+249	+183	+122	+ 59	− 3	− 23	− 82	−125	−186	−193	−208
+ 6	+ 34	+ 46	+ 51	+ 77	+ 76	+ 64	+ 57	+ 41	+ 32	+ 10	− 8	− 33	− 44
+ 14	+ 29	+ 44	+ 58	+ 68	+ 72	+ 66	+ 54	+ 43	+ 28	+ 11	− 10	− 28	− 40
+ 25	+ 52	+ 72	+ 88	+ 96	+ 93	+ 81	+ 60	+ 35	+ 13	− 5	− 17	− 29	− 39
− 11	− 23	− 28	− 30	− 28	− 21	− 15	− 6	+ 8	+ 15	+ 16	+ 7	+ 1	− 1
+ 29	+ 52	+ 74	+ 92	+107	+106	+ 81	+ 73	+ 37	+ 23	− 1	− 22	− 37	− 50
+ 30	+ 52	+ 73	+ 91	+102	+ 98	+ 87	+ 64	+ 44	+ 20	0	− 20	− 36	− 49
+ 24	+ 50	+ 70	+ 85	+ 93	+ 90	+ 79	+ 58	+ 34	+ 13	− 5	− 17	− 28	− 38
+ 6	+ 2	+ 3	+ 6	+ 9	+ 8	+ 8	+ 6	+ 10	+ 7	+ 5	− 3	− 8	− 11
+ 30	+ 44	+ 56	+ 65	+ 61	+ 58	+ 48	+ 30	+ 8	− 9	− 12	− 16	− 19	− 23
+ 27	+ 43	+ 55	+ 61	+ 61	+ 56	+ 45	+ 29	+ 10	− 4	− 12	− 16	− 19	− 25
+ 27	+ 42	+ 55	+ 63	+ 65	+ 60	+ 49	+ 33	+ 16	+ 2	− 8	− 16	− 23	− 30
0	+ 1	0	− 2	− 4	− 4	− 4	− 4	+ 4	− 6	− 4	0	+ 4	+ 5
+ 30	+ 47	+ 62	+ 74	+ 76	+ 74	+ 59	+ 44	+ 18	+ 2	− 8	− 18	− 25	− 32
+ 28	+ 46	+ 61	+ 71	+ 75	+ 70	+ 59	+ 40	+ 21	+ 4	− 8	− 17	− 25	− 33
+ 26	+ 45	+ 60	+ 71	+ 74	+ 70	+ 59	+ 41	+ 22	+ 6	− 7	− 16	− 25	− 33
+ 2	+ 1	+ 1	0	+ 1	0	0	− 1	− 1	− 2	− 1	− 1	0	0

of January-February of 1907 when it was only 3°. Moisture, besides, is an important factor, and, as will be seen later, its influence on the deviation of the temperature of the magnet from that recorded by the thermometer is considerable. Presence of moisture appears to help in equalising the temperatures while dryness tends to widen the difference. It would therefore be seen that by suitably enlarging the amplitude of the excess temperature variation, its curve could be made to fit the curve of the excess magnetic variation fairly closely. Accepting hence the inference that the excess magnetic inequalities are almost wholly the result of residual temperature effects, subsequent operations for the computation of the amplitudes and phases of the 'correction' inequalities to be made applicable to the rubb's series from month to month become fairly easy for which the following method has been adopted.

157. The smoothed excess magnetic inequality of the year given in row 7, table 86, has been taken as the standard inequality from which the monthly inequalities may be supposed to be derived by a change in phase and amplitude For securing the amplitude of the curves for each month, sums without regard to signs of the ordinates of the excess magnetic inequalities in the same table for each month, were taken and smoothed, and then each sum was divided by the sum of the year. The ratio so given was taken as the amplitude of the month in terms of the amplitude of the year, *vide* table below.

TABLE 87.—*Showing the calculations for the determination of the amplitude and phase in the excesses of the diurnal inequality of Horizontal Force as derived from the Grubb's Horizontal Force Magnetometer over the same as derived from the Horizontal Force Magnetograph.*

Months.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Amplitude. Unity = ·1γ = ·000001 C. G. S.													
Sums without regard to signs of the excesses in row 6, table 86.	1,643	1,519	748	969	1,019	627	723	899	817	809	1,343	987	1009
Sums in upper row (smoothed)	1,383	1,303	1,079	912	872	790	750	813	842	990	1,046	1,324	1009
Ratio of the smoothed monthly sums to the annual sum.	1·37	1·29	1·07	0·90	0·86	0·78	0·74	0·80	0·83	0·98	1·04	1·31	1·00
Phase.													
Approximate times of maximum in civil hours derived from excesses in row 7, table 86.	14·6	14·0	13·7	12·8	14·6	14·0	12·0	13·2	14·4	13·7	14·2	14·8	14·0
Approximate times of maximum (smoothed) ...	14·5	14·1	13·8	13·8	13·6	13·5	13·4	13·5	13·7	14·0	14·2	14·4	14·0
Adopted times of maximum	14·5	14·3	14·2	14·0	13·8	13·7	13·5	13·7	13·8	14·0	14·2	14·3	14·0

With regard to the maximum phase the time for each month for the maximum phase was derived by a process of inspection and approximation as shown in table 87 with the result that in July the maximum phase was timed to occur at 13·5 hours, while in January it occurred at 14·5 hours, the maximum phase thus appearing to shift from month to month by a progression of 10 minutes. Having secured the data for amplitude and phase the following table 88 was built up thus. It will be seen from table 87 that for the month of October the amplitude is denoted by factor ·98 or nearly 1·00 and the maximum phase occurs at 14·0 hours; hence the ordinates of the standard annual inequality are at once put down in the column for that month in the respective hours, the maximum being put at 14·0 hours. In April also the maximum phase occurs at the same hour; hence the standard annual series is reduced by ·90 and entered from hour to hour for that month with the maximum at 14·0 hours. For the month of January the annual series is multiplied by 1·37, and the maximum is entered not in the column of 14·0 hour but on the line between 14·0 and 15·0 hour and the rest are entered accordingly. Finally the mean of the two figures are entered in the hour column itself; and so on for other months, an allowance for 10 minutes being made from month to month in the phase and the hourly entries were completed by interpolation.

158. These computed inequalities in table 88 which may now be taken as temperature inequalities are entered in table 86, row 8, and are also charted in thick curve along with the smoothed magnetic inequalities as thin curve in figures I*a* to XV*a* in plate 3. These are used as final corrections for the period 1866 to 1872 to make the inequalities of the period strictly comparable with the magnetograph series. The differences are shown in row 9 as residual errors, which it will be seen are fairly small.

159. Similar results of experiment with the magnetometer without any quilt cover, shown in table 89, treated exactly in the same way, furnish corrections for the earlier period 1848 to 1865 which have

TABLE 88.—*Temperature Corrections for the Diurnal Inequality of Grubb's Horizontal Force Magnetometer 1866–1872.*

Unity=0·1γ= ·000001 C.G S.

Bombay Civil Time.		MONTHS.												October to March.	April to September.	Year.
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.			
H.	M.															
0	19 ...	−51	−50	−43	−38	−36	−32	−33	−36	−36	−41	−43	−50	−46	−35	−41
1	19 ...	−59	−58	−49	−42	−39	−35	−36	−39	−39	−46	−49	−58	−53	−38	−46
2	19 ...	−65	−62	−53	−45	−42	−38	−38	−42	−42	−49	−53	−62	−57	−41	−49
3	19 ...	−68	−64	−53	−45	−42	−38	−38	−42	−42	−49	−53	−64	−58	−41	−50
4	19 ...	−69	−65	−56	−48	−44	−40	−40	−44	−44	−52	−56	−65	−60	−43	−52
5	19 ...	−72	−68	−56	−48	−43	−38	−38	−42	−43	−52	−56	−68	−62	−42	−52
6	19 ...	−69	−64	−53	−44	−39	−35	−34	−38	−39	−48	−53	−64	−58	−38	−48
7	19 ...	−61	−55	−45	−37	−31	−25	−23	−27	−31	−40	−45	−55	−50	−29	−40
8	19 ...	−41	−35	−25	−18	−14	− 9	− 7	−10	−14	−20	−25	−35	−30	−12	−21
9	19 ...	−12	− 7	− 1	+ 2	+ 5	+ 8	+12	+ 9	+ 5	+ 2	− 1	− 7	− 4	+ 7	+ 1
10	19 ...	+21	+25	+26	+26	+26	+25	+28	+28	+26	+28	+26	+25	+25	+26	+26
11	19 ...	+51	+52	+46	+42	+41	+38	+41	+42	+41	+46	+46	+52	+49	+41	+45
12	19 ...	+73	+72	+64	+56	+54	+49	+51	+54	+54	+61	+64	+72	+68	+53	+60
13	19 ...	+91	+88	+75	+65	+61	+55	+56	+61	+61	+71	+75	+88	+81	+60	+71
14	19 ...	+101	+96	+80	+69	+63	+55	+55	+61	+63	+75	+80	+96	+88	+61	+74
15	19 ...	+99	+93	+77	+64	+58	+50	+49	+55	+58	+70	+77	+93	+85	+56	+70
16	19 ...	+88	+81	+66	+54	+48	+39	+38	+43	+48	+59	+66	+81	+73	+45	+59
17	19 ...	+68	+60	+46	+37	+31	+25	+23	+28	+31	+40	+46	+60	+53	+29	+41
18	19 ...	+41	+35	+26	+19	+15	+12	+ 9	+13	+15	+21	+26	+35	+31	+14	+22
19	19 ...	+17	+13	+ 8	+ 4	+ 2	0	− 2	0	+ 2	+ 4	+ 8	+13	+10	+ 1	+ 6
20	19 ...	− 3	− 5	− 6	− 7	− 8	− 8	− 9	− 8	− 8	− 8	− 6	− 5	− 5	− 8	− 7
21	19 ...	−17	−17	−17	−16	−15	−15	−16	−17	−15	−17	−17	−17	−17	−16	−16
22	19 ...	−29	−29	−26	−23	−22	−22	−22	−24	−22	−25	−26	−29	−27	−22	−25
23	19 ...	−40	−39	−35	−30	−29	−28	−28	−31	−29	−33	−35	−39	−37	−29	−33

TABLE 89.—*Temperature corrections for the Diurnal Inequality of Grubb's H. F. Magnetometer.*

1848—1865.

Unity = 0·1γ = ·000001 C. G. S.

Bombay Civil Time.		MONTHS.														
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	October to March.	April to September.	Year.
H.	m.															
0	19	− 54	− 53	− 45	− 39	− 36	− 32	− 32	− 36	− 36	− 42	− 45	− 53	− 49	− 35	− 42
1	19	− 59	− 56	− 48	− 41	− 38	− 34	− 34	− 38	− 38	− 44	− 48	− 56	− 52	− 37	− 44
2	19	− 61	− 58	− 49	− 41	− 38	− 34	− 34	− 38	− 38	− 45	− 49	− 58	− 53	− 37	− 45
3	19	− 63	− 59	− 50	− 43	− 40	− 36	− 36	− 40	− 40	− 47	− 50	− 59	− 55	− 39	− 47
4	19	− 64	− 60	− 50	− 42	− 38	− 33	− 33	− 37	− 38	− 46	− 50	− 60	− 55	− 37	− 46
5	19	− 60	− 56	− 46	− 38	− 33	− 30	− 28	− 32	− 33	− 41	− 46	− 56	− 51	− 32	− 42
6	19	− 50	− 45	− 36	− 29	− 24	− 19	− 17	− 21	− 24	− 32	− 36	− 45	− 41	− 22	− 31
7	19	− 31	− 25	− 17	− 12	− 8	− 5	− 2	− 5	− 8	− 14	− 17	− 25	− 21	− 7	− 14
8	19	− 4	+ 1	+ 5	+ 7	+ 9	+ 11	+ 14	+ 13	+ 9	+ 7	+ 5	+ 1	+ 2	+ 10	+ 6
9	19	+ 25	+ 29	+ 28	+ 27	+ 27	+ 25	+ 28	+ 28	+ 27	+ 29	+ 28	+ 29	+ 28	+ 27	+ 27
10	19	+ 50	+ 51	+ 48	+ 41	+ 40	+ 37	+ 39	+ 41	+ 40	+ 45	+ 48	+ 51	+ 49	+ 40	+ 44
11	19	+ 69	+ 68	+ 60	+ 52	+ 50	+ 45	+ 47	+ 50	+ 50	+ 57	+ 60	+ 68	+ 64	+ 49	+ 56
12	19	+ 84	+ 81	+ 68	+ 59	+ 55	+ 50	+ 50	+ 55	+ 55	+ 65	+ 68	+ 81	+ 74	+ 54	+ 64
13	19	+ 91	+ 86	+ 71	+ 61	+ 56	+ 49	+ 49	+ 54	+ 56	+ 67	+ 71	+ 86	+ 79	+ 54	+ 66
14	19	+ 86	+ 81	+ 67	+ 56	+ 50	+ 42	+ 41	+ 47	+ 50	+ 60	+ 67	+ 81	+ 74	+ 48	+ 61
15	19	+ 75	+ 68	+ 55	+ 45	+ 40	+ 32	+ 31	+ 35	+ 40	+ 49	+ 55	+ 68	+ 62	+ 37	+ 49
16	19	+ 55	+ 49	+ 37	+ 30	+ 24	+ 20	+ 18	+ 22	+ 24	+ 32	+ 37	+ 49	+ 43	+ 23	+ 33
17	19	+ 32	+ 27	+ 20	+ 14	+ 11	+ 8	+ 5	+ 9	+ 11	+ 15	+ 20	+ 27	+ 23	+ 10	+ 17
18	19	+ 11	+ 8	+ 5	+ 1	0	− 2	− 4	− 2	0	+ 1	+ 5	+ 8	+ 6	− 1	+ 3
19	19	− 5	− 7	− 7	− 8	− 9	− 9	− 10	− 9	− 9	− 9	− 7	− 7	− 7	− 9	− 8
20	19	− 18	− 18	− 17	− 16	− 15	− 15	− 15	− 17	− 15	− 17	− 17	− 18	− 17	− 15	− 16
21	19	− 29	− 28	− 25	− 23	− 22	− 21	− 21	− 23	− 22	− 24	− 25	− 28	− 26	− 22	− 24
22	19	− 39	− 38	− 33	− 29	− 28	− 26	− 26	− 29	− 28	− 32	− 33	− 38	− 35	− 28	− 32
23	19	− 48	− 47	− 40	− 35	− 33	− 30	− 31	− 33	− 33	− 38	− 40	− 47	− 43	− 32	− 38

TABLES 90 & 91.—*Grubb's Horizontal Force Magnetometer—Showing the mean diurnal inequality of Horizontal Force corrected for temperature for each of the years 1848—1872 and for the whole periods from 1850—1860 and from 1861—1871.*

Unity = 0·1γ = ·000001 C. G. S.

Bombay Civil Time. H. m.	YEARS. 1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1850-1860.
0 19	− 168	− 161	− 115	− 102	− 60	− 80	− 74	− 60	− 78	− 92	− 126	− 168	− 158	− 101
1 19	− 159	− 141	− 96	− 84	− 38	− 63	− 55	− 50	− 63	− 73	− 97	− 152	− 138	− 83
2 19	− 145	− 126	− 87	− 65	− 20	− 41	− 36	− 40	− 50	− 60	− 88	− 128	− 121	− 67
3 19	− 132	− 116	− 71	− 50	− 12	− 21	− 18	− 27	− 41	− 49	− 72	− 108	− 112	− 53
4 19	− 119	− 109	− 65	− 49	− 11	− 16	− 6	− 17	− 24	− 40	− 58	− 91	− 94	− 43
5 19	− 105	− 95	− 60	− 41	− 13	− 16	+ 4	− 17	− 15	− 31	− 48	− 75	− 85	− 36
6 19	− 81	− 70	− 64	− 51	− 16	− 24	− 10	− 18	− 7	− 23	− 37	− 51	− 73	− 34
7 19	− 25	− 18	− 26	− 32	0	− 15	− 7	− 10	+ 7	− 8	− 3	− 13	− 30	− 12
8 19	+ 125	+ 115	+ 85	+ 78	+ 86	+ 85	+ 72	+ 67	+ 105	+ 88	+ 124	+ 142	+ 128	+ 96
9 19	+ 294	+ 265	+ 219	+ 217	+ 200	+ 210	+ 176	+ 161	+ 212	+ 203	+ 267	+ 337	+ 307	+ 228
10 19	+ 408	+ 369	+ 320	+ 319	+ 282	+ 305	+ 258	+ 236	+ 279	+ 291	+ 372	+ 466	+ 433	+ 324
11 19	**+ 423**	**+ 392**	**+ 342**	**+ 347**	**+ 296**	**+ 323**	**+ 275**	**+ 254**	**+ 291**	**+ 313**	**+ 404**	**+ 495**	**+ 478**	**+ 347**
12 19	+ 362	+ 343	+ 298	+ 309	+ 248	+ 282	+ 232	+ 219	+ 241	+ 274	+ 347	+ 448	+ 413	+ 301
13 19	+ 262	+ 244	+ 213	+ 225	+ 163	+ 197	+ 156	+ 152	+ 153	+ 192	+ 242	+ 317	+ 304	+ 210
14 19	+ 154	+ 140	+ 118	+ 117	+ 59	+ 101	+ 69	+ 75	+ 68	+ 106	+ 124	+ 179	+ 171	+ 108
15 19	+ 65	+ 56	+ 37	+ 10	− 27	+ 4	− 10	+ 4	− 4	+ 20	+ 18	+ 46	+ 44	+ 13
16 19	− 16	+ 10	− 37	− 76	− 94	− 80	− 75	− 51	− 64	− 53	− 77	− 51	− 48	− 64
17 19	− 72	− 70	− 91	− 120	− 131	− 144	− 111	− 94	− 106	− 102	− 128	− 125	− 122	− 116
18 19	− 124	114	− 141	− 147	− 162	− 179	− 146	− 133	− 145	− 140	− 170	− 202	− 176	− 158
19 19	− 173	− 159	− 164	− 176	**− 190**	**− 202**	**− 173**	**− 158**	− 174	− 172	− 211	− 259	− 230	− 192
20 19	**− 193**	− 180	**− 167**	**− 177**	− 184	− 196	− 168	− 152	**− 175**	− 174	**− 213**	**− 274**	**− 249**	**− 194**
21 19	− 191	**− 190**	− 160	− 170	− 156	− 175	− 142	− 140	− 158	**− 176**	− 210	− 271	− 242	− 182
22 19	− 189	− 190	− 154	− 157	− 125	− 143	− 114	− 113	− 132	− 149	− 193	− 242	− 211	− 158
23 19	− 180	− 175	− 135	− 123	− 88	− 106	− 87	− 86	− 102	− 122	− 155	− 194	− 186	− 126
Range ...	616	582	509	524	486	525	448	412	466	489	617	769	727	541

Bombay Civil Time H. m.	YEARS. 1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1861-1871.
0 19	− 147	− 126	− 102	− 92	− 75	− 66	− 82	− 91	− 133	− 209	− 205	− 192	− 121
1 19	− 133	− 96	− 81	− 70	− 56	− 55	− 66	− 80	− 121	− 197	− 195	− 175	− 105
2 19	− 114	− 85	− 64	− 50	− 45	− 44	− 53	− 65	− 111	− 185	− 177	− 161	− 90
3 19	− 97	− 80	− 50	− 33	− 28	− 32	− 48	− 54	− 105	− 168	− 160	− 147	− 78
4 19	− 87	− 66	− 41	− 29	− 12	− 22	− 34	− 44	− 81	− 141	− 150	− 127	− 64
5 19	− 83	− 57	− 31	− 26	− 10	− 8	− 26	− 27	− 66	− 123	− 133	− 118	− 54
6 19	− 67	− 41	− 25	− 18	− 12	+ 2	− 18	− 17	− 40	− 85	− 94	− 86	− 38
7 19	− 25	− 3	+ 17	+ 14	+ 16	+ 46	+ 23	+ 22	+ 15	− 7	− 6	− 5	+ 10
8 19	+ 115	+ 114	+ 115	+ 113	+ 99	+ 139	+ 117	+ 98	+ 111	+ 140	+ 138	+ 130	+ 118
9 19	+ 278	+ 252	+ 240	+ 224	+ 207	+ 237	+ 230	+ 204	+ 240	+ 329	+ 314	+ 298	+ 250
10 19	+ 397	+ 360	+ 332	+ 303	+ 292	+ 298	+ 298	+ 277	+ 349	+ 486	+ 458	+ 423	+ 350
11 19	**+ 444**	**+ 395**	**+ 353**	**+ 327**	**+ 299**	**+ 300**	**+ 299**	**+ 292**	**+ 379**	**+ 534**	**+ 502**	**+ 461**	**+ 375**
12 19	+ 387	+ 345	+ 306	+ 272	+ 255	+ 238	+ 243	+ 247	+ 338	+ 485	+ 460	+ 410	+ 325
13 19	+ 280	+ 245	+ 210	+ 167	+ 168	+ 144	+ 152	+ 171	+ 243	+ 368	+ 347	+ 297	+ 227
14 19	+ 158	+ 127	+ 96	+ 72	+ 76	+ 49	+ 51	+ 74	+ 132	+ 215	+ 201	+ 161	+ 114
15 19	+ 39	+ 20	− 12	− 18	− 11	− 26	− 24	+ 1	+ 25	+ 76	+ 70	+ 46	+ 13
16 19	− 50	− 62	− 77	− 74	− 74	− 103	− 84	− 64	− 58	− 41	− 35	− 42	− 66
17 19	− 114	− 131	− 132	− 132	− 119	− 148	− 121	− 103	− 108	− 104	− 105	− 97	− 120
18 19	− 166	− 171	− 172	− 172	− 160	− 181	− 145	− 121	− 127	− 152	− 145	− 130	− 156
19 19	− 208	200	**− 197**	− 184	− 194	**− 198**	**− 163**	− 144	− 164	− 204	− 185	− 157	− 186
20 19	**− 219**	**− 203**	− 196	**− 186**	**− 199**	− 180	− 157	− 150	− 183	− 241	− 212	− 187	**− 193**
21 19	− 208	− 198	− 181	− 161	− 173	− 163	− 144	**− 151**	**− 192**	**− 270**	− 233	**− 202**	− 189
22 19	− 193	− 177	− 158	− 141	− 133	− 134	− 128	− 143	− 177	− 262	**− 236**	− 201	− 171
23 19	− 177	− 148	− 122	− 110	− 102	− 91	− 106	− 115	− 156	− 246	− 219	− 188	− 145
Range ...	663	598	550	513	498	498	462	443	571	804	738	663	568

TABLES 92 & 93.– *Grubb's Horizontal Force Magnetometer.—Showing the mean diurnal inequality of Horizontal Force corrected for temperature for the half-year (January to March and October to December), of each of the years 1848—1872 and for the whole periods from 1850—1860 and from 1861—1871.*

Unity = $0{\cdot}1\gamma$ = ·000001 C. G. S.

Bombay Civil Time.	YEARS. 1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1850-1860.
H. m.														
0 19	− 188	− 181	− 133	− 110	− 76	− 96	− 87	− 68	− 77	− 94	− 133	− 167	− 153	− 109
1 19	− 173	− 151	− 109	− 86	− 39	− 75	− 59	− 51	− 61	− 72	− 96	− 148	− 123	− 84
2 19	− 160	− 134	− 96	− 55	− 14	− 38	− 36	− 35	− 53	− 48	− 87	− 129	− 103	− 63
3 19	− 143	− 128	− 78	− 47	− 14	− 23	− 16	− 20	− 40	− 40	− 70	− 109	− 93	− 50
4 19	− 123	− 120	− 71	− 40	− 11	− 12	− 7	− 5	− 16	− 26	− 52	− 89	− 81	− 37
5 19	− 104	− 110	− 64	− 30	− 14	− 5	+ 13	− 1	− 6	− 15	− 40	− 60	− 64	− 26
6 16	− 79	− 86	− 60	− 41	− 7	+ 4	+ 15	+ 5	+ 16	+ 4	− 18	− 28	− 43	− 14
7 19	− 17	− 34	− 20	− 27	+ 9	+ 3	+ 17	− 3	+ 23	+ 12	+ 8	0	− 28	− 1
8 19	+ 144	+ 114	+ 96	+ 89	+ 103	+ 98	+ 99	+ 71	+ 124	+ 114	+ 135	+ 160	+ 119	+ 110
9 19	+ 312	+ 274	+ 229	+ 223	+ 218	+ 224	+ 198	+ 160	+ 232	+ 217	+ 273	+ 332	+ 284	+ 235
10 19	+ 430	+ 387	+ 336	+ 325	+ 302	+ 320	+ 271	+ 233	+ 296	+ 304	+ 381	+ 463	+ 414	+ 331
11 19	**+ 445**	**+ 420**	**+ 363**	**+ 358**	**+ 323**	**+ 350**	**+ 289**	**+ 261**	**+ 308**	**+ 325**	**+ 413**	**+ 509**	**+ 461**	**+ 360**
12 19	+ 371	+ 367	+ 316	+ 313	+ 258	+ 308	+ 240	+ 222	+ 246	+ 276	+ 348	+ 448	+ 405	+ 307
13 19	+ 258	+ 252	+ 215	+ 216	+ 159	+ 206	+ 150	+ 144	+ 142	+ 177	+ 227	+ 313	+ 292	+ 204
14 19	+ 153	+ 145	+ 124	+ 101	+ 53	+ 103	+ 54	+ 73	+ 51	+ 89	+ 109	+ 170	+ 158	+ 99
15 19	+ 70	+ 70	+ 48	0	− 29	+ 11	− 18	+ 1	− 11	+ 6	+ 17	+ 48	+ 34	+ 10
16 19	− 3	+ 7	− 24	− 81	− 90	− 79	− 78	− 47	− 72	− 73	− 73	− 43	− 47	− 64
17 19	− 59	− 45	− 73	− 117	− 126	− 147	− 120	− 89	− 108	− 119	− 114	− 126	− 104	− 113
18 19	− 109	− 98	− 133	− 141	− 164	− 184	− 156	− 137	− 162	− 161	− 164	− 205	− 156	− 160
19 19	− 162	− 156	− 162	− 174	− 196	− 216	− 184	**− 165**	− 192	− 187	− 211	− 268	− 234	− 199
20 19	− 200	− 184	− 177	− 176	**− 201**	**− 224**	**− 190**	− 163	**− 196**	− 181	− 220	− 288	**− 265**	**− 207**
21 19	− 214	− 209	− 178	**− 185**	− 173	− 210	− 165	− 158	− 174	**− 195**	**− 231**	**− 301**	− 263	− 203
22 19	**− 215**	**− 217**	**− 184**	− 173	− 146	− 177	− 134	− 134	− 144	− 169	− 220	− 269	− 227	− 180
23 19	− 201	− 202	− 166	− 135	− 118	− 132	− 99	− 100	− 110	− 140	− 168	− 207	− 191	− 142
Range...	660	637	547	543	524	574	479	426	504	520	644	810	726	567

Bombay Civil Time.	YEARS. 1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1861-1871.
H. m.													
0 19	− 147	− 115	− 96	− 101	− 77	− 64	− 98	− 102	− 124	− 210	− 204	− 198	− 122
1 19	− 125	− 94	− 71	− 72	− 61	− 54	− 80	− 87	− 110	− 181	− 194	− 172	− 103
2 19	− 94	− 72	− 55	− 45	− 42	− 39	− 57	− 65	− 88	− 166	− 175	− 152	− 82
3 19	− 82	− 67	− 40	− 32	− 26	− 22	− 50	− 57	− 84	− 141	− 151	− 124	− 68
4 19	− 72	− 52	− 29	− 26	− 6	− 13	− 33	− 42	− 68	− 117	− 134	− 94	− 54
5 19	− 60	− 45	− 17	− 14	− 2	− 1	− 21	− 22	− 58	− 98	− 115	− 91	− 41
6 19	− 44	− 23	− 12	− 11	− 3	+ 3	− 17	− 15	− 33	− 71	− 79	− 67	− 28
7 19	− 19	+ 13	+ 29	+ 19	+ 21	+ 48	+ 19	+ 17	+ 8	− 6	+ 6	+ 7	+ 14
8 19	+ 105	+ 130	+ 129	+ 118	+ 116	+ 153	+ 131	+ 91	+ 101	+ 121	+ 138	+ 124	+ 121
9 19	+ 254	+ 262	+ 252	+ 220	+ 229	+ 253	+ 250	+ 200	+ 230	+ 295	+ 300	+ 277	+ 250
10 19	+ 379	+ 366	+ 333	+ 302	+ 307	+ 314	+ 319	+ 270	+ 336	+ 452	+ 438	+ 400	+ 347
11 19	**+ 440**	**+ 388**	**+ 354**	**+ 331**	**+ 321**	**+ 317**	**+ 324**	**+ 286**	**+ 369**	**+ 500**	**+ 487**	**+ 444**	**+ 374**
12 19	+ 382	+ 333	+ 299	+ 274	+ 267	+ 248	+ 253	+ 253	+ 322	+ 455	+ 437	+ 390	+ 320
13 19	+ 266	+ 217	+ 184	+ 167	+ 170	+ 144	+ 153	+ 170	+ 216	+ 342	+ 317	+ 266	+ 213
14 19	+ 146	+ 103	+ 75	+ 73	+ 68	+ 40	+ 46	+ 71	+ 107	+ 202	+ 171	+ 137	+ 100
15 19	+ 34	+ 4	− 13	− 13	− 24	− 30	− 28	− 10	+ 9	+ 82	+ 59	+ 35	+ 6
16 19	− 45	− 67	− 81	− 67	− 71	− 118	− 83	− 55	− 59	− 15	− 21	− 38	− 62
17 19	− 106	− 132	− 129	− 133	− 121	− 172	− 125	− 84	− 99	− 65	− 80	− 92	− 113
18 19	− 165	− 175	− 177	− 169	− 161	− 200	− 145	− 106	− 115	− 128	− 120	− 117	− 151
19 19	− 209	**− 213**	− 206	− 176	− 209	**− 217**	**− 164**	− 128	− 148	− 191	− 167	− 143	− 184
20 19	**− 225**	− 211	**− 217**	**− 191**	**− 214**	− 193	− 156	− 141	− 175	− 236	− 208	− 186	**− 197**
21 19	− 219	− 197	− 194	− 174	− 195	− 175	− 148	− 148	**− 186**	− 275	− 242	**− 207**	− 196
22 19	− 212	− 181	− 173	− 151	− 155	− 142	− 145	**− 153**	− 178	**− 276**	**− 249**	− 203	− 183
23 19	− 190	− 145	− 122	− 127	− 116	− 92	− 121	− 127	− 152	− 263	− 225	− 184	− 153
Range...	665	601	571	522	535	534	488	439	555	776	736	651	571

TABLES 94 & 95.—*Grubb's Horizontal Force Magnetometer—Showing the mean diurnal inequality of Horizontal Force corrected for temperature for the half year April to September of each of the years 1848 to 1872 and for the whole periods 1850—1860 and 1861—1871.*

Unity = $0{\cdot}1\gamma$ = ·000001 C. G. S.

Bombay Civil Time.	YEARS.													1850 to 1860.
	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	
H. m.														
0 19	−149	−141	−94	−95	−44	−64	−61	−53	−79	−90	−119	−169	−163	−94
1 19	−145	−130	−84	−80	−36	−51	−51	−48	−64	−73	−97	−156	−151	−81
2 19	−131	−119	−77	−74	−27	−45	−35	−46	−48	−72	−90	−128	−139	−71
3 19	−120	−104	−64	−53	−8	−17	−20	−34	−42	−58	−74	−107	−129	−55
4 19	−113	−97	−59	−58	−10	−19	−3	−28	−32	−55	−64	−94	−107	−48
5 19	−108	−83	−55	−53	−11	−28	−7	−35	−26	−49	−58	−91	−106	−47
6 19	−82	−54	−67	−59	−23	−49	−35	−42	−28	−49	−55	−73	−103	−53
7 19	−33	−4	−32	−37	−10	−35	−31	−18	−10	−27	−14	−25	−38	−25
8 19	+107	+117	+74	+69	+71	+72	+45	+63	+86	+62	+113	+125	+137	+83
9 19	+274	+255	+209	+211	+180	+194	+152	+162	+193	+188	+259	+339	+331	+220
10 19	+385	+350	+302	+310	+262	+288	+243	+238	+262	+277	+362	+467	+451	+314
11 19	**+398**	**+364**	**+32**	**+334**	**+268**	**+294**	**+261**	**+246**	**+274**	**+299**	**+394**	**+481**	**+493**	**+333**
12 19	+353	+320	+280	+305	+237	+256	+224	+215	+237	+272	+345	+446	+421	+294
13 19	+265	+236	+209	+232	+165	+185	+162	+159	+163	+207	+255	+321	+315	+216
14 19	+154	+136	+112	+133	+66	+98	+83	+78	+85	+122	+140	+188	+183	+117
15 19	+59	+37	+26	+20	−25	−5	−3	+5	+1	+35	+18	+44	+54	+15
16 19	−29	−34	−49	−70	−99	−82	−72	−55	−55	−32	−82	−61	−48	−64
17 19	−84	−94	−109	−122	−134	−139	−102	−97	−103	−84	−141	−122	−138	−117
18 19	−139	−128	−148	−154	−160	−173	−134	−128	−125	−117	−174	−196	−193	−155
19 19	**−185**	−162	**−166**	−177	**−184**	**−190**	**−164**	**−151**	**−156**	−156	**−211**	−252	−226	**−185**
20 19	−185	**−175**	−158	**−178**	−168	−168	−145	−141	−155	**−167**	−207	**−262**	**−233**	−180
21 19	−170	−172	−141	−155	−139	−140	−118	−119	−140	−156	−188	−241	−221	−160
22 19	−164	−163	−123	141	−103	−109	−97	−95	−120	−131	−168	−216	−198	−136
23 19	−161	−149	−104	−110	−59	−81	−77	−73	−96	−105	−143	−181	−182	−110
Range.	583	539	486	512	452	484	425	397	430	466	605	743	726	518

Bombay Civil Time.	YEARS.												1861 to 1871.
	1861.	1662.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	
H. m.													
0 19	−148	−136	−109	−83	−72	−68	−68	−81	−144	−209	−207	−187	−120
1 19	−140	−116	−90	−67	−51	−58	−52	−74	−133	−214	−197	−179	−108
2 19	−133	−99	−73	−54	−48	−48	−49	−64	−132	−203	−177	−170	−98
3 19	−114	−94	−66	−35	−28	−39	−46	−51	−124	−194	−168	−169	−87
4 19	−102	−81	−54	−32	−19	−32	−37	−45	−95	−166	−167	−160	−75
5 19	−107	−70	−46	−39	−18	−16	−32	−32	−74	−148	−151	−147	−67
6 19	−90	−58	−36	−27	−19	+1	−20	−17	−47	−99	−109	−107	−47
7 19	−30	−19	+5	+9	+12	+43	+27	+25	+22	−9	−19	−18	+6
8 19	+125	+99	+101	+108	+82	+128	+104	+106	+124	+161	+141	+138	+116
0 19	+301	+240	+228	+230	+185	+222	+210	+207	+252	+365	+328	+320	+252
10 19	+416	+352	+330	+303	+276	**+287**	**+282**	+289	+368	+525	+482	+452	+355
11 19	**+447**	**+400**	**+351**	**+321**	**+276**	+286	+276	**+298**	+391	**+569**	**+520**	**+479**	**+376**
12 19	+394	+356	+315	+268	+243	+231	+235	+241	+355	+516	+484	+431	+331
13 19	+293	+272	+237	+165	+165	+146	+151	+172	+271	+394	+378	+329	+240
14 19	+170	+151	+116	+71	+83	+60	+58	+79	+157	+229	+231	+187	+128
15 19	+43	+35	−10	−24	+1	−23	−20	−2	+40	+70	+80	+56	+17
16 19	−55	−56	−72	−82	−79	−88	−83	−73	−57	−66	−48	−45	−69
17 19	−120	−129	−135	−130	−117	−126	−118	−122	−117	−143	−132	−105	−126
18 19	−164	−166	−167	−174	−157	−164	−147	−140	−140	−181	−174	−144	−161
19 19	−205	−186	**−187**	**−193**	−179	**−181**	**−1 3**	**−163**	−182	−221	−206	−173	−188
20 19	**−211**	−197	−176	−179	**−183**	−168	−159	−160	−194	−250	−218	−191	**−190**
21 19	−196	**−199**	−169	−148	−151	−153	−141	−154	**−197**	**−265**	**−225**	−198	−182
22 19	−176	−174	−145	−131	−111	−127	−112	−135	−178	−248	−225	**−199**	−160
23 19	−165	−152	−124	−95	−89	−92	−92	−104	−160	−229	−214	−192	−138
Range.	658	599	538	514	459	468	445	461	588	834	745	678	566

TABLES 96 & 97.—*Grubb's Horizontal Force Magnetometer.—Showing the mean diurnal inequality of Horizontal Force corrected for temperature for each average month of the periods 1850—1860 and 1861—1871 and for the whole year.*

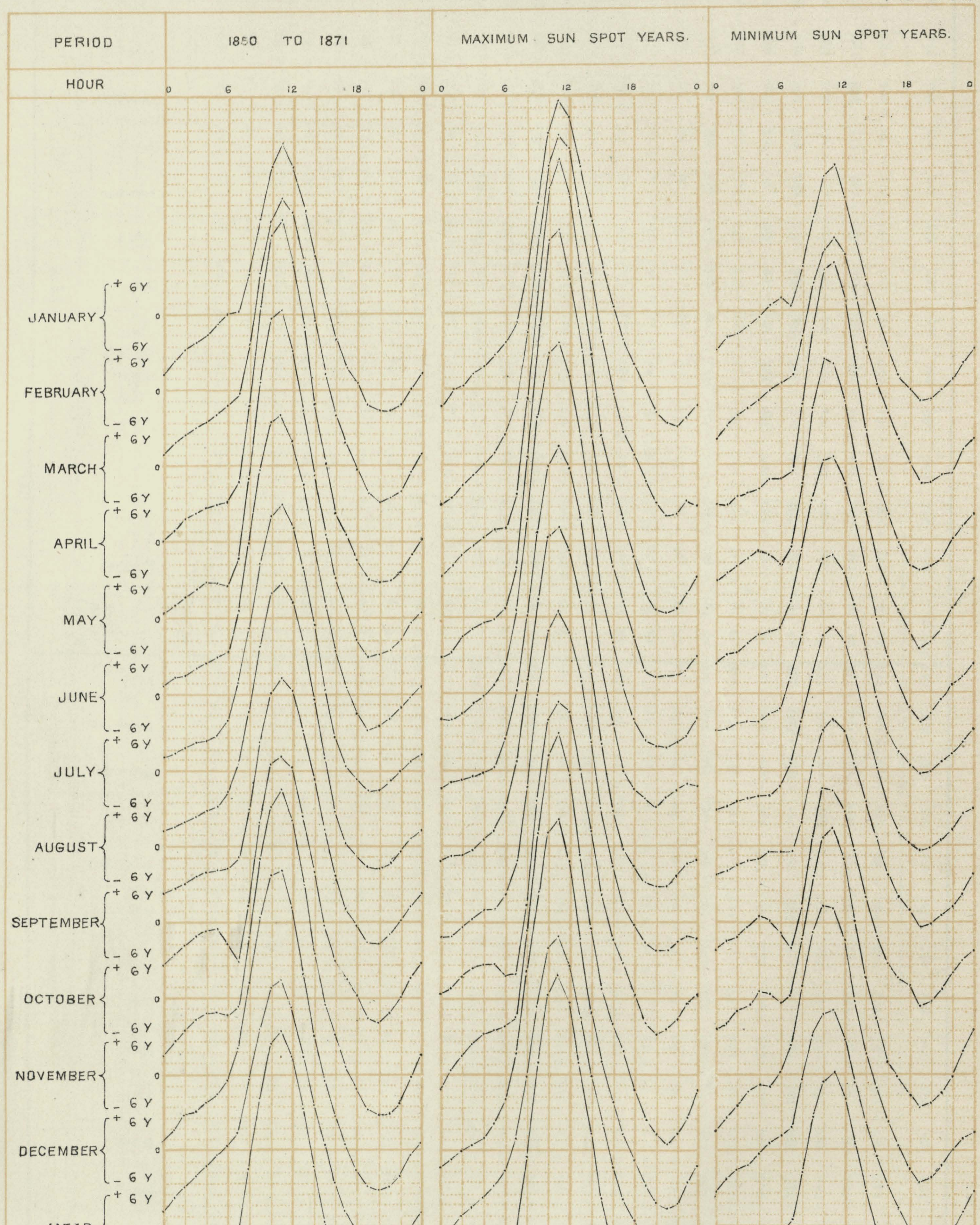
Unity = 0·1γ = ·000001 C. G. S.

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	-107	-109	-118	-107	-101	- 95	-104	- 90	- 65	-116	-112	- 97	-102
1 19	- 72	- 90	-106	- 95	- 94	- 84	- 87	- 82	- 43	- 88	- 88	- 61	- 82
2 19	- 57	- 65	- 86	- 82	- 91	- 76	- 80	- 77	- 18	- 60	- 66	- 41	- 67
3 19	- 45	- 57	- 76	- 57	- 71	- 63	- 71	- 63	- 5	- 40	- 60	- 24	- 53
4 19	- 26	- 49	- 64	- 48	- 62	- 67	- 59	- 54	- 1	- 28	- 48	- 10	- 43
5 19	- 11	- 37	- 61	- 55	- 56	- 58	- 51	- 53	- 10	- 25	- 29	+ 4	- 37
6 19	+ 11	- 21	- 61	- 75	- 56	- 46	- 36	- 57	- 47	- 31	- 6	+ 22	- 34
7 19	- 2	- 1	- 35	- 46	+ 3	+ 14	+ 9	- 42	- 92	- 33	+ 45	+ 33	- 12
8 19	+ 78	+ 81	+103	+101	+120	+114	+ 99	+ 49	+ 14	+104	+166	+126	+ 96
9 19	+181	+208	+286	+277	+256	+223	+215	+184	+168	+249	+281	+213	+228
10 19	+279	+314	+409	+386	+342	+306	+306	+276	+278	+350	+358	+285	+324
11 19	**+321**	**+364**	**+426**	**+393**	**+354**	**+327**	**+322**	**+312**	**+296**	**+388**	**+368**	**+303**	**+348**
12 19	+277	+327	+357	+328	+305	+288	+285	+290	+273	+330	+301	+255	+301
13 19	+190	+234	+243	+221	+225	+219	+220	+222	+191	+207	+185	+171	+211
14 19	+109	+125	+112	+111	+122	+116	+122	+137	+ 99	+ 89	+ 77	+ 87	+109
15 19	+ 28	+ 27	- 7	+ 7	+ 17	+ 7	+ 17	+ 42	- 3	+ 5	- 10	+ 17	+ 12
16 19	- 48	- 51	- 82	- 63	- 60	- 81	- 78	- 42	- 63	- 67	- 81	- 57	- 64
17 19	-107	- 99	-126	-123	-122	-134	-129	-100	- 95	-105	-132	-114	-115
18 19	-136	-154	-176	-174	-182	-158	-157	-127	-132	-154	-183	-165	-158
19 19	-173	-206	-208	-202	**-210**	**-181**	**-175**	-161	**-183**	-196	-212	-202	-192
20 19	-181	**-212**	**-210**	-192	-195	-171	-172	**-168**	-183	-211	**-220**	**-209**	**-194**
21 19	**-188**	-201	-202	-187	-167	-147	-159	-151	-153	**-217**	-209	-202	-182
22 19	-170	-184	-180	-167	-144	-123	-137	-126	-128	-190	-181	-170	-158
23 19	-142	-142	-146	-133	-123	-102	-113	-102	- 86	-150	-135	-134	-126
Range ...	509	576	636	595	564	508	497	480	479	605	588	512	542

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	-111	-122	-145	-153	-141	-126	-122	- 90	- 93	- 92	-136	-126	-121
1 19	- 96	-107	-125	-139	-122	-222	-119	- 71	- 76	- 72	-111	-108	-106
2 19	- 72	- 97	-108	-119	-120	-118	-114	- 55	- 63	- 50	- 82	- 80	- 90
3 19	- 57	- 82	- 99	-110	-112	-107	- 99	- 45	- 45	- 39	- 69	- 62	- 77
4 19	- 45	- 66	- 87	- 96	-101	-100	- 90	- 38	- 28	- 28	- 52	- 43	- 64
5 19	- 24	- 50	- 84	- 93	- 90	- 87	- 79	- 35	- 17	- 27	- 41	- 19	- 54
6 19	- 6	- 38	- 76	- 81	- 64	- 49	- 41	- 20	- 30	- 26	- 17	- 5	- 38
7 19	+ 14	- 5	- 17	- 12	+ 28	+ 31	+ 26	+ 6	- 43	+ 2	+ 50	+ 42	+ 10
8 19	+ 73	+ 92	+131	+139	+161	+136	+124	+ 88	+ 50	+124	+174	+133	+119
9 19	+174	+225	+302	+318	+291	+258	+244	+203	+197	+271	+299	+236	+251
10 19	+271	+318	+439	+445	+386	+352	+348	+288	+312	+361	+382	+316	+351
11 19	**+317**	**+357**	**+469**	**+467**	**+396**	**+374**	**+372**	**+315**	**+337**	**+388**	**+386**	**+332**	**+376**
12 19	+280	+333	+400	+383	+352	+325	+333	+287	+301	+324	+312	+272	+325
13 19	+195	+244	+271	+261	+261	+254	+251	+212	+207	+206	+189	+177	+227
14 19	+106	+135	+127	+136	+139	+144	+144	+114	+ 94	+ 80	+ 73	+ 81	+114
15 19	+ 23	+ 40	+ 8	+ 22	+ 24	+ 14	+ 28	+ 22	- 5	- 24	- 13	+ 7	+ 12
16 19	- 36	- 33	- 81	- 67	- 56	- 75	- 77	- 64	- 74	- 99	- 74	- 53	- 66
17 19	- 90	- 95	-130	-124	-120	-128	-138	-131	-107	-139	-126	-104	-119
18 19	-123	-136	-171	-181	-152	-157	-158	-164	-137	-178	-166	-129	-154
19 19	-153	-179	-208	**-219**	**-198**	-173	-176	**-190**	-171	-208	-200	-162	-186
20 19	**-172**	**-195**	-216	-215	-196	**-181**	**-185**	-187	**-180**	**-215**	-206	-176	**-194**
21 19	-165	-192	**-217**	-202	-197	-169	-178	-171	-177	-206	-209	**-182**	-189
22 19	-156	-193	-202	-186	-175	-156	-154	-143	-146	-177	**-218**	-176	-173
23 19	-127	-156	-175	-161	-160	-137	-137	-115	-114	-139	-164	-153	-145
Range ...	489	552	686	686	594	555	557	505	517	603	604	514	570

COLABA OBSERVATORY
Horizontal Force Diurnal Inequality
Magnetometer.

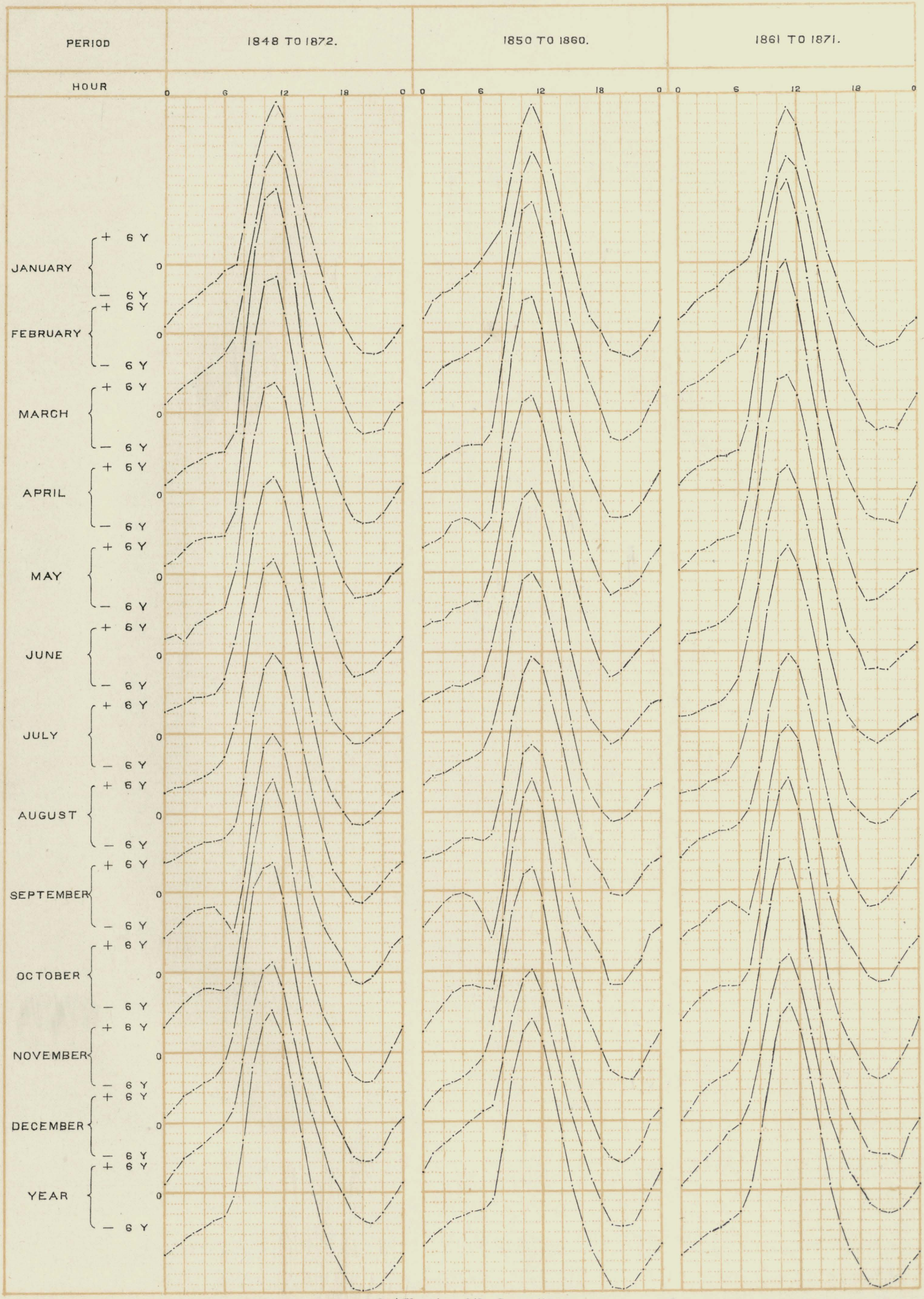
Plate 17.



Govt. Photozinco: Office, Poona, 1902.

Colaba Observatory
Horizontal Force Diurnal Inequality
(Magnetometer)

Plate 18.

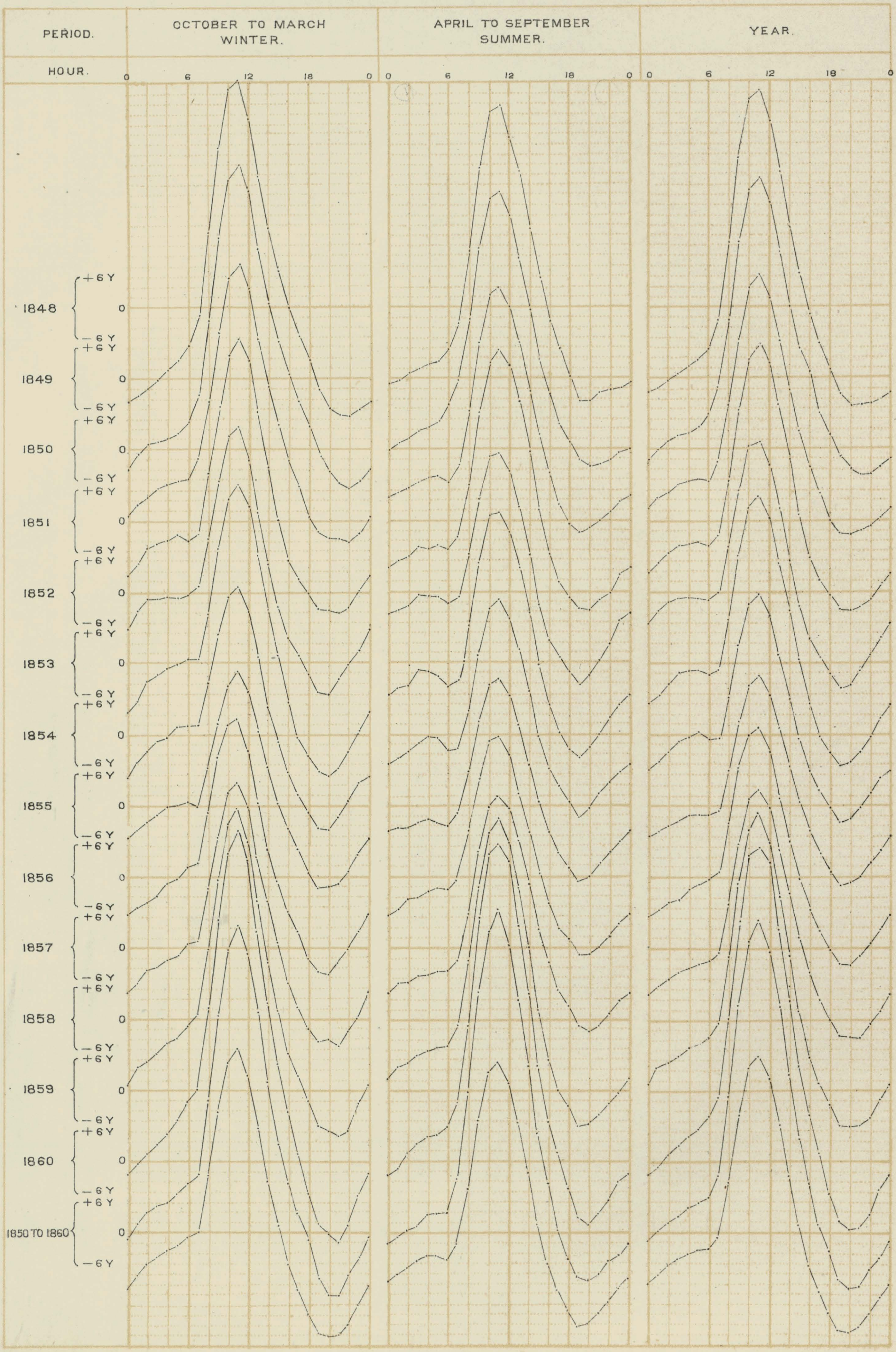


Govt. Photozinco; Office, Poona, 1909.

Colaba Observatory

Horizontal Force Diurnal Inequality.
(Magnetometer.)

Plate 19.

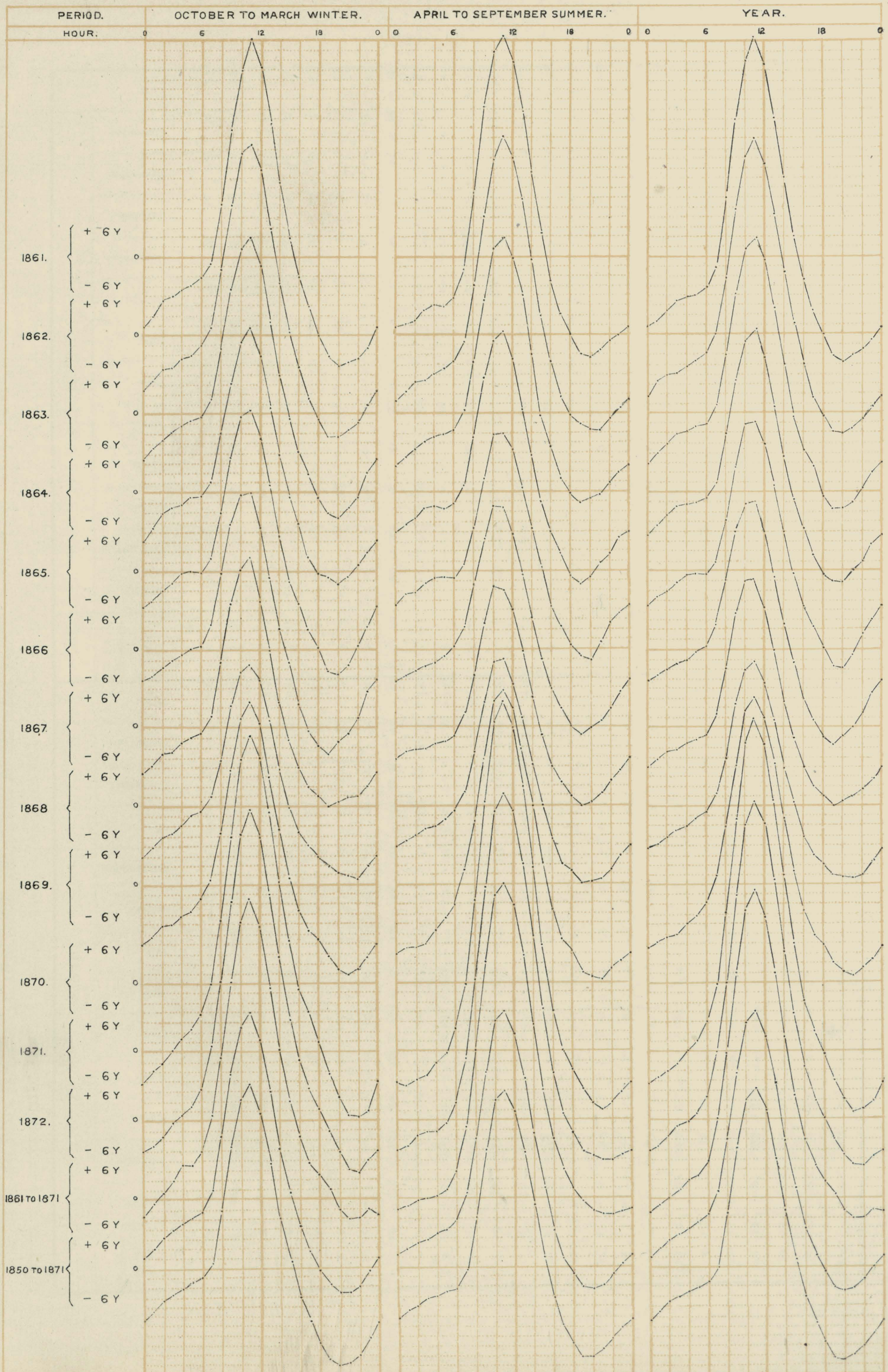


Govt. Photozinco. Office, Poona, 1909.

Colaba Observatory

Horizontal Force Diurnal Inequality (Magnetometer.)

Plate 20.



TABLES 98 & 99.—*Grubb's Horizontal Force Magnetometer—Showing the mean diurnal inequality of Horizontal Force corrected for temperature for each average month of the maximum sun-spot years (1848, 1849, 1859, 1860, 1861, 1870, 1871, 1872) and minimum sun-spot years (1854, 1855, 1856, 1866, 1867), and for the whole year.*

Unity = 0·1γ = ·000001 C. G. S.

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	−173	−211	−203	−212	−187	−166	−165	−167	−130	−162	−168	−169	−176
1 19	−144	−200	−181	−202	−187	157	−157	−161	−120	−132	−152	−142	−161
2 19	−133	−178	−163	−173	−174	−154	−155	−145	− 99	−105	−139	−117	−145
3 19	−111	−157	−147	−160	−154	−148	−147	−134	− 82	− 82	−130	−102	134
4 19	− 95	−137	−132	−148	−144	−142	−127	−118	− 77	− 61	−115	− 82	−115
5 19	− 78	−115	−120	142	−127	−133	−111	−117	− 75	− 55	− 89	− 68	−102
6 19	− 53	− 81	−116	−120	− 85	− 81	− 67	− 87	− 95	− 50	− 42	− 34	− 76
7 19	− 18	− 26	− 54	− 48	+ 13	+ 7	+ 19	− 28	− 94	− 34	+ 38	+ 23	− 17
8 19	+ 80	+107	+124	+157	+180	+145	+165	+110	+ 31	+126	+191	+139	+130
9 19	+205	+282	+351	+400	+368	+296	+314	+279	+226	+307	+338	+266	+303
10 19	+333	+413	+514	+553	+486	+415	+427	+394	+372	+445	+447	+371	+431
11 19	**+392**	**+470**	**+564**	**+573**	**+502**	**+455**	**+445**	**+433**	**+406**	**+488**	**+470**	**+397**	**+466**
12 19	+361	+445	+496	+483	+442	+414	+402	+393	+388	+411	+390	+340	+414
13 19	+270	+338	+359	+350	+332	+321	+310	+305	+281	+265	+250	+246	+302
14 19	+169	+206	+203	+193	+187	+189	+182	+191	+168	+126	+119	+139	+173
15 19	+ 81	+ 95	+ 58	+ 53	+ 51	+ 55	+ 50	+ 72	+ 53	+ 20	+ 25	+ 48	+ 55
16 19	+ 12	− 11	− 34	− 43	− 46	− 58	− 77	− 36	− 30	− 44	− 49	− 30	− 37
17 19	− 50	− 80	−100	−113	−123	−140	−145	−107	− 74	− 94	−109	− 87	−102
18 19	− 93	−119	−167	−173	−185	−174	−179	−148	−131	−166	−156	−124	−151
19 19	−139	−170	−236	−235	−227	−191	−203	−179	−187	−220	−209	−171	−197
20 19	−181	−210	−265	**−246**	−238	**−202**	**−212**	−192	**−202**	−248	−236	−202	−219
21 19	−204	**−233**	**−272**	−245	**−240**	−187	−211	**−193**	−193	**−269**	**−245**	**−225**	**−226**
22 19	**−212**	−231	−265	−245	−231	−175	−194	−174	−176	−246	−235	−210	−216
23 19	−193	−204	−239	−236	−218	−163	−174	−165	−148	−215	−198	−197	−196
Range ...	604	703	836	819	742	657	657	626	608	757	715	622	692

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 70	− 96	− 76	− 71	− 81	− 66	− 72	− 52	− 54	− 55	−103	− 76	− 73
1 19	− 44	− 71	− 78	− 58	− 67	− 61	− 65	− 43	− 36	− 46	− 78	− 53	− 58
2 19	− 40	− 50	− 58	− 44	− 61	− 53	− 56	− 33	− 25	− 20	− 55	− 37	− 44
3 19	− 25	− 39	− 51	− 30	− 48	− 50	− 51	− 30	− 6	− 8	− 30	− 27	− 33
4 19	− 10	− 23	− 44	− 19	− 31	− 51	− 49	− 23	+ 10	+ 15	− 19	− 7	− 21
5 19	+ 10	− 4	− 28	− 23	− 22	− 39	− 45	− 13	+ 5	+ 9	− 20	+ 13	− 13
6 19	+ 25	+ 7	− 28	− 41	− 20	− 27	− 30	− 12	− 16	− 3	+ 1	+ 26	− 10
7 19	+ 10	+ 23	− 12	− 9	+ 33	+ 31	+ 14	− 11	− 46	+ 8	+ 55	+ 44	+ 12
8 19	+ 81	+ 97	+109	+106	+123	+107	+ 88	+ 43	+ 29	+114	+163	+131	+ 99
9 19	+175	+191	+251	+243	+218	+189	+175	−149	+160	+226	+264	+212	+204
10 19	+250	+253	+357	**+332**	+287	+250	+249	+216	**+248**	+299	**+314**	+255	+276
11 19	**+272**	**+276**	**+370**	+324	**+291**	**+258**	**+264**	**+236**	+245	**+320**	+309	**+260**	**+285**
12 19	+210	+245	+298	+254	+244	+224	+237	+211	+203	+257	+246	+202	+236
13 19	+136	+165	+174	+147	+176	+164	+171	+151	+131	+142	+137	+127	+152
14 19	+ 59	+ 72	+ 61	+ 54	+ 87	+ 81	+ 88	+ 84	+ 48	+ 40	+ 38	+ 51	+ 64
15 19	− 9	+ 4	− 29	− 38	− 4	− 8	+ 7	+ 16	− 25	− 35	− 22	− 11	− 13
16 19	− 72	− 49	− 94	− 89	− 71	− 74	− 67	− 50	76	−118	− 85	− 63	− 76
17 19	−123	− 95	−142	−123	−116	−109	−114	− 92	−100	−141	−132	−105	−116
18 19	−141	−140	−185	−168	−165	−132	−132	−117	−118	−179	−179	−142	−150
19 19	**−163**	**−179**	**−193**	**−197**	**−191**	**−144**	**−148**	**−148**	**−153**	**−199**	**−200**	−177	**−174**
20 19	−160	−174	−185	−181	−177	−142	−143	−140	−142	−193	−186	**−180**	−167
21 19	−144	−160	−173	−159	−151	−125	−126	−127	−120	−170	−166	−171	−149
22 19	−126	−157	−135	−118	−122	−114	−105	−110	− 93	−141	−135	−147	−125
23 19	− 97	−113	− 97	− 86	−106	− 91	− 80	− 83	− 70	− 96	−115	−110	− 95
Range ...	435	455	563	529	482	402	412	384	401	519	514	440	459

TABLES 100 & 101.—*Grubb's Horizontal Force Magnetometer—Showing the mean diurnal inequality of Horizontal Force corrected for temperature for each average month of the periods 1848—1872 and 1850—1871, and for the whole year.*

Unity = 0·1γ = ·000001 C. G. S.

Bombay Civil Time.	MONTH.												
H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 120	− 136	− 140	− 139	− 126	− 113	− 117	− 97	− 86	− 105	− 127	− 119	− 119
1 19	− 95	− 116	− 124	− 127	− 119	− 105	− 108	− 86	− 66	− 81	− 103	− 90	− 102
2 19	− 78	− 99	− 105	− 109	− 131	− 99	− 103	− 76	− 47	− 58	− 81	− 67	− 88
3 19	− 63	− 85	− 94	− 91	− 97	− 88	− 93	− 63	− 32	− 40	− 72	− 53	− 73
4 19	− 47	− 72	− 81	− 82	− 87	− 86	− 82	− 56	− 23	− 27	− 58	− 36	− 61
5 19	− 30	− 57	− 77	− 81	− 73	− 77	− 70	− 53	− 22	− 27	− 43	− 19	− 52
6 19	− 9	− 39	− 74	− 80	− 61	− 50	− 41	− 45	− 46	− 29	− 17	0	− 41
7 19	+ 2	− 5	− 30	− 28	+ 16	+ 22	+ 17	− 20	− 73	− 16	+ 45	+ 32	− 3
8 19	+ 79	+ 91	+ 116	+ 123	+ 144	+ 126	+ 117	+ 72	+ 27	+ 115	+ 170	+ 129	+ 109
9 19	+ 213	+ 226	+ 339	+ 307	+ 281	+ 243	+ 237	+ 200	+ 180	+ 257	+ 333	+ 230	+ 254
10 19	+ 285	+ 329	+ 431	+ 428	+ 374	+ 333	+ 334	+ 291	+ 296	+ 358	+ 374	+ 308	+ 345
11 19	**+ 331**	**+ 371**	**+ 457**	**+ 439**	**+ 385**	**+ 355**	**+ 352**	**+ 321**	**+ 322**	**+ 389**	**+ 384**	**+ 324**	**+ 369**
12 19	+ 291	+ 343	+ 387	+ 365	+ 335	+ 314	+ 307	+ 295	+ 291	+ 326	+ 310	+ 271	+ 320
13 19	+ 203	+ 249	+ 265	+ 250	+ 248	+ 242	+ 239	+ 221	+ 206	+ 203	+ 189	+ 181	+ 225
14 19	+ 115	+ 139	+ 127	+ 129	+ 133	+ 133	+ 134	+ 129	+ 105	+ 81	+ 77	+ 92	+ 116
15 19	+ 32	+ 44	+ 9	+ 20	+ 23	+ 15	+ 26	+ 35	+ 3	− 11	− 6	+ 19	+ 17
16 19	− 34	− 35	− 73	− 62	− 57	− 75	− 74	− 49	− 60	− 80	− 74	− 50	− 60
17 19	− 88	− 93	− 122	− 121	− 124	− 132	− 129	− 110	− 95	− 119	− 125	− 104	− 113
18 19	− 121	− 138	− 171	− 174	− 176	− 158	− 155	− 141	− 130	− 164	− 169	− 140	− 153
19 19	− 157	− 184	− 209	**− 208**	**− 205**	**− 177**	− 176	− 172	− 172	− 200	− 202	− 175	− 186
20 19	− 175	**− 197**	**− 217**	− 205	− 200	− 176	**− 179**	**− 175**	**− 177**	**− 213**	**− 213**	− 190	**− 193**
21 19	**− 179**	− 194	− 214	− 197	− 186	− 159	− 168	− 160	− 163	− 213	− 212	**− 194**	− 187
22 19	− 172	− 189	− 197	− 182	− 166	− 143	− 148	− 135	− 140	− 185	− 188	− 178	− 169
23 19	− 145	− 154	− 168	− 156	− 149	− 124	− 128	− 113	− 105	− 147	− 151	− 149	− 141
Range ...	510	568	674	647	590	532	531	496	499	602	597	518	562

Bombay Civil Time.	MONTH.												
H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	− 109	− 116	− 132	− 130	− 121	− 111	− 112	− 89	− 79	− 102	− 125	− 111	− 111
1 19	− 84	− 99	− 116	− 118	− 108	− 103	− 102	− 77	− 59	− 79	− 100	− 83	− 94
2 19	− 65	− 80	− 96	− 101	− 105	− 96	− 97	− 66	− 40	− 55	− 73	− 61	− 78
3 19	− 52	− 70	− 88	− 82	− 91	− 85	− 84	− 54	− 25	− 39	− 64	− 43	− 65
4 19	− 36	− 58	− 75	− 71	− 81	− 83	− 74	− 46	− 15	− 28	− 50	− 27	− 54
5 19	− 18	− 44	− 72	− 73	− 72	− 73	− 64	− 43	− 13	− 26	− 35	− 8	− 45
6 19	+ 2	− 29	− 68	− 78	− 60	− 48	− 39	− 39	− 38	− 29	− 11	+ 8	− 36
7 19	+ 6	− 3	− 27	− 28	+ 15	+ 22	+ 18	− 18	− 69	− 15	+ 48	+ 37	− 1
8 19	+ 77	+ 86	+ 117	+ 120	+ 139	+ 125	+ 112	+ 68	+ 31	+ 113	+ 169	+ 129	+ 107
9 19	+ 177	+ 217	+ 294	+ 298	+ 273	+ 242	+ 230	+ 194	+ 182	+ 260	+ 290	+ 225	+ 240
10 19	+ 275	+ 316	+ 425	+ 416	+ 364	+ 329	+ 328	+ 283	+ 295	+ 356	+ 367	+ 300	+ 338
11 19	**+ 319**	**+ 359**	**+ 456**	**+ 429**	**+ 374**	**+ 350**	**+ 348**	**+ 313**	**+ 317**	**+ 388**	**+ 377**	**+ 316**	**+ 362**
12 19	+ 279	+ 329	+ 379	+ 356	+ 328	+ 308	+ 310	+ 288	+ 286	+ 327	+ 307	+ 263	+ 313
13 19	+ 192	+ 238	+ 257	+ 241	+ 243	+ 236	+ 235	+ 216	+ 199	+ 207	+ 188	+ 173	+ 219
14 19	+ 107	+ 129	+ 119	+ 123	+ 130	+ 129	+ 132	+ 125	+ 96	+ 84	+ 74	+ 84	+ 111
15 19	+ 25	+ 33	+ 1	+ 14	+ 21	+ 10	+ 23	+ 33	− 4	− 10	− 12	+ 12	+ 12
16 19	− 43	− 42	− 81	− 65	− 59	− 78	− 77	− 53	− 69	− 82	− 78	− 56	− 65
17 19	− 99	− 98	− 128	− 124	− 125	− 131	− 133	− 115	− 101	− 122	− 129	− 109	− 118
18 19	− 129	− 145	− 174	− 178	− 177	− 158	− 158	− 145	− 135	− 166	− 176	− 146	− 157
19 19	− 163	− 192	− 207	**− 209**	**− 205**	**− 176**	− 177	− 175	− 177	− 203	− 206	− 181	− 189
20 19	**− 177**	**− 203**	**− 213**	− 203	− 196	− 175	**− 179**	**− 177**	**− 181**	**− 213**	**− 213**	**− 193**	**− 194**
21 19	− 176	− 196	− 210	− 195	− 182	− 158	− 168	− 161	− 164	− 211	− 209	− 191	− 185
22 19	− 164	− 188	− 191	− 177	− 160	− 140	− 146	− 134	− 137	− 183	− 186	− 172	− 165
23 19	− 135	− 149	− 160	− 147	− 142	− 120	− 125	− 110	− 100	− 145	− 149	− 139	− 135
Range ...	496	562	669	638	579	526	527	490	498	601	590	509	556

TABLES 102 & 103.—*Grubb's Horizontal Force Magnetometer – Showing the mean diurnal inequality of Horizontal Force corrected for temperature for each average month of the periods 1848—1865 and 1866—1872, and for the whole year.*

Unity = 0·1γ = ·000001 C. G. S.

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	-117	-125	-132	-127	-111	-103	-113	-93	-74	-103	-115	-112	-110
1 19	-84	-108	-120	-114	-101	-93	-99	-82	-53	-76	-87	-81	-91
2 19	-71	-82	-100	-98	-97	-85	-93	-74	-31	-53	-68	-55	-76
3 19	-55	-73	-89	-75	-79	-70	-81	-60	-20	-35	-64	-41	-62
4 19	-40	-64	-77	-68	-71	-70	-71	-51	-14	-25	-51	-23	-52
5 19	-23	-51	-74	-72	-65	-64	-62	-50	-13	-23	-33	-8	-45
6 19	-4	-39	-74	-76	-59	-44	-41	-50	-47	-25	-6	+7	-38
7 19	-2	-12	-36	-33	+8	+20	+9	-32	-86	-21	+48	+32	-9
8 19	+76	+81	+114	+116	+132	+120	+102	+61	+17	+113	+174	+129	+103
9 19	+181	+220	+299	+296	+264	+232	+224	+193	+169	+252	+291	+222	+237
10 19	+284	+332	+425	+412	+355	+318	+322	+279	+278	+347	+367	+298	+335
11 19	**+330**	**+380**	**+447**	**+418**	**+366**	**+339**	**+342**	**+310**	**+301**	**+376**	**+377**	**+315**	**+358**
12 19	+291	+348	+377	+346	+318	+298	+303	+288	+276	+314	+299	+263	+310
13 19	+200	+250	+256	+237	+235	+226	+230	+217	+192	+196	+175	+178	+216
14 19	+112	+141	+123	+122	+126	+123	+128	+129	+99	+84	+71	+89	+112
15 19	+32	+42	+6	+17	+18	+6	+22	+37	0	-5	-12	+19	+15
16 19	-32	-37	-74	-61	-59	-80	-75	-40	-57	-72	-79	-52	-60
17 19	-92	-101	-121	-122	-126	-133	-127	-103	-88	-113	-130	-104	-113
18 19	-127	-150	-171	-179	-181	-160	-152	-136	-127	-165	-179	-150	-156
19 19	-168	-196	-211	**-209**	**-211**	**-181**	-174	-167	-170	-202	-212	-187	-191
20 19	**-184**	**-207**	**-215**	-199	-198	-176	**-175**	**-173**	**-174**	**-212**	**-221**	**-201**	**-194**
21 19	-184	-203	-208	-191	-173	-153	-161	-155	-157	-210	-216	-193	-184
22 19	-172	-191	-187	-175	-151	-132	-143	-129	-131	-182	-185	-174	-163
23 19	-144	-155	-160	-148	-132	-112	-123	-106	-94	-141	-143	-140	-133
Range ...	514	587	662	627	577	520	517	483	475	588	598	515	552

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 19	-129	-165	-157	-171	-165	-140	-130	-106	-117	-113	-156	-137	-140
1 19	-118	-151	-131	-159	-156	-133	-135	-95	-100	-96	-142	-118	-128
2 19	-97	-141	-115	-135	-153	-136	-130	-81	-87	-69	-116	-99	-113
3 19	-83	-113	-108	-134	-145	-137	-125	-75	-63	-54	-94	-85	-101
4 19	-66	-90	-97	-118	-126	-130	-111	-69	-45	-29	-77	-67	-85
5 19	-46	-70	-84	-107	-92	-112	-94	58	-36	-33	-67	-44	-70
6 19	-22	-40	-75	-90	-66	-67	-43	-35	-43	-35	-44	-21	-48
7 19	+15	+14	-14	-17	+36	-8	+41	+11	-40	+2	+37	+32	+9
8 19	+86	+114	+127	+142	+178	+142	+156	+101	+56	+119	+162	+128	+126
9 19	+192	+240	+301	+334	+325	+270	+271	+222	+212	+271	+297	+247	+265
10 19	+288	+322	+446	+468	+424	+373	+366	+323	+345	+388	+388	+334	+372
11 19	**+330**	**+352**	**+482**	**+493**	**+432**	**+394**	**+379**	**+350**	**+369**	**+423**	**+403**	**+349**	**+396**
12 19	+302	+330	+414	+412	+381	+354	+344	+315	+331	+357	+341	+292	+348
13 19	+222	+247	+290	+283	+283	+281	+261	+233	+239	+220	+219	+193	+246
14 19	+121	+134	+140	+147	+154	+162	+150	+129	+118	+73	+94	+99	+127
15 19	+34	+50	+18	+24	+37	+38	+35	+29	+15	-27	+6	+20	+23
16 19	-38	-26	-67	-65	-52	-65	-73	-71	-70	-98	-64	-46	-61
17 19	-83	-74	-126	-119	-117	-126	-136	-130	-111	-135	-110	-91	-113
18 19	-104	-106	-172	-162	-162	-152	-163	-156	-138	-160	-142	-112	-144
19 19	-127	-151	-203	-209	-191	-165	-184	**-180**	-177	-195	-177	-143	-175
20 19	-152	-170	-220	**-221**	-204	**-177**	**-188**	-177	**-182**	-211	-190	-165	-188
21 19	-167	-170	**-230**	-213	**-218**	-176	-187	-173	-178	**-218**	**-203**	**-194**	**-194**
22 19	**-170**	**-181**	-222	-199	-205	-170	-163	-152	-158	-193	-195	-188	-183
23 19	-146	-152	-190	-178	-194	-150	-141	-130	-134	-163	-174	-173	-160
Range ...	500	533	712	714	650	571	567	530	551	641	606	543	590

been adopted in the reductions, and the inequalities so derived after the application of these corrections appear in tables 90 to 103.

The simultaneous records for the year 1872 have so far furnished data for connecting the two series. How far these corrections have enabled the earlier and later series to be accurately linked up is best seen—and it is the only method that could be thought of—from the comparison of the mean diurnal variations of the five 11-year periods with each other, of which the first two have been derived from the indications of Grubb's Magnetometer duly corrected, and the last three from those of the magnetograph. The amplitudes should fairly closely be proportional to the solar spot numbers with which we know they are in some way intimately connected. Taking the mean diurnal variation of the five 11-year cycles as our average standard, the excess variations over this of each of the five 11-year cycles are given in table 104. The character and the amplitudes of the excess variations when the last three are compared among themselves, and then with the first two, indicate how far the results of Grubb's record might be depended upon as being free from any serious errors. It will be seen later that these excess inequalities correctly indicate the relative intensity of the incidence of the 11-year period disturbance on each of the five 11-year groups (*vide* Chapters V and VI, Part II), the excesses for 1894—1904 showing the least secular disturbance, while those for 1861—1871 the greatest effect.

TABLE 104.—*Comparison of the Diurnal Inequalities by Grubb's Horizontal Force Magnetometer and Horizontal Force Magnetograph.*

Unity = 0·1γ = ·000001 C. G. S.

Bombay Civil Time.	Diurnal Inequalities.							Excesses over the mean of 1850-1904.				
	1850-1860.	1861-1871.	1872-1882.	1883-1993.	1894-1904.	Mean, 1850-1904.	Mean, 1872-1904.	1850-1860.	1861-1871.	1872-1882.	1883-1893.	1894-1904.
H. M.												
0 19 ...	−102	−121	−113	−106	− 92	−107	−103	+ 6	−14	− 6	+ 1	+15
1 19 ...	− 82	−106	−104	− 99	− 85	− 95	− 95	+12	−11	− 9	− 4	+10
2 19 ...	− 67	− 90	− 96	− 90	− 78	− 84	− 88	+17	− 6	−12	− 6	+ 6
3 19 ...	− 53	− 77	− 86	− 81	− 73	− 74	− 81	+21	− 3	−12	− 7	+ 1
4 19 ...	− 43	− 64	− 78	− 73	− 68	− 65	− 73	+22	+ 1	−13	− 8	− 3
5 19 ...	− 37	− 54	− 69	− 63	− 62	− 57	− 65	+21	+ 3	−12	− 6	− 5
6 19 ...	− 34	− 38	− 50	− 48	− 45	− 43	− 48	+ 9	+ 5	− 7	− 5	− 2
7 19 ...	− 12	+ 10	0	+ 1	− 2	− 1	0	−11	+11	+ 1	+ 2	− 1
8 19 ...	+ 96	+119	+ 91	+ 89	+ 79	+ 95	+ 86	+ 2	+24	− 4	− 6	−16
9 19 ...	+228	+251	+201	+194	+177	+210	+191	+18	+41	− 9	−16	−33
10 19 ...	+324	+351	+284	+282	+255	+299	+273	+25	+52	−15	−17	−44
11 19 ...	+348	+376	+312	+312	+284	+326	+303	+20	+50	−14	−14	−42
12 19 ...	+301	+325	+274	+276	+251	+285	+267	+16	+40	−11	− 9	−34
13 19 ...	+211	+227	+191	+196	+175	+200	+187	+11	+27	− 9	− 4	−25
14 19 ...	+109	+114	+ 97	+ 96	+ 87	+101	+ 94	+ 8	+13	− 4	− 5	−14
15 19 ...	+ 12	+ 12	+ 13	+ 10	+ 11	+ 12	+ 12	+ 1	0	+ 1	− 2	− 1
16 19 ...	− 64	− 66	− 48	− 60	− 49	− 57	− 52	− 7	−19	+ 9	− 3	+ 8
17 19 ...	−115	−119	− 84	− 92	− 82	− 98	− 85	−17	−21	+14	+ 6	+16
18 19 ...	−158	−154	−104	−109	−101	−125	−105	−34	−29	+21	+16	+24
19 19 ...	−192	−186	−117	−123	−115	−147	−118	−45	−39	+30	+24	+32
20 19 ...	−194	−194	−129	−133	−123	−155	−129	−39	−39	+26	+22	+32
21 19 ...	−182	−189	−135	−134	−123	−153	−130	−29	−36	+18	+19	+30
22 19 ...	−158	−173	−133	−131	−117	−142	−127	−16	−31	+ 9	+11	+25
23 19 ...	−126	−145	−123	−116	−104	−123	−115	− 2	−22	0	+ 7	+19
Range ...	542	570	447	446	407	...	...	...	...	...	...	...
Mean observed sun-spot number.	48	58	37	39	30	...	...	...	...	...	...	...

5. *The Zero of Grubb's Magnetometer.*

160. Having secured corrections for the uncompensated effects of temperature in the diurnal inequality, we have next to see how far does this defect affect the monthly values of zeros. A glance at table 77 shows that the average monthly values of the zeros given at the bottom of the table have a large annual variation (*vide* fig. X, plate 2). We have seen in the discussion of the magnetograph zero that due to difference in position there may exist a *minute* variation (*vide* fig. IX, plate 2) set up by actual magnetic causes. But such a large annual fluctuation as ±15γ in the Grubb's zero curve cannot possibly be due to such a cause and must be ascribed to some inherent defect in the instrument itself. That the temperature of the magnet in the Grubb's enclosure fails to be correctly measured in its *diurnal* march by the attached thermometer has been proved by experiments and referred to in paragraph 151. A similar investigation in regard to its seasonal march extending the observations of the attached thermometer and that in contact with the magnet as in experiment above referred to, was conducted throughout the year, continuing the observations of the thermometers five times a day at 6, 10, 14, 16, and 22 hours, from which the monthly means, duly corrected

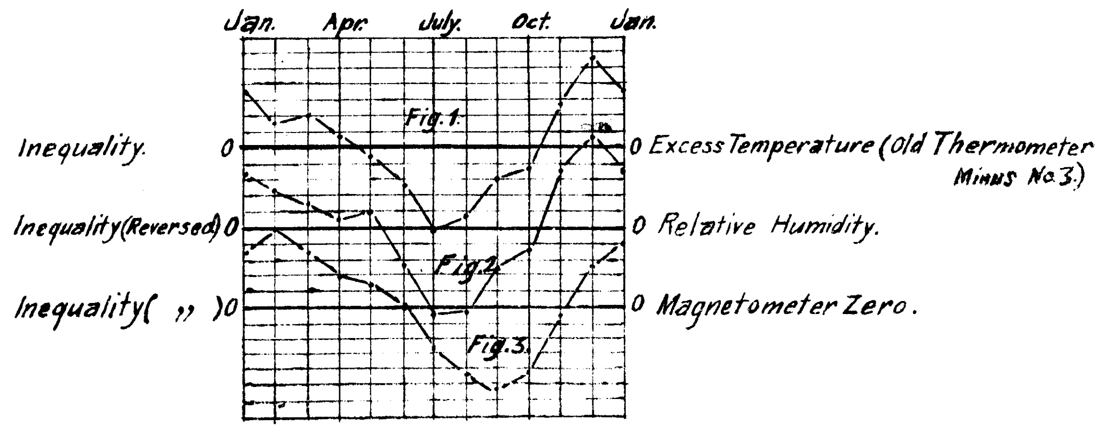
Annual Variation of Zero.

for excess of 24 hours over five, were obtained. However, as the variation instrument is standardised by absolute observations the mean time of which falls at 14 hours, the results of observations at that hour alone, are used for the discussion and given in table below.

TABLE 105.

			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
			°	°	°	°	°	°	°	°	°	°	°	°	°
1	Thermometer No. 3.	Monthly means ...	77·72	77·84	79·54	84·90	86·42	85·86	82·88	80·85	82·78	84·65	83·93	79·43	82·23
2		Annual inequality ...	− 4·51	− 4·39	− 2·69	+ 2·67	+ 4·19	+ 3·63	+ 0·65	− 1·38	+ 0·55	+ 2·42	+ 1·70	− 2·80	...
3	Old Thermometer.	Monthly means ...	79·49	79·44	81·17	86·39	87·80	87·06	83·78	81·85	84·01	85·95	85·65	81·39	83·66
4		Annual inequality ...	− 4·17	− 4·22	− 2·49	+ 2·73	+ 4·14	+ 3·40	+ 0·12	− 1·81	+ 0·35	+ 2·29	+ 1·99	− 2·27	...
5	Thermometer No. 1.	Monthly means ...	78·39	78·36	80·09	85·40	86·89	86·20	83·09	81·06	83·14	85·05	84·52	80·13	82·69
6		Annual inequality ...	− 4·30	− 4·33	− 2·60	+ 2·71	+ 4·20	+ 3·51	+ 0·40	− 1·63	+ 0·45	+ 2·36	+ 1·83	− 2·56	...
7	Excess annual inequality, old thermometer minus No. 3.		+ 0·34	+ 0·17	+ 0·20	+ 0·06	− 0·05	− 0·23	− 0·53	− 0·43	− 0·20	− 0·13	+ 0·29	+ 0·53	...
8	Excess annual inequality, old thermometer minus No 1.		+ 0·13	+ 0·11	+ 0·11	+ 0·02	− 0·06	− 0·11	− 0·28	− 0·18	− 0·10	− 0·07	+ 0·16	+ 0·29	...
9	Excess annual inequality, thermometer No. 1 minus No. 3		+ 0·21	+ 0·06	+ 0·09	+ 0·04	+ 0·01	− 0·12	− 0·25	− 0·25	− 0·10	− 0·06	+ 0·13	+ 0·24	...
10	Annual variation of relative humidity of air		− ·095	− ·069	− ·037	− ·022	− ·027	+ ·075	+ ·157	+ ·160	+ ·088	+ ·047	− ·110	− ·163	...

161. The results indicate clearly that the *annual* march of temperature in this instrument likewise suffers from a discrepancy as does the diurnal march. The excess inequality of temperature indicated by the monthly means in the 7th row, giving the excess of the temperature recorded by the old thermometer over that of No. 3 which is in actual contact with the magnet, when compared with the annual variation of relative humidity for the same period drawn reversed, given in the last row (10), shows such a striking parallelism (*vide* the first two figures charted below) as to leave little room for d ubt as regards the connection between the two phenomena. This will presently be referred to.



162. What actually occurs in the enclosure of Grubb's may thus be presumably summarised. As the magnet records a smaller range in the *diurnal* march of temperature supposing that the magnet and the thermometer start with precisely the same temperature, it may happen that after 30 or 31 such cycles of record of the diurnal change (that is after the lapse of a month) the temperature of the magnet in its contracted march, following up the thermometer changes, may have gained or lost on the mean temperature recorded by the thermometer. Obviously the error arising out of this excess or deviation of temperature is carried over to the mean value of the month and does not affect the diurnal inequality, except that a portion of it forms a part of the correction for the aperiodic contribution.

163. Similarly, when the monthly values are treated and the annual variation is derived and corrected by $-(\frac{2n-13}{24})\,s$ for progressive change, the growing or lessening deviation of the temperature of the magnet from that of the thermometer appears finally in the yearly mean. Thus have the diurnal and annual inequalities of the difference effects of the temperature which affect the magnetic inequality, been derived, the secular change in both being eventually transferred to the monthly and yearly mean. It is, of course, arbitrarily assumed throughout the above discussion that this non-cyclic effect in the difference temperature series proceeds from day to day and month to month regularly and at an uniform rate. That such is really the case may be problematic and yet some such assumption is necessary.

164. The large annual inequality shown in table 77 clearly thus indicates the operation of definite causes. During the dry months of the year the magnet on an average appears to record a lower temperature while during the wet monsoon months it stands higher, and yet the parallelism seen in the curves referred to in figures 1 and 2 in paragraph 161 is not quite so closely maintained by the curve of the actual zero given in table 77 which is charted side by side as figure 3. Though fairly parallel this curve is slightly different in phase and shows that some other factors besides humidity control this phenomenon of which the most probable are temperature, and the possible difference, if any, of actual magnetic conditions due to difference of place, all of which together possibly co-operate in determining this deviation curve. Whatever therefore be the cause or causes, and at best they can only be guessed, this annual variation of zero must affect the monthly mean values of force derived from corrections by Grubb's and have to be allowed for. The final table which gives the monthly mean values of force by this instrument is derived as explained in the following paragraph.

165. The annual inequalities of the horizontal force from year to year given in table 106 have in the first instance been derived as usual from the crude monthly mean scale-readings which appear in table 73. These variations are then added to the correct annual mean values of force given in column 17, table 73, and the monthly mean values of force thus derived are given in table 107 which are subsequently corrected for the variation of zero above referred to, and appear in table 108. These are the final monthly means required. It may be noted that they include all small irregularities of instrumental change, from month to month, though the cumulative secular (instrumental) change from year to year has been removed by the adoption of the corrected annual means, leaving other irregular changes, instrumental and magnetic, unaffected. The comparison of the values of these monthly means with the results of observations corrected by the magnetograph given in column 8 of table 13 and collected together in table 240, Part II, shows how far they differ from the latter and thus indicate the character and magnitude of the irregularities. It will however appear from the discussion of the annual variations (charted in plate 9, figures X and XI) derived from these monthly means that when compared with those derived from the absolute determinations in Chapter I, Part II, their general run is fairly correct and the monthly means by this instrument given in table 108 may not wholly be regarded as unreliable after the treatment adopted.

The faulty behaviour of the instrument in recording the diurnal and annual inequalities, and the secular values of force for the whole period during which it had been in action, has been so far referred to in detail. The annual means will be taken up for discussion in Part II.

6. The use of the differential instrument.

166. The use of the differential instrument, by which the diurnal variations have been secured, has already been fully referred to. After 1868, however, as shown in the preamble, it was put to another no less important use—that of supplying corrections for the values of the absolute observations in order to reduce them to the mean of the day. For this purpose it had been the practice throughout to take simultaneous readings at the times of the absolute observations of *this* instrument which was then considered sufficiently accurate for the requirements.

167. A strong suspicion, however, that these corrections, though very small, were not always to be relied upon to the degree of accuracy aimed at, having been created in 1903, simultaneous readings of the magnetograph were supplemented as part of the routine work. The investigations, which followed and resulted subsequently in the detection of the defective working of the instrument and its cause, left no alternative but to revise the whole absolute series. Fresh tabulations, from the date the magnetograph was available, were made at the exact times of the absolute determinations, and the monthly mean values of absolute force were thus re-derived with the help of the magnetograph. These, when compared with the old series of values derived by the aid of Grubb's instrument, at once show that the heavy labour entailed in the re-derivation of the series was well worth taking. The old series corrected by Grubb's and the differences of these from the results derived by the help of magnetograph tabulations are respectively

TABLE 106.—*Variations of monthly mean scale readings of Grubb's H. F. Magnetometer in C. G. S. Units.*

Unity = 0·1γ = ·000001 C. G. S.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
	MONTH.											
1848 ...	- 511	- 371	- 205	- 83	+ 43	+ 158	+ 58	+ 169	+ 504	+ 68	+ 4	+ 169
1849 ...	- 421	- 324	- 126	- 14	+ 68	- 4	+ 32	+ 97	+ 86	+ 137	+ 155	+ 320
1850 ...	- 335	- 238	- 90	- 7	+ 58	+ 50	- 14	+ 58	+ 58	+ 83	+ 198	+ 184
1851 ...	- 1534	- 907	- 414	- 61	+ 173	+ 295	+ 324	+ 360	+ 230	+ 349	+ 637	+ 562
1852 ...	- 310	- 457	- 173	- 166	+ 40	+ 83	+ 108	+ 158	+ 54	+ 191	+ 238	+ 256
1853 ...	- 270	- 215	- 99	- 15	- 29	+ 4	- 18	+ 113	- 73	+ 219	+ 208	+ 197
1854 ...	- 197	- 153	- 106	- 175	- 7	+ 84	- 18	+ 26	- 4	+ 84	+ 197	+ 252
1855 ...	- 128	- 135	- 62	- 33	+ 7	+ 29	- 66	- 29	+ 26	+ 22	+ 139	+ 248
1856 ...	- 331	+ 165	+ 91	+ 108	+ 165	- 17	- 51	- 131	- 148	- 97	+ 85	+ 154
1857 ...	+ 136	+ 221	+ 204	+ 204	+ 62	+ 164	- 11	- 74	- 261	- 176	- 255	- 232
1858 ...	+ 28	+ 101	- 28	- 68	+ 124	+ 11	- 96	- 73	- 141	- 118	+ 175	+ 101
1859 ...	+ 34	- 67	+ 17	00	+ 73	- 17	+ 45	+ 202	- 180	- 224	+ 79	+ 62
1860 ...	+ 11	+ 196	- 84	- 185	- 90	- 22	- 129	- 241	- 146	+ 45	+ 320	+ 325
1861 ...	+ 28	+ 34	+ 34	+ 123	+ 162	- 134	- 17	- 78	- 134	- 84	+ 22	+ 22
1862 ...	+ 11	+ 106	+ 117	+ 106	+ 111	+ 167	- 50	- 223	- 150	- 317	00	+ 100
1863 ...	- 72	- 6	+ 139	+ 50	+ 139	+ 44	- 56	- 134	- 189	- 84	+ 78	+ 106
1864 ...	+ 50	+ 89	+ 28	- 22	- 83	- 161	- 172	- 205	- 200	+ 72	+ 272	+ 339
1865 ...	- 61	+ 44	+ 161	+ 133	+ 150	+ 66	+ 6	- 427	- 166	- 216	+ 11	+ 283
1866 ...	+ 111	+ 28	+ 100	+ 221	+ 304	+ 138	- 199	- 343	- 326	- 293	+ 11	+ 238
1867 ...	+ 61	+ 116	+ 22	+ 50	+ 50	+ 11	- 72	- 160	- 254	- 227	+ 138	+ 271
1868 ...	+ 138	+ 83	+ 99	- 22	+ 55	+ 39	- 72	- 83	- 248	- 193	+ 110	+ 121
1869 ...	+ 16	0	+ 38	- 104	- 55	+ 44	+ 88	- 104	- 247	- 71	+ 176	+ 209
1870 ...	- 115	- 77	+ 16	- 22	+ 187	+ 187	+ 220	- 5	- 269	- 269	- 27	+ 209
1871 ...	0	- 55	+ 5	- 220	+ 170	+ 154	+ 27	- 88	- 60	- 38	- 137	+ 220
1872 ...	+ 192	+ 22	+ 16	+ 104	+ 291	+ 137	- 22	- 192	- 170	- 280	- 22	- 82
1873 ...	- 377	- 354	- 285	- 114	+ 6	- 29	+ 40	+ 69	+ 74	+ 131	+ 320	+ 531
1874 ...	- 92	- 189	- 23	- 115	+ 46	+ 57	+ 17	+ 6	- 6	- 97	+ 92	+ 269
1875 ...	- 46	- 46	- 178	- 52	+ 11	+ 80	- 34	- 11	- 126	- 23	+ 138	+ 253
1876 ...	- 11	- 23	- 34	+ 17	+ 57	+ 80	- 11	- 46	- 92	- 75	+ 46	+ 126
1877 ...	- 11	+ 63	+ 17	0	- 52	- 29	- 23	- 23	- 40	- 46	+ 11	+ 115
1878 ...	+ 34	+ 40	+ 86	+ 63	+ 40	- 6	+ 29	- 63	- 132	- 126	- 46	+ 57
1879 ...	+ 126	+ 218	+ 86	+ 75	- 11	- 63	- 92	- 126	- 212	- 121	0	+ 86
1880 ...	+ 86	+ 224	+ 92	+ 132	+ 80	+ 103	- 6	- 276	- 172	- 132	- 115	- 57
1881 ...	+ 69	- 52	+ 75	+ 57	+ 103	+ 69	- 17	- 6	- 201	- 98	- 63	+ 69
1882 ...	+ 247	+ 212	+ 270	- 40	+ 34	- 6	0	- 155	+ 11	- 195	- 287	- 98
1883 ...	- 17	+ 23	+ 6	0	+ 92	+ 57	- 86	- 40	- 218	- 103	+ 11	+ 253
1884 ...	+ 63	+ 52	- 23	- 17	+ 11	+ 52	- 69	- 23	- 75	- 109	0	+ 167
1885 ...	- 69	+ 98	+ 57	+ 46	- 98	- 69	+ 6	- 126	- 201	- 63	+ 115	+ 299
1886 ...	+ 103	+ 247	+ 178	+ 34	+ 11	+ 29	- 109	- 138	- 109	- 178	- 92	+ 23
1887 ...	0	+ 86	+ 63	+ 6	+ 52	+ 52	- 17	- 98	- 179	- 109	+ 29	+ 132
1888 ...	- 75	+ 29	+ 29	+ 23	+ 29	+ 29	- 23	- 81	- 121	- 58	+ 17	+ 202
1889 ...	+ 167	+ 190	+ 75	+ 92	+ 40	+ 23	- 92	- 138	- 190	- 144	- 75	+ 58
1890 ...	+ 87	+ 185	+ 127	+ 87	+ 64	+ 58	- 35	- 127	- 173	- 197	- 92	+ 52
1891 ...	+ 208	+ 220	+ 127	- 23	- 116	+ 29	- 40	- 139	- 301	- 185	+ 17	+ 156
1892 ...	+ 249	+ 52	- 23	+ 110	+ 6	+ 69	- 162	- 173	- 110	- 197	+ 110	+ 64
1893 ...	+ 70	+ 99	+ 104	+ 110	+ 174	+ 58	- 75	- 197	- 197	- 162	- 58	+ 110
1894 ...	+ 191	+ 58	+ 99	+ 58	+ 209	+ 70	- 180	- 226	- 284	- 81	- 75	+ 151
1895 ...	+ 58	+ 6	+ 46	+ 17	+ 105	+ 70	- 41	- 58	- 105	- 186	- 76	+ 174
1896 ...	+ 87	+ 52	+ 41	+ 81	- 12	+ 105	- 35	- 204	- 204	- 122	+ 52	+ 134
1897 ...	- 29	+ 64	+ 12	- 180	- 105	+ 47	+ 64	- 64	- 47	- 23	+ 134	+ 140
1898 ...	+ 239	+ 227	+ 52	+ 82	+ 105	+ 47	- 35	- 157	- 443	- 192	- 6	+ 76
1899 ...	+ 158	+ 76	+ 35	+ 29	0	+ 12	- 146	- 64	- 128	- 88	+ 18	+ 134
1900 ...	+ 82	+ 128	- 41	- 6	- 88	+ 70	- 18	- 117	- 146	- 105	+ 64	+ 164
1901 ...	+ 135	+ 216	+ 111	+ 82	+ 117	+ 29	- 99	- 181	- 228	- 211	- 53	+ 70
1902 ...	+ 135	+ 158	+ 100	+ 6	+ 82	+ 47	- 53	- 100	- 182	- 146	- 53	+ 6
1903 ...	+ 276	+ 352	+ 282	+ 194	+ 162	+ 70	- 59	- 170	- 211	- 264	- 423	- 229
1904 ...	- 29	+ 94	+ 164	+ 6	- 6	- 6	- 47	- 70	- 100	- 129	- 6	+ 117
1905 ...	+ 76	+ 135	+ 94	+ 59	+ 94	+ 82	- 18	- 153	- 206	- 88	- 171	+ 82

TABLE 107.—*Crude monthly values of Horizontal Force as given by Grubb's H. F. magnetometer in C. G. S. unit.*

Unity $=1\gamma=\cdot00001$ C. G. S.

Years.		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
		Month.											
1848	...	36506	36520	36537	36549	36561	36573	36563	36574	36607	36564	36557	36574
1849	...	36580	36590	36609	36621	36629	36622	36625	36632	36631	36636	36637	36654
1850	...	36653	36662	36677	36685	36692	36691	36685	36692	36692	36694	36706	36704
1851	...	36565	36627	36677	36712	36735	36747	36750	36754	36741	36753	36782	36774
1852	...	36779	36764	36793	36793	36814	36818	36821	36826	36815	36829	36834	36836
1853	...	36813	36819	36830	36839	36837	36840	36838	36851	36833	36862	36861	36860
1854	...	36865	36870	36874	36868	36884	36893	36883	36888	36885	36893	36905	36910
1855	...	36917	36917	36924	36927	36931	36933	36923	36927	36933	36932	36944	36955
1856	...	36920	36969	36962	36964	36969	36951	36948	36940	36938	36943	36961	36968
1857	...	36968	36976	36974	36974	36960	36970	36953	36947	36928	36930	36929	36931
1858	...	36934	36941	36928	36924	36943	36932	36921	36924	36917	36919	36948	36941
1859	...	36955	36945	36954	36952	36959	36950	36956	36972	36934	36930	36960	36958
1860	...	36978	36997	36969	36959	36968	36975	36964	36953	36962	36981	37009	37009
1861	...	37015	37015	37015	37024	37028	36999	37010	37004	36999	37004	37014	37014
1862	...	37032	37042	37043	37042	37042	37048	37026	37009	37016	36999	37031	37041
1863	...	37051	37057	37072	37063	37072	37062	37052	37045	37039	37050	37066	37069
1864	...	37088	37092	37086	37081	37075	37067	37066	37063	37063	37090	37110	37117
1865	...	37113	37123	37135	37132	37134	37126	37120	37076	37102	37097	37120	37147
1866	...	37144	37136	37143	37155	37163	37147	37113	37099	37100	37104	37134	37157
1867	...	37165	37171	37161	37164	37164	37160	37152	37143	37134	37136	37173	37186
1868	...	37191	37181	37187	37175	37182	37181	37170	37169	37152	37158	37188	37189
1869	...	37181	37179	37183	37169	37174	37183	37188	37169	37154	37172	37197	37200
1870	...	37185	37188	37198	37194	37215	37215	37218	37196	37169	37169	37193	37217
1871	...	37217	37212	37217	37195	37234	37232	37220	37208	37211	37213	37203	37239
1872	...	37247	37230	37230	37238	37257	37242	37226	37209	37211	37200	37226	37220
1873	...	37150	37153	37160	37177	37189	37185	37192	37195	37195	37201	37220	37241
1874	...	37240	37230	37247	37238	37254	37255	37251	37250	37248	37239	37258	37276
1875	...	37288	37288	37275	37288	37294	37301	37290	37292	37280	37291	37307	37318
1876	...	37328	37327	37326	37331	37335	37337	37328	37324	37320	37322	37334	37342
1877	...	37346	37353	37349	37347	37342	37344	37345	37345	37343	37342	37348	37358
1878	...	37364	37365	37370	37367	37365	37360	37364	37355	37348	37348	37356	37367
1879	...	37382	37391	37378	37376	37368	37363	37360	37356	37348	37357	37369	37378
1880	...	37378	37391	37378	37382	37377	37379	37368	37341	37352	37356	37358	37363
1881	...	37377	37365	37377	37376	37380	37377	37368	37369	37350	37360	37364	37377
1882	...	37381	37377	37383	37352	37359	37355	37356	37341	37357	37337	37327	37346
1883	...	37367	37371	37370	37369	37378	37375	37360	37365	37347	37359	37370	37394
1884	...	37403	37402	37395	37395	37398	37402	37390	37395	37390	37386	37397	37414
1885	...	37405	37422	37418	37417	37402	37405	37413	37399	37392	37406	37423	37442
1886	...	37426	37441	37434	37419	37417	37419	37405	37402	37405	37398	37407	37418
1887	...	37418	37427	37424	37419	37423	37423	37416	37408	37400	37407	37421	37431
1888	...	37420	37430	37430	37429	37430	37430	37425	37419	37415	37421	37429	37447
1889	...	37453	37455	37443	37445	37440	37438	37427	37422	37417	37422	37429	37442
1890	...	37449	37458	37453	37449	37446	37446	37437	37427	37423	37420	37431	37445
1891	...	37453	37454	37445	37430	37420	37435	37428	37418	37402	37414	37434	37448
1892	...	37437	37417	37410	37423	37413	37419	37396	37395	37401	37392	37423	37418
1893	...	37429	37432	37432	37433	37439	37428	37415	37402	37402	37406	37416	37433
1894	...	37432	37419	37423	37419	37434	37420	37395	37390	37385	37405	37406	37428
1895	...	37432	37427	37431	37428	37436	37433	37422	37420	37416	37407	37418	37443
1896	...	37438	37434	37433	37437	37428	37439	37426	37409	37409	37417	37434	37442
1897	...	37439	37448	37443	37424	37432	37447	37448	37436	37437	37440	37455	37456
1898	...	37465	37464	37446	37449	37451	37446	37438	37425	37397	37422	37440	37449
1899	...	37451	37443	37438	37438	37435	37436	37420	37429	37422	37426	37437	37448
1900	...	37454	37459	37442	37445	37437	37453	37444	37434	37431	37436	37452	37462
1901	...	37459	37468	37457	37454	37458	37449	37436	37428	37423	37425	37441	37453
1902	...	37448	37451	37445	37436	37443	37440	37430	37425	37417	37420	37430	37436
1903	...	37440	37447	37440	37431	37428	37419	37406	37395	37391	37386	37370	37389
1904	...	37395	37407	37414	37399	37397	37397	37393	37391	37388	37385	37397	37410
1905	...	37398	37403	37399	37396	37399	37398	37388	37375	37369	37381	37373	37398

TABLE 108.—*Monthly values and inequalities of Horizontal Force as given by Grubb's H. F. Magnetometer (corrected for the annual variation of zero).*

Unity = 1γ = ·00001 C. G. S.

Year.	Month.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1848	36494	36505	36527	36544	36557	36573	36571	36587	36622	36578	36559	36566	36557
1849	36568	36575	36599	36616	36625	36622	36633	36645	36646	36650	36639	36646	36622
1850	36641	36647	36667	36680	36688	36691	36693	36705	36707	36708	36708	36696	36686
1851	36553	36612	36667	36707	36731	36747	36758	36767	36756	36767	36784	36766	36718
1852	36767	36749	36783	36788	36810	36818	36829	36839	36830	36843	36836	36828	36810
1853	36801	36804	36820	36834	36833	36840	36846	36864	36848	36876	36863	36852	36840
1854	36853	36855	36864	36863	36880	36893	36891	36901	36900	36907	36907	36902	36885
1855	36905	36902	36914	36922	36927	36933	36931	36940	36948	36946	36946	36947	36930
1856	36908	36954	36952	36959	36965	36951	36956	36953	36953	36957	36963	36960	36953
1857	36956	36961	36964	36969	36956	36970	36961	36960	36943	36950	36931	36923	36954
1858	36922	36926	36918	36919	36939	36932	36929	36937	36932	36933	36950	36933	36931
1859	36943	36930	36944	36947	36955	36950	36964	36985	36949	36944	36962	36950	36952
1860	36966	36982	36959	36954	36964	36975	36972	36966	36977	36995	37011	37001	36977
1861	37003	37000	37005	37019	37024	36999	37018	37017	37014	37018	37016	37006	37012
1862	37020	37027	37033	37037	37038	37048	37034	37022	37031	37013	37033	37033	37031
1863	37039	37042	37062	37058	37068	37062	37060	37058	37054	37064	37068	37061	37058
1864	37076	37077	37076	37076	37071	37067	37074	37076	37078	37104	37112	37109	37083
1865	37101	37108	37125	37127	37130	37126	37128	37089	37117	37111	37122	37139	37119
1866	37132	37121	37133	37150	37159	37147	37121	37112	37115	37118	37136	37149	37133
1867	37153	37156	37151	37159	37160	37160	37160	37156	37149	37150	37175	37178	37159
1868	37179	37166	37177	37170	37178	37181	37178	37182	37167	37172	37190	37181	37177
1869	37169	37164	37173	37164	37170	37183	37196	37182	37169	37186	37199	37192	37179
1870	37173	37173	37188	37189	37211	37215	37226	37209	37184	37183	37195	37209	37196
1871	37205	37197	37207	37190	37230	37232	37228	37221	37226	37227	37205	37231	37217
1872	37235	37215	37220	37233	37253	37242	37234	37222	37226	37214	37228	37212	37228
1873	37138	37138	37150	37172	37185	37185	37200	37208	37210	37215	37222	37233	37188
1874	37228	37215	37237	37233	37250	37255	37259	37263	37263	37253	37260	37268	37249
1875	37276	37273	37265	37283	37290	37301	37298	37305	37295	37305	37309	37310	37293
1876	37316	37312	37316	37326	37331	37337	37336	37337	37335	37336	37336	37334	37329
1877	37334	37338	37339	37342	37338	37344	37353	37358	37358	37356	37350	37350	37347
1878	37352	37350	37360	37362	37361	37360	37372	37368	37363	37362	37358	37359	37361
1879	37370	37376	37368	37371	37364	37363	37368	37369	37363	37371	37371	37370	37369
1880	37366	37376	37368	37377	37373	37379	37376	37354	37367	37370	37360	37355	37369
1881	37365	37350	37367	37371	37376	37377	37376	37382	37365	37374	37366	37369	37370
1882	37369	37362	37373	37347	37355	37355	37364	37354	37372	37351	37329	37338	37356
1883	37355	37356	37360	37364	37374	37375	37368	37378	37362	37373	37372	37386	37369
1884	37391	37387	37385	37390	37394	37402	37398	37408	37405	37400	37399	37406	37397
1885	37393	37407	37408	37412	37398	37405	37421	37412	37407	37420	37425	37434	37412
1886	37414	37426	37424	37414	37413	37419	37413	37415	37420	37412	37409	37410	37416
1887	37406	37412	37414	37414	37419	37423	37424	37421	37415	37421	37423	37423	37418
1888	37408	37415	37420	37424	37426	37430	37433	37432	37430	37435	37431	37439	37427
1889	37441	37440	37433	37440	37436	37438	37435	37435	37432	37436	37431	37434	37436
1890	37437	37443	37443	37444	37442	37446	37445	37440	37438	37434	37433	37437	37440
1891	37441	37439	37435	37425	37416	37435	37436	37431	37417	37428	37436	37440	37432
1892	37425	37402	37400	37418	37409	37419	37404	37408	37416	37406	37425	37410	37412
1893	37417	37417	37422	37428	37435	37428	37423	37415	37417	37420	37418	37425	37422
1894	37420	37404	37413	37414	37430	37420	37403	37403	37400	37419	37408	37420	37413
1895	36420	37412	37421	37423	37432	37433	37430	37433	37431	37421	37420	37435	37426
1896	37426	37419	37423	37432	37424	37439	37434	37422	37424	37431	37436	37434	37429
1897	37427	37433	37433	37419	37428	37447	37456	37449	37452	37454	37457	37448	37442
1898	37453	37449	37436	37444	37447	37446	37446	37438	37412	37436	37442	37441	37441
1899	37439	37428	37428	37433	37431	37436	37428	37442	37437	37440	37439	37440	37435
1900	37442	37444	37432	37440	37433	37453	37452	37447	37446	37450	37454	37454	37446
1901	37447	37453	37447	37449	37454	37449	37444	37441	37438	37439	37443	37445	37446
1902	37436	37436	37435	37431	37439	37440	37438	37438	37432	37434	37432	37428	37435
1903	37428	37432	37430	37426	37424	37419	37414	37408	37406	37400	37372	37381	37412
1904	37383	37392	37404	37394	37393	37397	37401	37404	37403	37399	37399	37402	37398
1905	37386	37348	37389	37391	37395	37398	37396	37388	37384	37395	37375	37390	37390
Annual inequality, 1848-1872 ...	−·000056	−·000087	−·000011	+·000008	+·000079	+·000071	+·000055	+·000031	−·000011	−·000010	+·000011	−·000076	
Annual inequality, 1872-1904 ...	−·000027	−·000046	−·000032	−·000010	+·000011	+·000044	+·000036	+·000019	−·000009	+·000003	−·000006	+·000013	

B 1034—37

TABLE 109.—*Absolute Horizontal Force corrected for the mean of the day by Grubb's H. F. Magnetometer.*

37000 + [Unity = 1γ = ·00001 C. G. S.]

Years.	MONTHS.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1867 ...	...	...	...	...	...	...	108	160	104	139	111	146	...
1868 ...	143	113	140	166	153	164	171	091	148	151	169	142	146
1869 ...	156	200	176	141	128	159	169	154	172	152	196	155	163
1870 ...	154	168	188	175	168	213	210	196	182	165	177	202	183
1871 ...	197	200	197	176	190	211	225	215	217	233	189	192	203
1872 ...	194	183	217	241	252	251	230	216	229	205	212	233	222
1873 ...	221	223	236	256	265	260	270	265	252	261	254	265	252
1874 ...	274	246	253	280	286	290	286	301	292	299	286	295	282
1875 ...	292	279	294	312	316	319	319	311	305	329	332	313	310
1876 ...	304	315	317	332	343	341	338	343	346	344	338	330	333
1877 ...	336	344	344	346	334	326	343	344	340	345	350	349	342
1878 ...	350	347	360	351	340	344	364	365	356	357	364	367	355
1879 ...	361	370	367	377	365	374	378	373	362	370	358	356	368
1880 ...	375	387	371	391	374	370	374	341	350	343	345	356	365
1881 ...	359	357	355	344	363	363	369	367	350	360	348	345	357
1882 ...	346	348	360	326	330	343	349	342	356	343	311	326	340
1883 ...	348	349	344	364	375	378	368	387	386	394	403	395	374
1884 ...	406	395	396	419	429	428	423	425	414	404	406	413	413
1885 ...	410	400	412	408	409	412	416	405	408	412	415	412	410
1886 ...	400	413	426	416	409	422	409	415	407	400	386	382	407
1887 ...	405	418	406	399	413	409	408	410	411	414	417	412	410
1888 ...	409	422	421	424	421	424	426	416	422	424	409	425	420
1889 ...	423	422	419	425	428	426	433	432	431	434	428	428	427
1890 ...	430	431	434	434	434	439	443	445	427	423	429	433	433
1891 ...	438	429	420	415	413	424	426	426	415	414	424	427	423
1892 ...	400	392	388	412	388	392	382	392	413	416	434	433	403
1893 ...	417	423	421	422	434	424	415	406	416	419	409	413	418
1894 ...	403	392	398	412	430	414	397	401	392	422	410	422	408
1895 ...	410	403	414	422	440	430	420	429	426	436	433	452	426
1896 ...	448	425	439	441	436	455	444	442	437	449	450	455	443
1897 ...	446	446	449	432	447	455	466	447	454	445	446	433	447
1898 ...	437	444	433	426	434	438	437	436	408	428	430	454	434
1899 ...	447	427	425	437	441	448	433	437	431	434	442	445	437
1900 ...	438	431	435	445	418	441	437	439	451	445	452	436	439
1901 ...	442	434	433	440	439	447	437	439	433	425	432	423	435
1902 ...	425	433	432	424	424	434	430	425	415	420	421	418	425
1903 ...	421	427	420	408	408	424	426	410	403	396	380	383	409
1904 ...	405	400	403	377	388	394	394	392	392	372	376	391	390
1905 ...	380	374	383	375	384	385	387	382	382	379	369	389	381

shown in tables 109 and 110. The difference table 110 indicates in the first instance that on the average the corrections by Grubb's were smaller by about 1·6γ, and secondly that though the greatest error in the annual means was not more than 4γ, the monthly means were markedly divergent.

It will hence become at once apparent that an instrument even when used for the purpose of small differential corrections, may introduce large errors. Examining the method of observations at Colaba it will be noted that the time of the absolute observations systematically falls on an average at 2 p.m. Thus practically the ordinate at 2 p.m. in its relation to the mean ordinate of 24 hours for the month, determines this correction. This ordinate as indicated by the average result of the magnetograph when corrected for temperature is remarkably constant from month to month. The differences then as denoted by the figures in table 110 explain themselves as the result of the irregular behaviour of the Grubb's instrumental zero, which we know now was subject to a grave defect—temperature errors. Absolute observations are taken about 4 or 5 times in the month only, and the value of the datum is derived from the mean of the 5 points in the whole month, each determined by observations at 2 p.m. The mean datum of these 5 points, as the results show, does not correspond to the mean datum of the whole month derived from 24 × 30 hourly readings, or more correctly, as after 1872 the Grubb's instrument was read only 5 times a day, from 5 × 30 hourly readings.

168. The march of the temperature as denoted by the thermometer in the Grubb's enclosure from day to day not being the same as that of the actual temperature of the magnet, the effect of this error is taken up by the monthly mean and appears in it; and some portion of this error is bound to affect the indications of the zero of the instrument from which the monthly mean is derived (1) from the results of 24 × 30 hours and (2) from those of 5 hours distributed over the month at the times of absolute observations at about 2 p.m. It should not be lost sight of also that in all variation instruments, even if free from such defects, if the zero cannot be depended upon for a fairly uniform creep from month to month, the corrections derived for the absolute values cannot be regarded as being absolutely above suspicion.

169. The importance under such circumstances of having a duplicate set of instruments working side by side, allowing of an intelligent and effectual control being exercised over the working of the instruments and their results can hardly have been better demonstrated or more strongly emphasised than by the experience derived from the record of Grubb's magnetometer at Colaba.

TABLE 110.—*Differences between Absolute Horizontal Force corrected by Grubb's H. F. Magonetometer and by H. F. Magnetograph.*

Unity = 1γ = ·00001 C. G. S.

Years.	MONTHS.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1872 ...	− 8	...	...	− 11	+ 12	− 3	− 12	− 6	− 6	− 21	− 16	− 1	0
1873 ...	+ 14	− 3	+ 5	− 1	− 5	+ 6	+ 1	− 5	+ 5	− 4	0	− 3	+ 1
1874 ...	− 3	− 9	+ 3	+ 10	+ 12	+ 11	+ 2	+ 2	+ 2	− 6	0	− 2	+ 1
1875 ...	0	+ 2	− 5	− 6	− 1	− 2	− 6	− 1	0	− 6	− 3	− 3	− 3
1876 ...	− 3	+ 5	0	0	− 2	− 3	0	− 1	0	+ 1	− 2	− 2	0
1877 ...	− 3	...	− 2	− 1	− 2	− 4	+ 3	+ 2	+ 1	− 2	− 4	+ 2	0
1878 ...	− 2	− 1	− 1	− 2	+ 1	− 5	− 9	− 10	− 10	− 7	− 3	0	− 4
1879 ...	− 4	− 5	− 7	− 6	− 7	− 7	− 8	− 8	+ 1	0	− 2	− 2	− 4
1880 ...	− 1	+ 4	+ 6	− 2	+ 1	+ 1	+ 1	+ 6	+ 1	0	0	− 1	+ 2
1881 ...	− 1	0	− 1	− 2	− 1	− 1	− 1	0	− 2	+ 1	− 2	− 4	− 1
1882 ...	0	+ 3	+ 2	0	+ 1	− 2	0	0	0	0	− 1	− 2	0
1883 ...	− 3	− 1	− 4	− 1	− 1	− 2	0	+ 1	− 2	+ 2	+ 3	− 3	− 1
1884 ...	− 1	+ 1	− 2	− 1	− 1	− 2	+ 3	0	− 1	− 3	− 2	− 3	− 1
1885 ...	− 1	− 1	+ 4	− 2	0	0	+ 1	0	− 3	− 3	− 2	− 1	− 1
1886 ...	+ 1	0	+ 5	+ 1	0	+ 1	− 1	+ 2	+ 2	+ 1	− 1	0	+ 1
1887 ...	− 1	− 4	0	− 2	− 1	+ 1	− 2	+ 2	− 1	− 2	− 5	− 2	− 1
1888 ...	+ 1	− 2	− 3	− 1	− 1	− 3	− 1	− 3	− 3	− 3	− 2	+ 1	− 2
1889 ...	− 1	− 3	− 1	− 2	0	+ 2	− 3	− 2	− 1	− 2	− 2	− 1	− 2
1890 ...	− 2	+ 1	− 1	0	− 1	0	0	− 1	+ 1	− 1	− 1	− 1	− 1
1891 ...	− 4	− 1	+ 1	0	− 1	− 1	− 1	+ 1	0	− 2	0	− 7	− 1
1892 ...	− 2	− 2	0	0	− 3	0	− 2	− 2	− 3	0	0	− 3	− 2
1893 ...	− 2	− 2	0	− 2	− 1	− 1	− 1	+ 1	− 2	+ 1	0	− 2	− 1
1894 ...	0	+ 3	0	− 1	− 1	− 3	+ 1	+ 2	− 1	− 3	− 4	0	0
1895 ...	− 1	− 4	− 3	+ 1	− 1	+ 3	− 1	+ 1	0	− 3	− 3	0	− 1
1896 ...	+ 2	− 1	− 1	− 2	− 1	− 2	+ 1	− 2	0	0	− 4	− 1	− 1
1897 ...	− 2	− 3	− 2	− 2	+ 1	− 1	+ 1	− 1	− 1	− 2	− 2	− 5	− 2
1898 ...	− 5	− 5	− 2	− 3	− 2	− 2	+ 1	− 3	− 4	− 2	− 5	− 3	− 3
1899 ...	− 4	− 4	− 4	− 2	− 4	+ 3	− 3	− 3	− 3	− 3	− 5	− 6	− 4
1900 ...	− 3	− 4	− 4	− 2	− 2	− 4	− 4	− 4	− 1	− 2	− 3	− 5	− 3
1901 ...	− 4	− 2	− 5	− 4	− 4	− 2	− 13	− 3	− 3	− 4	− 9	− 5	− 4
1902 ...	− 2	− 2	− 3	− 5	− 3	− 1	− 3	− 3	− 1	− 2	− 7	− 6	− 3
1903 ...	− 5	− 2	− 1	− 1	− 3	− 3	0	+ 1	0	− 4	− 12	− 3	− 3
1904 ...	− 6	− 3	+ 4	− 2	− 1	+ 4	+ 4	− 1	+ 1	− 3	− 6	− 3	− 1
1905 ...	− 2	− 4	− 2	+ 1	− 1	− 3	− 1	0	+ 2	0	− 4	− 4	− 1
Mean ...	− 1·7	− 1·4	− 0·7	− 1·6	− ·07	− 0·7	− 1·6	− 1·1	− 0·9	− 2·5	− 3·2	− 2·4	− 1·6

CHAPTER IV.

DECLINATION.

Variation Instrument.

The Declination Magnetograph.

170. The declination magnetograph was installed in the underground room along with the other magnetographs, late in the year 1870 and a continuous record from January 1871 to March 1906 is available for the variation of this element.

171. The instrument is of the usual Kew type magnetographs. The magnet is suspended by a single bunch of about 6 silk fibres. The magnet hence places itself in the magnetic meridian, but the direction must obviously be affected to a greater or less extent by the residual torsion in the suspension skein. As however the instrument is intended for differential purposes, it is not so much the amount of the residual torsion which is to be guarded against, as the constancy of this torsion which is so difficult to maintain. The silk skein was initially prepared with care all threads being kept parallel in position and it was then immersed in a solution of shellac in alcohol for the purpose of protecting it from moisture effects. The torsion was removed by the usual methods, the skein being allowed to stretch under a suitable weight for several months. The magnet and the two mirrors (one attached to the magnet and the other fixed to the base plate of the instrument giving the zero) were then suitably fixed in position and the enclosure was closed late in 1870 after due adjustments of the magnet, mirrors, etc. The air within, was exhausted and the pressure in the enclosure was reduced to about 3 inches of mercury. The receiver however leaked slowly, and to prevent the indications of the instrument from being vitiated by moisture effects, several attempts were made from time to time to stop the leak, but it was not till July 1876 that the efforts proved successful and the enclosure was closed once for all. Fresh lime for absorbing the residual moisture in the enclosure was put in the receiver before its final closure. It has since remained in a dry atmosphere at a constant attenuated pressure of about 2 inches of mercury.

172. As the beam of light which strikes the magnet mirror, is reflected on to a position on the photographic paper towards the north, while the zero mirror places the reflected speck of light to the south contrary to conditions in the force magnetograph,—any increase of ordinate means decrease of easterly declination and *vice versâ*.

2. The scale co-efficient.

173. If the distance d of the mirror attached to the magnet from either the cylinder which carries the photographic paper, or the scale attached to the telescope intended for the purposes of eye reading, is known, it is obvious that the angular movement of the mirror that is of the magnet would be equal to $\sin^{-1}\frac{1}{2d}$ for an unit of ordinate on the paper, or an unit of division of the scale.

174. For the determination of the co-efficient the following measurements necessary for its correct derivation were taken :—

Distance from the back of the magnet mirror to surface of the recording cylinder = 60·25 inches. Thickness of the lens = ·6 inch ; thickness of mirror = ·115 inch. Thickness of glass plate in the gun metal cylinder = ·18 inch.

From the above, assuming the refractive index of glass to be 1·5, the virtual distance of the mirror from the cylinder = 59·95 inches. Thence the scale co-efficient allowing for the torsion co-efficient of the silk skein = 1·0016, equals 28′·72 or ·00835 for an ordinate of 1 inch; or 11′·31 or ·00329 for an ordinate of 1 c.m.

Similarly the distance from the back of the mirror to the scale attached to the telescope for the eye readings = 42·56 inches, whence with the above thickness of the mirror and glass plate and the refractive index, and assuming that the final result will be reduced by ·01 due to the angle subtended at the mirror, by the telescope and scale, the virtual distance from the back of the mirror to the telescope scale = 42·45 inches.

175. As the scale attached to the telescope is circular in form, and the chord of an arc divided into 50 divisions, measures 10 inches, the scale co-efficient, allowing for the torsion co-efficient, works out as 8′·13 or ·002365 for one unit division of the scale.

176. It is obvious from the above that the factor for changing the scale reading into ordinate in inches would be $\frac{\cdot 002365}{\cdot 00835} = \cdot 283$, and for changing the ordinate in inches into scale reading would be $\frac{\cdot 00835}{\cdot 002365} = 3\cdot 53$.

Similar factors for changing the scale reading into ordinate in centimeters, and the ordinate in centimeters into scale reading, are respectively ·719 and 1·390.

3. Use of the Differential Instrument.

177. As temperature variations are known to have no appreciable influence upon the indications of a declination magnet, we are in a position to make use of the variation instrument, having ascertained its scale co-efficient in the first instance, to secure by its help the absolute values of declination corresponding to the mean of every month, and of the year. Absolute observations taken every Thursday at the electrometer tower, have supplied from 4 to 5 absolute determinations every month. In table 111 are collected all the data in full from the year 1871 to 1905 in which are set forth step by step the various operations involved, leading up to the final result. In column 2 are given the mean *observed* declination for the month. Column 3 gives the mean date of the observations which suggests a small correction if it differs from the usual mean date of the month. These corrections are almost always inappreciable in this instrument. Column 4 contains the ordinate of the magnetograms corresponding to the exact time of the absolute determination and column 5 the mean ordinate of the month. By the help of these, the mean monthly values of declination are derived and entered in column 6 from which again are derived the mean values of the zero in column 7. In column 8 are given the values of the theoretical zeros derived from a formula referred to in paragraph 181, while column 9 gives the departure of the theoretical from the observed zeros or the difference between column 7 and column 8. In column 10 the departures in column 9 are corrected for the annual mean, and in column 11 they are further corrected for the annual variation of zero (*vide* next section).

Reduction of the observed absolute values to the mean of the day.

It will be seen from the above that table 111 contains 11 columns in all. Columns 1 to 6 refer to the derivation of the absolute values and are useful for that purpose, while columns 7 to 11 supply data which furnish us with materials indicating the behaviour of the instrumental zero.

178. It must be noted however that the discussion about the latter, whatever be the result and conclusion arrived at, refers solely to the behaviour of the instrument throwing some light upon other collateral phenomena; but it should not be regarded as essentially affecting the results of absolute observations in columns 1 to 6 as already remarked elsewhere.

4. Declination magnetograph as a recorder of secular change.

179. The instrument was allowed to remain in undisturbed adjustment, as already referred to, for a long term of years and the examination of the zero series of the magnetograms for this reason promises to be of interest.

The creep of the zero.

In table 112 are collected the mean monthly values of the derived zeros from the year 1871 to 1905. The instrument was initially adjusted in 1870 and both the zero and the magnet mirrors, as also the suspension head remained undisturbed during the period.

180. The enclosure was initially exhausted to a pressure of about 3 inches of mercury, but owing to some defect in the receiver it was difficult to maintain permanently the conditions of a constant dry attenuated atmosphere. It was not till July 1876 that this defect was effectually remedied and the leakage stopped. The period 1871—1876 is therefore omitted, and the monthly and annual values of the zeros from 1877 to 1905 collected in the above table, constitute an absolutely undisturbed series and are taken in hand for discussion.

181. The annual values in column 14 are charted in figure II and also on a larger scale in figure V, plate 4, where the abscissæ indicate time and the ordinates the values of the zero. From the general run of the curve it will be readily seen that the dominant features though small in magnitude, are the steady rise in the values of the zero, which attain to a maximum about 1890 and the fall thereafter steadily to 1905. As the annual increments and decrements appear to be subject to a fairly steady rate of increase and decrease

TABLE 111.—*Reductions of monthly and annual means of Absolute Declination.*

Month.	Mean observed absolute Declination.	Mean Date of observation.	Mean ordinate of Declination Magnetograms corresponding to times of Absolute observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Differences in Column 9 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11
1871.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	49 7	15·5	3·126	3·098	49 55	138 54	137 7	+1 47	+0 50	+0 35
February ...	50 18	10·6	3·084	3·085	50 16	138 52	137 8	+1 44	+0 47	+0 36
March ...	49 32	16·0	3·114	3·078	50 34	138 58	137 9	+1 49	+0 52	+0 46
April ...	48 31	16·5	3·155	3·068	51 1	139 8	137 10	+1 58	+1 1	+0 49
May ...	49 11	14·5	3·107	3·043	51 1	138 25	137 11	+1 14	+0 17	+0 3
June ...	48 37	15·0	3·085	3·015	50 38	137 14	137 11	+0 3	−0 54	−0 48
July ...	48 48	16·5	3·083	3·009	50 56	137 22	137 12	+0 10	−0 47	−0 34
August ...	49 10	17·0	3·083	3·001	51 31	137 43	137 13	+0 30	−0 27	−0 20
September ...	48 50	17·5	3·082	2·998	51 15	137 21	137 14	+0 7	−0 50	−0 30
October ...	50 6	15·5	3·053	2·986	52 1	137 46	137 14	+0 32	−0 25	−0 13
November ...	51 31	14·3	3·009	2·973	52 33	137 56	137 15	+0 41	−0 16	−0 15
December ...	51 52	17·5	3·004	2·984	52 26	138 8	137 16	+0 52	−0 5	−0 11
Means ...	49 38	15·5	3·082	3·028	51 11	138 9	137 12	+0 57	...	...
1872										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January	53 11	14·5	2·968	2·989	52 35	138 25	137 17	+1 8	+0 6	−0 9
February	52 43	15·0	2·974	2·976	52 40	138 8	137 17	+0 51	−0 11	−0 22
March	50 57	17·7	3·031	2·964	52 52	137 59	137 18	+0 41	−0 21	−0 27
April	50 45	14·5	3·054	2·969	53 11	138 27	137 19	+1 8	+0 6	−0 6
May	50 29	16·0	3·069	2·998	52 31	138 37	137 20	+1 17	+0 15	+0 1
June	51 6	16·5	3·041	2·985	52 42	138 25	137 20	+1 5	+0 3	+0 9
July	50 6	14·5	3·061	2·974	52 36	138 1	137 21	+0 40	−0 22	−0 9
August	51 6	15·0	3·031	2·962	53 5	138 9	137 22	+0 47	−0 15	−0 8
September	50 8	15·5	3·078	2·968	53 18	138 32	137 22	+1 10	+0 8	+0 28
October	52 46	14·0	2·983	2·951	53 41	138 26	137 23	+1 3	+0 1	+0 13
November	52 35	14·6	3·000	2·960	53 44	138 44	137 24	+1 20	+0 18	+0 19
December	52 58	15·5	2.984	2·962	53 36	138 40	137 24	+1 16	+0 14	+0 8
Means	51 34	15·3	3·023	2·971	53 3	138 23	137 21	+1 2	...	...
1873.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	53 6	16·6	2·992	2·964	53 54	139 1	137 25	+1 36	+0 27	+0 12
February ...	53 2	16·7	2·986	2·963	53 42	138 48	137 26	+1 22	+0 13	+0 2
March ...	52 35	16·5	2·993	2·950	53 49	138 32	137 26	+1 6	−0 3	−0 9
April ...	53 14	13·5	2·967	2·948	53 47	138 27	137 27	+1 0	−0 9	−0 21
May ...	52 0	15·0	3·024	2·953	54 2	138 50	137 28	+1 22	+0 13	−0 1
June ...	52 20	15·5	3·005	2·947	54 0	138 38	137 28	+1 10	+0 1	+0 7
July ...	52 52	17·0	2·994	2·941	54 23	138 51	137 29	+1 22	+0 13	+0 26
August ...	51 15	17·5	3·057	2·940	54 37	139 3	137 30	+1 33	+0 24	+0 31
September ...	51 49	14·5	3·014	2·934	54 7	138 23	137 31	+0 52	−0 17	+0 3
October ...	52 46	16·0	2·980	2·939	53 57	138 21	137 31	+0 50	−0 19	−0 7
November ...	52 59	16·5	2·974	2·940	53 58	138 24	137 32	+0 52	−0 17	−0 16
December ...	53 36	14·5	2·950	2·942	53 50	138 19	137 33	+0 46	−0 23	−0 29
Means ...	52 38	15·8	2·995	2·947	54 0	138 38	137 29	+1 9	...	...
1874.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January	53 17	15·0	2·956	2·942	53 41	138 10	137 34	+0 36	−0 14	−0 29
February	54 36	15·5	2·917	2·935	54 5	138 22	137 34	+0 48	−0 2	−0 13
March	54 8	15·5	2·938	2·932	54 18	138 30	137 35	+0 55	+0 5	−0 1
April	52 16	16·0	2·997	2·927	54 17	138 21	137 36	+0 45	−0 5	−0 17
May	52 33	17·5	2·990	2·931	54 15	138 25	137 37	+0 48	−0 2	−0 16
June	53 26	14·5	2·967	2·927	54 35	138 39	137 37	+1 2	+0 12	+0 18
July	53 30	16·0	2·957	2·924	54 27	138 25	137 38	+0 47	−0 3	+0 10
August	52 50	16·7	2·974	2·920	54 23	138 14	137 39	+0 35	−0 15	−0 8
September	52 37	13·5	2·985	2·921	54 27	138 20	137 40	+0 40	−0 10	+0 10
October	53 49	15·0	2·947	2·912	54 49	138 27	137 40	+0 47	−0 3	+0 9
November	53 38	15·5	2·963	2·921	54 50	138 43	137 41	+1 2	+0 12	+0 13
December	54 27	17·0	2·940	2·918	55 5	138 53	137 41	+1 12	+0 22	+0 16
Means	53 26	15·6	2·961	2·926	54 26	138 27	137 38	+0 50	...	...
1875.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	54 3	17·5	2·960	2·930	54 55	139 4	137 42	+1 22	+0 22	+0 7
February ...	54 13	14·5	2·956	2·922	55 11	139 6	137 42	+1 24	+0 24	+0 13
March ...	55 41	14·5	2·895	2·904	55 26	138 50	137 43	+1 7	+0 7	+0 1
April ...	54 53	15·0	2·927	2·906	55 29	138 56	137 43	+1 13	+0 13	+0 1
May ...	53 52	16·5	2·971	2·907	55 42	139 11	137 44	+1 27	+0 27	+0 13
June ...	54 8	13·5	2·950	2·905	55 26	138 52	137 44	+1 8	+0 8	+0 14
July ...	54 35	15·0	2·926	2·899	55 22	138 38	137 45	+0 53	−0 7	+0 6
August ...	53 57	16·0	2·948	2·900	55 20	138 37	137 46	+0 51	−0 9	−0 2
September ...	53 11	16·0	2·957	2·893	55 1	138 6	137 46	+0 20	−0 40	−0 20
October ...	53 55	17·7	2·939	2·892	55 16	138 20	137 47	+0 33	−0 27	−0 15
November ...	54 51	14·5	2·911	2·890	55 27	138 27	137 48	+0 39	−0 21	−0 20
December ...	55 53	16·0	2·889	2·890	55 51	138 51	137 48	+1 3	+0 3	−0 3
Means ...	54 26	15·6	2·936	2·903	55 22	138 45	137 45	+1 0	...	...
1876										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″		
January	56 4	16·5	2·884	2·890	55 54	138 54	137 49	+1 5	...	...
February	55 36	13·5	2·892	2·885	55 48	138 39	137 50	+0 49	...	...
March	55 30	16·0	2.887	2·877	55 47	138 25	137 50	+0 35	...	...
April	54 44	16·5	2.908	2·881	55 31	138 16	137 51	+0 25	...	...
May	53 34	14·5	2·944	2·877	55 29	138 7	137 52	+0 15	...	...
June	53 33	15·0	2·934	2·868	55 27	137 49	137 52	−0 3	...	...
July	54 28	16·5	2·900	2·859	55 39	137 46	137 53	−0 7	...	...
August	54 51	17·0	2·896	2·853	56 5	138 1	137 54	+0 7	...	...
September	55 0	17·5	2·902	2·849	56 31	138 20	137 54	+0 26	...	...
October	54 52	15·7	2·906	2·849	56 30	138 19	137 55	+0 24	...	...
November	55 42	16·0	2·873	2·852	56 18	138 13	137 55	+0 18	...	...
December	56 37	17·5	2·844	2·847	56 32	138 18	137 56	+0 22	...	...
Means	55 3	16·0	2·897	2·866	55 58	138 16	137 53	+0 23	...	...

Monthly mean zeros for 1876 are not comparable due to exhaustion of the enclosure in July 1876.

TABLE 111.—*Reductions of monthly and annual means of Absolute Declination.*

Month.	Mean observed absolute Declination.	Mean Date of observation.	Mean ordinate of Declination Magnetograms corresponding to times of Absolute observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, column 7—column 8.	Differences in column 9 corrected for mean annual excess.	Differences in column 10 corrected for annual variation of Zero.	Mean observed absolute Declination.	Mean date of observation.	Mean ordinate of Declination Magnetograms corresponding to times of Absolute observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Differences in Column 9 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11	2	3	4	5	6	7	8	9	10	11
	1877.										1878.									
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	56 21	14·5	2·858	2·847	56 40	138 26	137 56	+0 30	+0 28	+0 20	56 56	17·0	2·837	2·829	57 10	138 25	138 3	+0 22	+0 26	+0 18
February ...	55 57	11·5	2·865	2·852	56 19	138 14	137 57	+0 17	+0 15	+0 3	56 32	17·5	2·856	2·826	57 24	138 34	138 3	+0 31	+0 35	+0 23
March ...	56 22	15·0	2·852	2·844	56 36	138 17	137 57	+0 20	+0 18	+0 15	56 21	17·5	2·851	2·828	57 1	138 14	138 4	+0 10	+0 14	+0 11
April ...	55 23	15·5	2·882	2·846	56 25	138 9	137 58	+0 11	+0 9	+0 11	55 59	14·5	2·865	2·823	57 11	138 16	138 4	+0 12	+0 16	+0 18
May ...	55 11	17·2	2·885	2·841	56 27	138 3	137 58	+0 5	+0 3	+0 12	55 31	16·0	2·867	2·818	56 55	137 51	138 5	−0 14	−0 10	−0 1
June ...	54 52	17·5	2·888	2·842	56 11	137 48	137 59	−0 11	−0 13	−0 11	55 53	16·5	2·855	2·820	56 53	137 52	138 5	−0 13	−0 9	−0 7
July ...	55 32	15·5	2·857	2·833	56 13	137 35	137 59	−0 24	−0 26	−0 26	56 0	14·5	2·848	2·826	56 38	137 48	138 6	−0 18	−0 14	−0 14
August ...	54 23	16·2	2·902	2·831	56 25	137 43	138 0	−0 17	−0 19	−0 17	55 22	15·0	2·857	2·829	56 10	137 25	138 7	−0 42	−0 38	−0 36
September ...	54 23	16·5	2·908	2·828	56 41	137 54	138 0	−0 6	−0 8	−0 7	55 21	15·5	2·865	2·827	56 26	137 38	138 7	−0 29	−0 25	−0 24
October ...	55 34	14·5	2·870	2·826	56 50	138 0	138 1	−0 1	−0 3	+0 2	55 8	13·5	2·876	2·819	56 46	137 44	138 7	−0 23	−0 19	−0 14
November ...	56 6	15·0	2·851	2·822	56 56	137 59	138 1	−0 2	−0 4	−0 4	56 31	14·2	2·837	2·815	57 9	138 0	138 8	−0 8	−0 4	−0 4
December ...	56 24	16·5	2·847	2·825	57 2	138 10	138 2	+0 8	+0 6	+0 3	56 31	15·5	2·857	2·815	57 43	138 34	138 8	+0 26	+0 30	+0 27
Means ...	55 32	15·4	2·872	2·836	56 34	138 1	137 59	+0 2	...	...	56 0	15·6	2·856	2·823	56 57	138 2	138 6	−0 4	...	...
	1879.										1880.									
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	56 58	16·2	2·842	2·819	57 38	138 36	138 9	+0 27	+0 14	+0 6	57 25	15·0	2·816	2·832	56 57	138 17	138 14	+0 3	+0 16	+0 8
February ...	57 20	16·5	2·829	2·819	57 37	138 35	138 9	+0 26	+0 13	+0 1	57 23	15·5	2·814	2·829	56 57	138 14	138 15	−0 1	+0 12	0 0
March ...	57 29	16·5	2·819	2·815	57 35	138 26	138 9	+0 17	+0 4	+0 1	57 26	14·5	2·797	2·812	57 0	137 46	138 15	−0 29	−0 16	−0 19
April ...	56 41	13·5	2·839	2·818	57 17	138 13	138 10	+0 3	−0 10	−0 8	56 14	15·0	2·852	2·822	57 6	138 9	138 16	−0 7	+0 6	+0 8
May ...	55 48	15·0	2·873	2·825	57 11	138 19	138 10	+0 9	−0 4	+0 5	55 25	16·5	2·868	2·812	57 1	137 47	138 16	−0 29	−0 16	−0 7
June ..	56 21	15·5	2·857	2·825	57 16	138 24	138 11	+0 13	0 0	+0 2	55 30	13·5	2·871	2·813	57 10	137 57	138 17	−0 20	−0 7	−0 5
July ...	55 44	17·0	2·889	2·828	57 29	138 42	138 11	+0 31	+0 18	+0 18	56 0	15·0	2·856	2·812	57 16	138 2	138 17	−0 15	−0 2	−0 2
August ...	55 45	17·7	2·880	2·832	57 8	138 28	138 12	+0 16	+0 3	+0 5	55 5	15·7	2·894	2·810	57 30	138 12	138 17	−0 5	+0 8	+0 10
September ...	56 21	14·5	2·870	2·818	57 51	138 47	138 12	+0 35	+0 22	+0 23	55 50	16·0	2·861	2·809	57 20	138 1	138 18	−0 17	−0 4	−0 3
October ...	55 52	16·0	2·861	2·816	57 10	138 3	138 13	−0 10	−0 23	−0 18	56 15	17·5	2·837	2·806	57 8	137 43	138 18	−0 35	−0 22	−0 17
Novembe- ...	55 50	16·5	2·864	2·821	57 4	138 5	138 13	−0 8	−0 21	−0 21	56 50	14·5	2·835	2·810	57 33	138 15	138 18	−0 3	+0 10	+0 10
December ...	56 59	14·5	2·830	2·825	57 7	138 15	138 14	+0 1	−0 12	−0 15	56 47	16·0	2·842	2·819	57 27	138 25	138 19	+0 6	+0 19	+0 16
Means ...	56 26	15·8	2·854	2·822	57 22	138 24	138 11	+0 13	...	...	56 21	15·4	2·845	2·815	57 12	138 4	138 17	−0 13	...	...
	1881.										1882.									
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	56 10	16·5	2·864	2·826	57 15	138 25	138 19	+0 6	+0 4	0 4	56 29	15·7	2·845	2·845	56 29	138 12	138 24	−0 12	0 0	−0 8
February ...	57 8	13·5	2·829	2·816	57 30	138 23	138 19	+0 4	+0 2	−0 10	56 50	12·7	2·828	2·845	56 21	138 4	138 24	−0 20	−0 8	−0 20
March ...	57 9	17·0	2·824	2·819	57 17	138 15	138 20	−0 5	−0 7	−0 10	55 42	16·0	2·871	2·844	56 29	138 10	138 24	−0 14	−0 2	−0 5
April ...	55 33	17·7	2·885	2·821	57 23	138 24	138 20	+0 4	+0 2	+0 4	56 6	16·5	2·863	2·828	57 6	138 19	138 25	−0 6	+0 6	+0 8
May ...	54 51	15·5	2·921	2·824	57 39	138 45	138 20	+0 25	+0 23	+0 32	54 41	14·7	2·899	2·825	56 49	137 57	138 25	−0 28	−0 16	−0 7
June ...	54 59	16·0	2·907	2·827	57 17	138 29	138 21	+0 8	+0 6	+0 8	55 6	15·0	2·886	2·828	56 46	137 59	138 26	−0 27	−0 15	−0 13
July ...	55 51	17·5	2·867	2·822	57 8	138 11	138 21	−0 10	−0 12	−0 12	55 11	16·5	2·887	2·830	56 49	138 6	138 26	−0 20	−0 8	−0 8
August ...	54 36	14·5	2·917	2·831	57 4	138 22	138 21	+0 1	−0 1	+0 1	54 38	17·0	2·899	2·830	56 37	137 54	138 26	−0 32	−0 20	−0 18
September ...	55 18	15·0	2·886	2·827	57 0	138 12	138 22	−0 10	−0 12	−0 11	55 27	17·7	2·883	2·837	56 46	138 15	138 27	−0 12	0 0	+0 1
October ...	56 3	16·5	2·869	2·828	57 14	138 27	138 22	+0 5	+0 3	+0 8	56 15	15·7	2·863	2·822	57 26	138 29	138 27	+0 2	+0 14	+0 19
November ...	56 43	13·5	2·853	2·828	57 26	138 39	138 23	+0 16	+0 14	+0 14	56 52	16·2	2·848	2·816	57 47	138 40	138 27	+0 13	+0 25	+0 25
December ...	56 40	15·0	2·834	2·840	56 30	138 4	138 23	0 19	−0 21	−0 24	57 39	17·5	2·823	2·834	57 20	138 44	138 27	+0 17	+0 29	+0 26
Means ...	55 55	15·7	2·871	2·826	57 14	138 23	138 21	+0 2	...	...	55 55	15·9	2·866	2·832	56 54	138 14	138 26	−0 12	...	...

TABLE III.—*Reductions of monthly and annual means of Absolute Declination.*

Month.	Mean observed Absolute Declination.	Mean Date of Observation.	Mean ordinate of Declination Magnetograms corresponding to times of Absolute Observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Differences in Column 9 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11
1883.										
	′ ″		in.	in.	′ ″	″	′ ″	′ ″	′ ″	′ ″
January ...	56 54	14·5	2·851	2·836	57 20	138 47	138 28	+0 19	−0 1	−0 9
February ...	57 32	11·5	2·843	2·837	57 42	139 11	138 28	+0 43	+0 23	+0 11
March ...	57 1	15·2	2·852	2·834	57 32	138 56	138 28	+0 28	+0 8	+0 5
April ...	55 32	15·7	2·904	2·837	57 27	138 56	138 28	+0 28	+0 8	+0 10
May ...	55 12	17·0	2·908	2·848	56 55	138 43	138 29	+0 14	−0 6	+0 3
June ...	55 56	17·5	2·911	2·849	57 43	139 32	138 29	+1 3	+0 43	+0 45
July ...	56 28	15·7	2·881	2·847	57 27	139 13	138 29	+0 44	+0 24	+0 24
August ...	56 7	16·0	2·881	2·852	56 57	138 52	138 29	+0 23	+0 3	+0 5
Septembr ...	54 29	16·7	2·930	2·845	56 55	138 38	138 30	+0 8	−0 12	−0 11
October ...	55 8	15·0	2·908	2·851	56 46	138 39	138 30	+0 9	−0 11	−0 6
November ...	55 46	15·4	2·869	2·856	56 8	138 9	138 30	−0 21	−0 41	−0 41
December ...	54 55	16·7	2·902	2·871	55 48	138 15	138 30	−0 15	−0 35	−0 38
Means ...	55 55	15·6	2·887	2·847	57 3	138 49	138 29	+0 20	...	...
1884.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January	55 33	17·0	2·875	2·876	55 31	138 7	138 31	−0 24	−0 5	−0 13
February	56 24	17·5	2·857	2·876	55 51	138 27	138 31	−0 4	+0 15	+0 3
March	55 21	16·7	2·891	2·868	56 1	138 23	138 31	−0 8	+0 11	+0 8
April	54 8	13·5	2·931	2·868	55 57	138 19	138 31	−0 12	+0 7	+0 9
May	53 37	15·0	2·940	2·872	55 34	138 3	138 32	−0 29	−0 10	−0 1
June	53 26	15·5	2·949	2·871	55 40	138 7	138 32	−0 25	−0 6	−0 4
July	54 32	17·2	2·906	2·870	55 34	138 0	138 32	−0 32	−0 13	−0 13
August	52 42	18·0	2·967	2·879	55 14	137 55	138 32	−0 37	−0 18	−0 16
Septembr	53 44	14·5	2·939	2·886	55 15	138 8	138 33	−0 25	−0 6	−0 5
October	54 53	16·0	2·901	2·885	55 21	138 12	138 33	−0 21	−0 2	+0 3
November	54 14	16·5	2·931	2·893	55 19	138 24	138 33	−0 9	+0 10	+0 10
December	56 0	14·5	2·875	2·905	55 8	138 34	138 33	+0 1	+0 20	+0 17
Means	54 33	16·0	2·913	2·879	55 32	138 13	138 32	−0 19	...	...
1885.										
	′ ″		in.	in.	′	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	55 43	15·0	2·888	2·901	55 21	138 40	138 34	+0 6	−0 2	−0 10
February ...	54 32	15·5	2·930	2·907	55 12	138 41	138 34	+0 7	−0 1	−0 13
March ...	55 8	15·5	2·904	2·907	55 3	138 32	138 34	−0 2	−0 10	−0 13
April ...	54 2	16·0	2·949	2·909	55 11	138 44	138 34	+0 10	+0 2	+0 4
May ...	53 6	17·5	2·985	2·906	55 22	138 49	138 35	+0 14	+0 6	+0 15
June ...	53 44	14·5	2·965	2·908	55 22	138 53	138 35	+0 18	+0 10	+0 12
July ...	53 32	16·0	2·970	2·913	55 10	138 49	138 35	+0 14	+0 6	+0 6
August ...	52 3	16·7	3·020	2·914	55 6	138 47	138 35	+0 12	+0 4	+0 6
September ...	52 21	13·5	3·010	2.917	55 1	138 47	138 35	+0 12	+0 4	+0 5
October ...	54 6	15·0	2·936	2·920	54 34	138 25	138 36	−0 11	−0 19	−0 14
November ...	53 46	15·7	2·956	2·928	54 34	138 39	138 36	+0 3	−0 5	−0 5
December ...	54 25	17·0	2·937	2·936	54 27	138 46	138 36	+0 10	+0 2	−0 1
Means ...	53 52	15·7	2·954	2·914	55 2	138 43	138 35	+0 8	...	... ...
1886.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January	54 0	17·5	2·950	2·932	54 31	138 43	138 36	+0 7	+0 19	+0 11
February	54 5	14·5	2·939	2·946	53 53	138 29	138 36	−0 7	+0 5	−0 7
March	53 57	14·7	2·940	2·943	53 52	138 23	138 36	−0 13	−0 1	−0 4
April	52 25	15·0	2·982	2·944	53 30	138 3	138 37	−0 34	−0 22	−0 20
May	51 6	16·5	3·021	2·946	53 15	137 51	138 37	−0 46	−0 34	−0 25
June	52 20	13·5	2·993	2·958	53 20	138 17	138 37	−0 20	−0 8	−0 6
July	52 49	15·0	2·982	2·953	53 39	138 27	138 37	−0 10	+0 2	+0 2
August	51 25	15·5	3·033	2·962	53 27	138 31	138 37	−0 6	+0 6	+0 8
September	51 13	16·2	3·037	2·973	53 3	138 26	138 37	−0 11	+0 1	+0 2
October	52 8	18·2	3·002	2·971	53 1	138 20	138 38	−0 18	−0 6	−0 1
November	52 28	14·5	3·001	2·979	53 6	138 39	138 38	+0 1	+0 13	+0 13
December	52 56	16·0	2·992	2·987	53 4	138 51	138 38	+0 13	+0 25	+0 22
Means	52 34	15·6	2·989	2·958	53 28	138 25	138 37	−0 12	...	...
1887.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	52 30	16·7	3·011	2·991	53 4	138 58	138 38	+0 20	+0 9	+0 1
February ...	53 1	13·7	3·005	2·996	53 16	139 18	138 38	+0 40	+0 29	+0 17
March ...	53 3	17·2	2·996	2·996	53 3	139 5	138 38	+0 27	+0 16	+0 13
April ...	51 0	17·5	3·061	2·999	52 47	138 55	138 39	+0 16	+0 5	+0 7
May ...	50 39	15·5	3·064	3·007	52 17	138 39	138 39	0 0	−0 11	−0 2
June ...	50 38	16·0	3·071	3·009	52 25	138 51	138 39	+0 12	+0 1	+0 3
July ...	50 18	17·7	3·078	3·013	52 10	138 42	138 39	+0 3	−0 8	−0 8
August ...	49 56	15·0	3·089	3·016	52 2	138 40	138 39	+0 1	−0 10	−0 8
September ...	49 56	15·0	3·088	3·015	52 2	138 38	138 39	−0 1	−0 12	−0 11
October ...	50 32	16·7	3·062	3·021	51 43	138 29	138 39	−0 10	−0 21	−0 16
November ...	51 9	13·5	3·054	3·029	51 52	138 52	138 39	+0 13	+0 2	+0 2
December ...	51 49	15·0	3·032	3·037	51 40	138 54	138 39	+0 15	+0 4	+0 1
Means ...	51 13	15·8	3·051	3·011	52 22	138 50	138 39	+0 11	...	...
1888.										
	′ ″		in.	in.	′ ″	′	′ ″	′ ″	′ ″	′ ″
January	51 1	15·5	3·050	3·043	51 13	138 37	138 40	−0 3	−0 24	−0 32
February	51 4	12·5	3·061	3·042	51 37	138 59	138 40	+0 19	−0 2	−0 14
March	51 27	15·2	3·053	3·042	51 46	139 8	138 40	+0 28	+0 7	+0 4
April	50 16	15·5	3·109	3·043	52 10	139 34	138 40	+0 54	+0 33	+0 35
May	49 56	17·2	3·115	3·048	51 51	139 24	138 40	+0 44	+0 23	+0 32
June	50 0	17·5	3·098	3·054	51 16	138 59	138 40	+0 19	−0 2	0 0
July	49 15	15·5	3·128	3·055	51 21	139 6	138 40	+0 26	+0 5	+0 5
August	49 10	16·4	3·128	3·058	51 11	139 1	138 40	+0 21	0 0	+0 2
September	48 53	16·5	3·131	3·057	51 1	138 49	138 40	+0 9	−0 12	−0 11
October	49 59	14·5	3·101	3·064	51 3	139 3	138 40	+0 23	+0 2	+0 7
November	50 5	15·0	3·093	3·063	50 57	138 56	138 40	+0 16	−0 5	−0 5
December	49 42	16·5	3·095	3·078	50 11	138 35	138 40	−0 5	−0 26	−0 29
Means	50 4	15·6	3·097	3·054	51 18	139 1	138 40	+0 21	...	...

TABLE III.—*Reductions of monthly and annual means of Absolute Declination.*

Month.	Mean observed Absolute Declination.	Mean Date of Observation.	Mean ordinate of Declination Magnetograms corresponding to times of Absolute Observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly Absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Differences in Column 9 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11
	1889.									
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	49 35	17·0	3·099	3·083	50 3	138 36	138 41	−0 5	−0 9	−0 17
February ...	49 1	14·0	3·123	3·094	49 51	138 43	138 41	+0 2	−0 2	−0 14
March ...	49 38	14·2	3·099	3·092	49 50	138 39	138 41	−0 2	−0 6	−0 9
April ...	47 57	14·5	3·162	3·100	49 44	138 46	138 41	+0 5	+0 1	+0 3
May ...	47 39	16·0	3·169	3·101	49 36	138 40	138 41	−0 1	−0 5	+0 4
June ...	48 10	16·5	3·149	3·107	49 22	138 36	138 41	−0 5	−0 9	−0 7
July ...	48 6	14·5	3·153	3·117	49 8	138 39	138 41	−0 2	−0 6	−0 6
August ...	47 36	15·0	3·169	3·110	49 18	138 37	138 41	−0 4	−0 8	−0 6
September ...	46 54	15·5	3·197	3·120	49 7	138 43	138 41	+0 2	−0 2	−0 1
October ...	48 1	17·0	3·168	3·124	49 17	139 0	138 41	+0 19	+0 15	+0 20
November ...	47 50	17·5	3·177	3·129	49 13	139 5	138 41	+0 24	+0 20	+0 20
December ...	48 14	15·5	3·160	3·141	48 47	139 0	138 41	+0 19	+0 15	+0 12
Means ...	48 13	15·6	3·152	3·110	49 26	138 45	138 41	+0 4	...	...
	1890.									
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	″	′ ″
January ...	47 48	16·0	3·171	3·144	48 35	138 53	138 41	+0 2	+0 12	+0 4
February ...	48 35	16·5	3·145	3·150	48 26	138 54	138 41	+0 3	+0 13	+0 1
March ...	47 29	16·5	3·181	3·158	48 9	138 51	138 41	+0 10	+0 10	+0 7
April ...	46 47	13·5	3·197	3·168	47 37	138 36	138 41	−0 5	−0 5	−0 3
May ...	46 9	15·0	3·218	3·166	47 39	138 35	138 41	−0 6	−0 6	+0 3
June ...	45 34	15·5	3·234	3·180	47 7	138 27	138 41	−0 14	−0 14	−0 12
July ...	45 5	13·5	3·258	3·189	47 4	138 39	138 41	−0 2	−0 2	−0 2
August ...	45 16	14·4	3·259	3·189	47 17	138 52	138 41	+0 11	+0 11	+0 13
September ...	44 34	14·7	3·276	3·195	46 54	138 40	138 41	−0 10	−0 10	−0 9
October ...	45 49	16·2	3·232	3·195	46 53	138 39	138 41	−0 11	−0 11	−0 6
November ...	46 18	16·7	3·220	3·200	46 52	138 46	138 41	−0 4	−0 4	−0 4
December ...	47 4	14·5	3·197	3·212	46 38	138 53	138 41	+0 3	+0 3	0 0
Means ...	46 22	15·2	3·216	3·179	47 26	138 41	138 41	0 0	...	...
	1891.									
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	46 22	15·0	3·220	3·219	46 24	138 51	138 41	+0 10	+0 1	−0 7
February ...	46 16	15·5	3·234	3·218	46 44	139 9	138 41	+0 28	+0 19	+0 7
March ...	46 8	15·5	3·230	3·215	46 34	138 54	138 41	+0 13	+0 4	+0 1
April ...	44 54	16·0	3·267	3·220	46 15	138 43	138 41	+0 2	−0 7	−0 5
May ...	43 24	17·5	3·310	3·222	45 56	138 28	138 41	−0 13	−0 22	−0 13
June ...	43 33	14·5	3·315	3·235	45 51	138 45	138 41	+0 4	−0 5	−0 3
July ...	43 43	16·0	3·305	3·252	45 14	138 38	138 41	−0 3	−0 12	−0 12
August ...	43 13	17·2	3·326	3·254	45 17	138 44	138 41	+0 3	−0 6	−0 4
September ...	42 33	13·5	3·356	3·254	45 29	138 56	138 41	+0 15	+0 6	+0 7
October ...	43 44	15·0	3·309	3·252	45 22	138 46	138 41	+0 5	−0 4	+0 1
November ...	44 34	15·5	3·292	3·256	45 36	139 6	138 41	+0 25	+0 16	+0 16
December ...	44 53	17·0	3·280	3·270	45 10	139 5	138 40	+0 25	+0 16	+0 13
Means ...	44 26	15·7	3·287	3·239	45 49	138 50	138 41	+0 9	...	...
	1892.									
	′ ″		in.	in.	′ ″	′ ″	′	′ ″	′ ″	′
January ...	43 40	18·0	3·312	3·269	44 54	138 47	138 40	+0 7	+0 12	+0 4
February ...	44 19	14·5	3·293	3·264	45 9	138 53	138 40	+0 13	+0 18	+0 6
March ...	44 11	17·0	3·284	3·264	44 45	138 29	138 40	−0 11	−0 6	−0 9
April ...	42 15	17·5	3·344	3·278	44 9	138 17	138 40	−0 23	−0 18	−0 16
May ...	42 15	15·5	3·341	3·279	44 2	138 12	138 40	−0 28	−0 23	−0 14
June ...	41 31	16·0	3·369	3·304	43 23	138 17	138 40	−0 23	−0 18	−0 16
July ...	41 52	17·5	3·349	3·300	43 16	138 3	138 40	−0 37	−0 32	−0 32
August ...	41 16	14·5	3·381	3·314	43 11	138 22	138 40	−0 18	−0 13	−0 11
September ...	41 29	15·0	3·383	3·316	43 24	138 39	138 40	−0 1	+0 4	+0 5
October ...	42 8	16·5	3·363	3·312	43 36	138 44	138 40	+0 4	+0 9	+0 14
November ...	43 16	13·5	3·342	3·329	43 38	139 15	138 40	+0 35	+0 40	+0 40
December ...	43 46	15·0	3·317	3·336	43 13	139 2	138 39	+0 23	+0 28	+0 25
Means ...	42 40	15·9	3·340	3·297	43 53	138 35	138 40	−0 5	...	...
	1893.									
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	42 2	15·7	3·383	3·350	42 59	139 12	138 39	+0 33	+0 22	+0 14
February ...	41 25	12·5	3·398	3·350	42 48	139 1	138 39	+0 22	+0 11	−0 1
March ...	41 13	16·0	3·403	3·358	42 31	138 58	137 39	+0 19	+0 8	+0 5
April ...	41 8	16·5	3·400	3·363	42 12	138 48	138 39	+0 9	−0 2	0 0
May ...	39 19	14·7	3·470	3·378	41 58	138 59	138 39	+0 20	+0 9	+0 18
June ...	39 34	15·0	3·448	3·390	41 14	138 36	138 39	−0 3	−0 14	−0 12
July ...	39 7	16·5	3·457	3·395	40 54	138 25	138 39	−0 14	−0 25	−0 25
August ...	38 15	17·0	3·477	3·392	40 41	138 7	138 39	−0 32	−0 43	−0 41
September ...	38 32	17·7	3·475	3·394	40 52	138 21	138 38	−0 17	−0 28	−0 27
October ...	40 12	15·7	3·438	3·394	41 28	138 57	138 38	+0 19	+0 8	+0 13
November ...	41 27	16·2	3·401	3·411	41 10	139 8	138 38	+0 30	+0 19	+0 19
December ...	41 29	17·5	3·411	3·429	40 58	139 27	138 38	+0 49	+0 38	+0 35
Means ...	40 19	15·9	3·430	3·384	41 39	138 50	138 39	+0 11	...	...
	1894.									
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	41 24	14·5	3·408	3·4313	40 44	139 17	138 38	+0 39	+0 32	+0 24
February ...	40 29	11·5	3·428	3·4255	40 33	138 56	138 38	+0 18	+0 11	−0 1
March ...	39 53	15·0	3·440	3·4287	40 12	138 40	138 37	+0 3	−0 4	−0 7
April ...	38 17	15·5	3·481	3·4393	39 29	138 16	138 37	−0 21	−0 28	−0 26
May ...	38 4	17·0	3·492	3·4501	39 16	138 21	138 37	−0 16	−0 23	−0 14
June ...	37 36	17·5	3·507	3·4542	39 7	138 19	138 37	−0 18	−0 25	−0 23
July ...	37 13	15·5	3·513	3·4500	39 2	138 7	138 37	−0 30	−0 37	−0 37
August ...	37 1	16·4	3·534	3·4523	39 22	138 31	138 37	−0 6	−0 13	−0 11
September ...	37 3	16·5	3·543	3·4576	39 30	138 48	138 36	+0 12	+0 5	+0 6
October ...	37 39	14·5	3·528	3·4698	39 19	138 58	138 36	+0 22	+0 15	+0 20
November ...	38 50	15·0	3·496	3·4803	39 17	139 14	138 36	+0 38	+0 31	+0 31
December ...	39 15	16·5	3·481	3·4952	38 51	139 14	138 36	+0 38	+0 31	+0 28
Means ...	38 34	15·4	3·488	3·4529	39 33	138 43	138 37	+0 7	...	...

From September to December 1890, the monthly mean zeros are corrected for 9″ due to the introduction of the V. F. No. 2 magnet in the magnetograph room in order to make them comparable with those of previous months.

TABLE III.—*Reductions of monthly and annual means of Absolute Declination.*

Month.	Mean observed absolute Declination	Mean date of observation.	Mean ordinate of Declination Magnetograms corresponding to times of absolute observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc.)	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Differences in Column 9 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11
1895.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	38 4	17·0	3·518	3·5027	38 30	139 6	138 36	+0 30	+0 19	+0 11
February ...	38 8	17·5	3·512	3·5015	38 26	139 0	138 36	+0 24	+0 13	+0 1
March ...	37 3	17·5	3·542	3·5063	38 4	138 46	138 35	+0 11	0 0	−0 3
April ...	36 26	14·7	3·560	3·5204	37 34	138 40	138 35	+0 5	−0 6	−0 4
May ...	35 18	16·0	3·597	3·5283	37 16	138 35	138 35	0 0	−0 11	−0 2
June ...	35 30	16·5	3·591	3·5378	37 2	138 38	138 35	+0 3	−0 8	−0 6
July ...	35 40	14·5	5·586	3·5479	36 46	138 40	138 35	+0 5	−0 6	−0 6
August ...	34 55	15·0	3·610	3·5574	36 25	138 35	138 34	+0 1	−0 10	−0 8
September ...	34 50	15·5	3·624	3·5673	36 27	138 53	138 34	+0 19	+0 8	+0 9
October ...	35 46	17·0	3·581	3·5612	36 20	138 37	138 34	+0 3	−0 8	−0 3
November ...	36 2	17·5	3·580	3·5610	36 35	138 51	138 34	+0 17	+0 6	+0 6
December ...	36 12	15·5	3·575	3·5783	36 6	138 52	138 33	+0 19	+0 8	+0 5
Means ...	36 9	16·2	3·573	3·539	37 8	138 46	138 35	+0 11	...	...
1896.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	35 12	16·0	3·606	3·5867	35 45	138 46	138 33	+0 13	+0 13	+0 5
February ...	35 0	16·5	3·605	3·5836	35 37	138 32	138 33	−0 1	−0 1	−0 13
March ...	34 13	15·5	3·618	3·5759	35 25	138 7	138 33	−0 26	−0 26	−0 29
April ...	33 34	16·0	3·632	3·5801	35 3	137 52	138 32	−0 40	−0 40	−0 38
May ...	33 19	17·7	3·655	3·5837	35 22	138 17	138 32	−0 15	−0 15	−0 6
June ...	33 51	14·5	3·635	3·6100	34 34	138 15	138 32	−0 17	−0 17	−0 15
July ...	33 39	16·0	3·651	3·6224	34 28	138 30	138 32	+0 8	+0 8	+0 8
August ...	32 51	16·5	3·678	3·6276	34 18	138 29	138 31	+0 8	+0 8	+0 10
September ...	33 1	13·7	3·701	3·6245	35 13	139 19	138 31	+0 48	+0 48	+0 49
October ...	33 22	15·2	3·664	3·6151	34 46	138 36	138 31	+0 5	+0 5	+0 10
November ...	33 46	15·7	3·652	3·6307	34 23	138 39	138 31	+0 8	+0 8	+0 8
December ...	33 20	17·0	3·670	3·6454	34 2	138 44	138 30	+0 14	+0 14	+0 11
Means ...	33 46	15·9	3·647	3·607	34 55	138 30	138 32	0 0	...	...
1897.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	32 49	17·5	3·694	3·6587	33 50	138 55	138 30	+0 25	−0 2	−0 10
February ...	32 47	14·5	3·696	3·6693	33 33	138 56	138 30	+0 26	−0 1	−0 13
March ...	33 8	14·5	3·696	3·6742	33 45	139 16	138 30	+0 46	+0 19	+0 16
April ...	32 5	15·0	3·723	3·6706	33 35	139 0	138 30	+0 30	+0 3	+0 5
May ...	31 25	16·5	3·741	3·6802	33 10	138 52	138 29	+0 23	−0 4	+0 5
June ...	30 25	13·7	3·777	3·6964	32 44	138 54	138 29	+0 25	−0 2	0 0
July ...	30 58	15·0	3·778	3·7200	32 38	139 28	138 29	+0 59	+0 32	+0 32
August ...	29 17	15·7	3·816	3·7229	31 57	138 52	138 28	+0 24	−0 3	−0 1
September ...	29 44	16·0	3·808	3·7306	31 57	139 6	138 28	+0 38	+0 11	+0 12
October ...	30 46	17·7	3·764	3·7241	31 55	138 52	138 28	+0 24	−0 3	+0 2
November ...	30 54	14·5	3·741	3·7231	31 25	138 21	138 27	−0 6	−0 33	−0 33
December ...	31 35	16·0	3·725	3·7297	31 27	138 34	138 27	+0 7	−0 20	−0 23
Means ...	31 19	15·5	3·747	3·700	32 40	138 55	138 29	+0 27	...	...
1898.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	30 33	17·0	3·755	3·7437	30 52	138 23	138 27	−0 4	−0 9	−0 17
February ...	30 13	13·5	3·774	3·7531	30 49	138 36	138 26	+0 10	+0 5	−0 7
March ...	31 41	14·0	3·728	3·7495	31 4	138 45	138 26	+0 19	+0 14	+0 11
April ...	28 16	14·2	3·827	3·7618	30 8	138 10	138 26	−0 16	−0 21	−0 19
May ...	27 30	15·5	3·849	3·7715	29 43	138 2	138 25	−0 23	−0 28	−0 19
June ...	28 20	16·0	3·846	3·7938	29 50	138 47	138 25	+0 22	+0 17	+0 19
July ...	28 4	17·5	3·854	3·8046	29 29	138 45	138 25	+0 20	+0 15	+0 15
August ...	27 37	14·5	3·875	3·8110	29 27	138 54	138 24	+0 30	+0 25	+0 27
September ...	27 6	15·0	3·894	3·8155	29 21	138 56	138 24	+0 32	+0 27	+0 28
October ...	27 52	16·5	3·849	3·8092	29 0	138 24	138 24	0 0	−0 5	0 0
November ...	27 59	13·5	3·843	3·8212	28 36	138 21	138 23	−0 2	−0 7	−0 7
December ...	27 43	15·0	3·838	3·8330	27 52	137 57	138 23	−0 26	−0 31	−0 34
Means ...	28 34	15·2	3·828	3·789	29 41	138 30	138 25	+0 5	...	...
1899.										
	′		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	26 19	15·5	3·9037	3·8527	27 47	138 26	138 23	+0 3	+0 4	−0 4
February ...	26 32	12·5	3·8999	3·8582	27 44	138 32	138 22	+0 10	+0 11	−0 1
March ...	26 30	16·0	3·8841	3·8572	27 16	138 3	138 22	−0 19	−0 18	−0 21
April ...	25 50	16·7	3·9074	3·8641	27 4	138 3	138 22	−0 19	−0 18	−0 16
May ...	24 36	14·7	3·9635	3·8791	27 1	138 25	138 21	+0 4	+0 5	+0 14
June ...	25 36	15·2	3·9443	3·9023	26 48	138 52	138 21	+0 31	+0 32	+0 34
July ...	25 9	16·5	3·9428	3·9015	26 20	138 23	138 20	+0 3	+0 4	+0 4
August ...	24 4	17·0	3·9788	3·9104	26 2	138 20	138 20	0 0	+0 1	+0 3
September ...	24 14	17·5	3·9667	3·9186	25 37	138 10	138 20	−0 21	−0 20	−0 19
October ...	25 8	15·5	3·9473	3·9129	26 7	138 30	138 19	+0 11	+0 12	+0 17
November ...	25 24	16·2	3·9307	3·9227	25 38	138 17	138 19	−0 2	−0 1	−0 1
December ...	25 17	17·5	3·9305	3·9303	25 17	138 10	138 18	−0 8	−0 7	−0 10
Means ...	25 23	15·9	3·933	3·892	26 33	138 20	138 21	−0 1	...	...
1900.										
	′ ″		in.	in.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	25 1	14·5	3·9703	3·9406	25 52	139 2	138 18	+0 44	+0 20	+0 1[illegible]
February ...	25 37	11·5	3·9634	3·9527	25 55	139 26	138 18	+1 8	+0 44	+0 3[illegible]
March ...	23 55	15·2	4·0014	3·9522	25 20	138 50	138 17	+0 33	+0 9	+0 [illegible]
April ...	23 10	15·7	4·0152	3·9566	24 51	138 29	138 17	+0 12	−0 12	−0 1[illegible]
May ...	23 9	17·2	4·0203	3·9596	24 53	138 36	138 16	+0 20	−0 4	+0 [illegible]
June ...	23 15	17·5	4·0168	3·9756	24 26	138 37	138 16	+0 21	−0 3	−0 [illegible]
July ...	22 52	15·5	4·0333	3·9781	24 27	138 42	138 15	+0 27	+0 3	+0 [illegible]
August ...	22 0	16·2	4·0648	3·9868	24 14	138 44	138 15	+0 29	+0 5	+0 [illegible]
September ...	20 20	16·5	4·1105	3·9934	23 41	138 22	138 15	+0 7	−0 17	−0 1[illegible]
October ...	22 31	15·0	4·0264	3·9851	23 42	138 9	138 14	−0 5	−0 29	−0 2[illegible]
November ...	22 33	15·0	4·0407	4·0029	23 38	138 36	138 14	+0 22	−0 2	−0 [illegible]
December ...	22 44	16·5	4·0299	4·0132	23 13	138 29	138 13	+0 16	−0 8	−0 1[illegible]
Means ...	23 6	15·5	4·024	3·975	24 31	138 40	138 16	+0 24	...	...

TABLE III.—*Reductions of monthly and annual means of Absolute Declination.*

1901.

Month.	Mean observed absolute Declination.	Mean date of observation.	Mean ordinate of Declination Magnetograms corresponding to times of absolute observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Differences in Column 9 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11
	′ ″		c. m.	c. m.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	23 16	17·0	10·185	10·225	22 49	138 28	138 13	+0 15	+0 3	−0 5
February ...	22 30	17·5	10·269	10·244	22 48	138 39	138 13	+0 26	+0 14	+0 2
March ...	21 22	18·0	10·309	10·239	22 10	137 59	138 12	−0 13	−0 25	−0 28
April ...	21 11	14·5	10·351	10·255	22 16	138 16	138 12	+0 4	−0 8	−0 6
May ...	20 35	16·0	10·407	10·273	22 6	138 18	138 11	+0 7	−0 5	+0 4
June ...	20 30	16·7	10·443	10·315	21 57	138 37	138 11	+0 26	+0 14	+0 16
July ...	20 22	14·2	10·476	10·353	21 46	138 52	138 10	+0 42	+0 30	+0 30
August ...	19 40	15·2	10·519	10·352	21 33	138 38	138 10	+0 28	+0 16	+0 18
September ...	19 8	16·0	10·504	10·311	21 19	137 57	138 10	−0 13	−0 25	−0 24
October ...	20 15	17·0	10·407	10·322	21 13	137 58	138 9	−0 11	−0 23	−0 18
November ...	21 9	17·7	10·374	10·363	21 16	138 29	138 8	+0 21	+0 9	+0 9
December ...	21 12	15·5	10·354	10·369	21 2	138 19	138 8	+0 11	−0 1	−0 4
Mean ...	20 56	16·7	10·383	10·302	21 51	138 22	138 11	+0 12	...	...

1902.

Month.	Mean observed absolute Declination.	Mean date of observation.	Mean ordinate of Declination Magnetograms corresponding to times of absolute observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Difference in Column 8 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11
	′ ″		c. m.	c. m.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	20 53	16·2	10·382	10·398	20 42	138 19	138 7	+0 12	+0 7	−0 1
February ...	20 30	16·5	10·447	10·435	20 38	138 40	138 7	+0 33	+0 28	+0 16
March ...	20 0	16·7	10·476	10·439	20 25	138 29	138 6	+0 23	+0 18	+0 15
April ...	19 41	14·0	10·490	10·441	20 14	138 20	138 6	+0 14	+0 9	+0 11
May ...	18 35	15·0	10·569	10·455	19 52	138 7	138 5	+0 2	−0 3	+0 6
June ...	17 20	15·7	10·663	10·482	19 23	137 57	138 5	−0 8	−0 13	−0 11
July ...	18 4	17·0	10·627	10·522	19 15	138 16	138 4	+0 12	+0 7	+0 7
August ...	16 26	17·7	10·771	10·553	18 54	138 16	138 4	+0 12	+0 7	+0 9
September ...	16 46	14·7	10·749	10·558	18 56	138 21	138 3	+0 18	+0 13	+0 14
October ...	17 52	16·2	10·627	10·556	18 40	138 4	138 3	+0 1	−0 4	+0 1
November ...	17 59	16·5	10·576	10·558	18 11	137 36	138 3	−0 27	−0 32	−0 32
December ...	17 25	14·5	10·612	10·573	17 51	137 27	138 2	−0 35	−0 40	−0 43
Mean ...	18 28	15·9	10·582	10·497	19 25	138 9	138 5	+0 5	...	...

1903.

Month.	Mean observed absolute Declination.	Mean date of observation.	Mean ordinate of Declination Magnetograms corresponding to times of absolute observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Differences in Column 9 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11
	′ ″		c. m.	c. m.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	18 17	15·2	10·620	10·571	18 50	138 24	138 2	+0 22	+0 3	−0 5
February ...	18 1	15·7	10·641	10·623	18 13	138 22	138 1	+0 21	+0 2	−0 10
March ...	17 58	15·5	10·670	10·628	18 27	138 40	138 0	+0 40	+0 21	+0 18
April ...	16 29	16·4	10·742	10·627	17 47	137 59	138 0	−0 1	−0 20	−0 18
May ...	15 8	17·5	10·828	10·652	17 8	137 37	137 59	−0 22	−0 41	−0 32
June ...	16 0	14·5	10·785	10·674	17 15	137 59	137 59	0 0	−0 19	−0 17
July ...	16 36	16·0	10·799	10·705	17 40	138 45	137 58	+0 47	+0 28	+0 28
August ...	15 29	17·0	10·893	10·707	17 35	138 41	137 58	+0 43	+0 24	+0 26
September ...	15 26	13·7	10·878	10·735	17 3	138 28	137 57	+0 31	+0 12	+0 13
October ...	16 48	15·0	10·735	10·691	17 18	138 13	137 57	+0 16	−0 3	+0 2
November ...	16 45	15·5	10·735	10·713	17 0	138 10	137 56	+0 14	−0 5	−0 5
December ...	16 54	17·0	10·720	10·741	16 40	138 9	137 56	+0 13	−0 6	−0 9
Mean ...	16 39	15·7	10·754	10·672	17 35	138 17	137 59	+0 19	...	...

1904.

Month.	Mean observed absolute Declination.	Mean date of observation.	Mean ordinate of Declination Magnetograms corresponding to times of absolute observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Difference in Column 8 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11
	′ ″		c. m.	c. m.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	16 28	17·5	10·778	10·756	16 43	138 23	137 55	+0 28	+0 4	−0 4
February ...	15 47	14·5	10·843	10·794	16 20	138 25	137 54	+0 31	+0 7	−0 5
March ...	15 49	17·0	10·857	10·796	16 30	138 37	137 54	+0 43	+0 19	+0 16
April ...	14 33	17·5	10·950	10·811	16 7	138 24	137 53	+0 31	+0 7	+0 9
May ...	14 44	15·5	10·878	10·803	15 35	137 46	137 53	−0 7	−0 31	−0 22
June ...	14 31	16·0	10·929	10·844	15 29	138 8	137 52	+0 16	−0 8	−0 6
July ...	14 42	17·5	10·950	10·878	15 31	138 33	137 51	+0 42	+0 18	+0 18
August ...	12 43	14·7	11·123	10·906	15 10	138 31	137 51	+0 40	+0 16	+0 18
September ...	12 38	15·0	11·094	10·908	14 44	138 7	137 50	+0 17	−0 7	−0 6
October ...	13 15	16·5	11·037	10·906	14 44	138 5	137 50	+0 15	−0 9	−0 4
November ...	14 21	13·5	10·900	10·900	14 21	137 38	137 49	−0 11	−0 35	−0 35
December ...	14 2	15·0	11·001	10·947	14 39	138 28	137 48	+0 40	+0 16	+0 13
Mean ...	14 28	15·8	10·945	10·854	15 29	138 15	137 52	+0 24	...	...

1905.

Month.	Mean observed absolute Declination.	Mean date of observation.	Mean ordinate of Declination Magnetograms corresponding to times of absolute observations.	Mean monthly ordinate of Declination Magnetograms.	Mean monthly absolute Declination.	Mean monthly value of Zero (in arc).	Mean monthly value of Zero calculated by Formula.	Differences, Column 7—Column 8.	Differences in Column 9 corrected for mean annual excess.	Differences in Column 10 corrected for annual variation of Zero.
1	2	3	4	5	6	7	8	9	10	11
	′ ″		c. m.	c. m.	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
January ...	14 39	15·5	10·900	10·932	14 17	137 56	137 48	+0 8	+0 9	+0 1
February ...	15 17	12·5	10·821	10·921	14 9	137 41	137 47	−0 6	−0 5	−0 17
March ...	13 4	16·0	11·022	10·931	14 6	137 44	137 47	−0 3	−0 2	−0 5
April ...	12 39	16·7	11·101	10·946	14 24	138 13	137 46	+0 27	+0 28	+0 30
May ...	12 39	14·5	11·022	10·906	13 58	137 19	137 46	−0 27	−0 26	−0 17
June ...	12 34	15·0	11·087	10·921	14 27	137 59	137 45	+0 14	+0 15	+0 17
July ...	11 18	16·5	11·180	10·971	13 40	137 45	137 44	+0 1	+0 2	+0 2
August ...	11 55	17·4	11·137	10·954	13 59	137 53	137 44	+0 9	+0 10	+0 12
September ...	11 10	18·0	11·202	10·958	13 56	137 53	137 43	+0 10	+0 11	+0 12
October ...	12 15	15·5	11·080	10·946	13 46	137 35	137 43	−0 8	−0 7	−0 2
November ...	12 53	16·2	10·994	10·937	13 32	137 14	137 42	−0 28	−0 27	−0 27
December ...	13 55	17·5	10·936	10·974	13 29	137 37	137 42	−0 5	−0 4	−0 7
Mean ...	12 51	15·9	11·040	10·941	13 59	137 44	137 45	−0 1	...	...

TABLE 112.—*Mean monthly and yearly values of D. Magnetograph Zero and Annual Inequalities.*

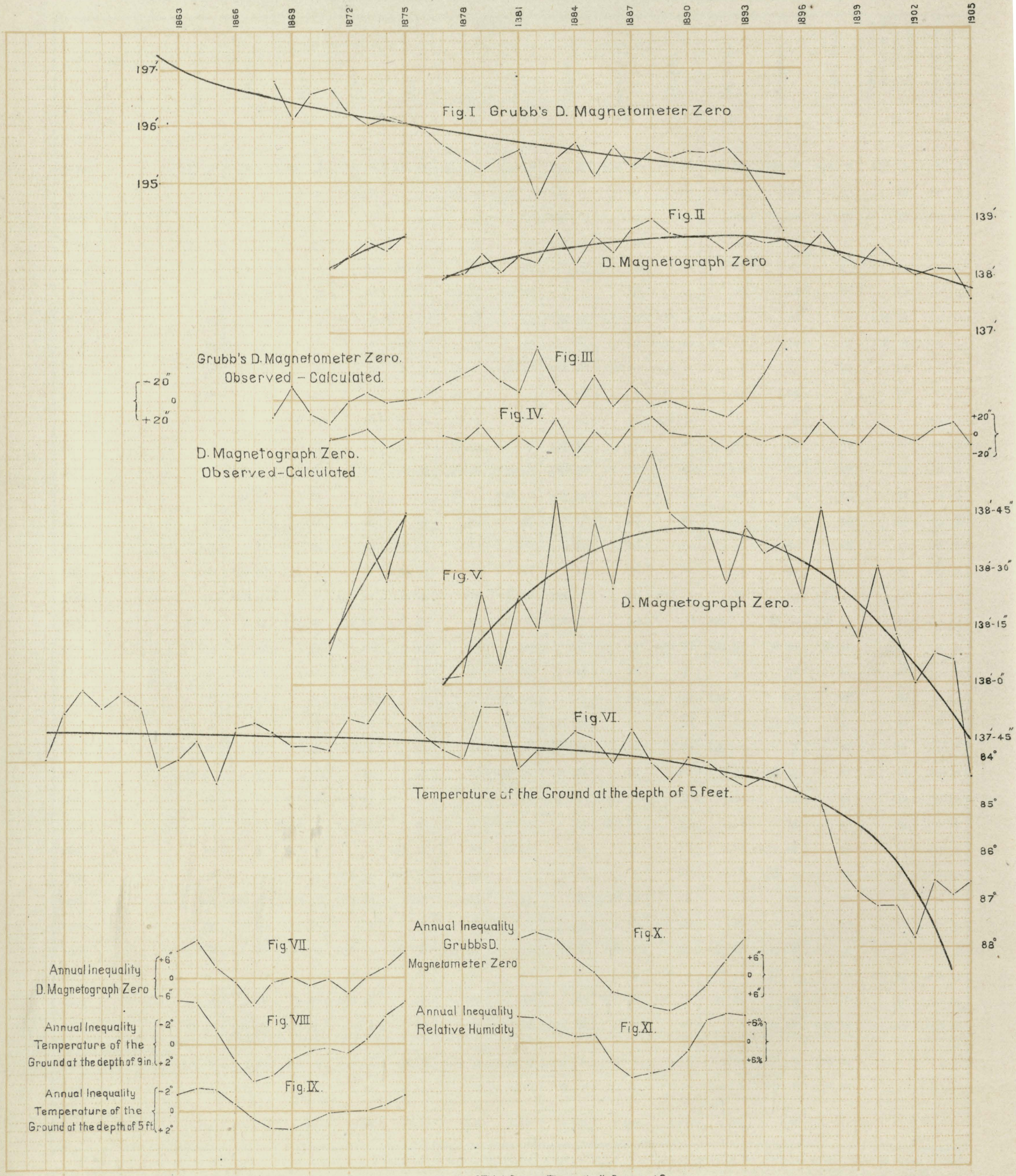
Year.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly mean.	Yearly means calculated by the method of least squares	Observed *minus* calculated.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
1871	138 54	138 52	138 58	139 8	138 25	137 14	137 22	137 43	137 21	137 46	137 56	138 8	138 9	138 11	−0 2
1872	25	8	137 59	138 27	37	138 25	138 1	138 9	138 32	138 26	138 44	40	23	20	+0 3
1873	139 1	48	138 32	27	50	38	51	139 3	23	21	24	19	38	28	+0 10
1874	138 10	22	30	21	25	39	25	138 14	20	27	43	53	27	37	−0 10
1875	139 4	139 6	50	56	139 11	52	38	37	6	20	27	51	45	44	+0 1
1876	138 54	138 39	25	16	138 7	137 49	137 46	1	20	19	13	18	16	22	−0 6
1877	26	14	17	9	3	48	35	137 43	137 54	138 0	137 59	10	1	137 59	+0 2
1878	25	34	14	16	137 51	52	48	25	38	137 44	138 0	34	2	138 6	−0 4
1879	36	35	26	13	138 19	138 24	138 42	138 28	138 47	138 3	5	15	24	11	+0 13
1880	17	14	137 46	9	137 47	137 57	2	12	1	137 43	15	25	4	17	−0 13
1881	25	23	138 15	24	138 45	138 29	11	22	12	138 27	39	4	23	21	+0 2
1882	12	4	10	19	137 57	137 59	6	137 54	15	29	40	44	14	26	−0 12
1883	47	139 11	56	56	138 43	139 32	139 13	138 52	38	39	9	15	49	29	+0 20
1884	7	138 27	23	19	3	138 7	138 0	137 55	8	12	24	34	13	32	−0 19
1885	40	41	32	44	49	53	49	138 47	47	25	39	46	43	35	+0 8
1886	43	29	23	3	137 51	17	27	31	26	20	39	51	25	37	−0 12
1887	58	139 18	139 5	55	138 39	51	42	40	38	29	52	54	50	39	+0 11
1888	37	138 59	8	139 34	139 24	59	139 6	139 1	49	139 3	56	35	139 1	40	+0 21
1889	36	43	138 39	138 46	138 40	36	138 39	138 37	43	0	139 5	139 0	138 45	41	+0 4
1890	53	54	51	36	35	27	39	52	31	138 30	138 37	138 44	138 41	41	0 0
1891	42	139 0	45	34	19	36	29	35	47	37	57	56	41	41	0 0
1892	38	138 44	20	8	3	8	137 54	13	30	35	139 6	53	26	40	−0 14
1893	139 3	52	49	39	50	27	138 16	137 58	12	48	138 59	139 18	41	39	+0 2
1894	8	47	31	7	12	10	137 58	138 22	39	49	139 5	5	34	37	−0 3
1895	138 57	51	37	31	26	29	138 31	26	44	28	138 42	138 43	37	35	+0 2
1896	37	23	137 58	137 43	8	6	21	20	139 10	27	30	35	21	32	−0 11
1897	46	47	139 7	138 51	43	45	139 19	43	138 57	43	12	25	46	29	+0 17
1898	14	27	138 36	1	137 53	38	138 36	45	47	15	12	137 48	21	25	−0 4
1899	17	23	137 54	137 54	138 16	43	14	11	1	21	8	138 1	11	21	−0 10
1900	53	139 17	138 41	138 20	27	28	33	35	138 13	0	27	20	31	16	+0 15
1901	19	138 30	137 50	7	9	28	43	29	137 48	137 49	20	10	13	11	+0 2
1902	10	31	138 20	138 11	137 58	137 48	7	7	138 12	55	137 27	137 18	0	5	−0 5
1903	15	13	31	137 50	28	50	36	32	19	138 4	138 1	138 0	8	137 59	+0 9
1904	14	16	28	138 15	37	59	24	22	137 58	137 56	137 29	19	6	52	+0 14
1905	137 47	137 32	137 35	4	10	50	137 36	137 44	44	26	5	137 28	137 35	45	−0 10
Annual Inequality— 1877-1905 ...	+0 8	+0 12	+0 3	−0 2	−0 9	−0 2	0 0	−0 2	−0 1	−0 5	0 0	+0 3	138 24	...	...
1871-75 ...	+0 15	+0 11	+0 6	+0 12	+0 14	−0 6	−0 13	−0 7	−0 20	−0 12	−0 1	+0 6	138 28	...	...
Ground temperature 9 inches deep ...	−4·5	−[illegible]	−1·3	+1·8	+4·0	+3·6	+1·7	+0·8	+0·4	+1·0	−0·4	−2·8			

Monthly and annual means from 1891 to 1905 are corrected for 9″ due to the introduction of the V. F. No. 2 magnet in the magnetograph room in order to make them comparable with those of previous years, and the calculated values in column 15 for 1871 to 1876 are corrected for 59″ due to the exhaustion in July 1876.

Colaba Observatory.

Curves showing the behaviour of the Grubb's Declinometer and Declination Magnetograph as indicating the Secular and Annual Variations of Absolute Declination.

Plate 4.



Figs. I, II, V and VI. { Thick Curve = Theoretically Computed Curve
Thin Curve = Observed Curve }

Govt Photozinco. Office, Poona, 1909.

the series may be approximately represented by the formula $\xi = \alpha + \beta t + \gamma t^2$ where t is the time in number of years counted from a convenient starting initial year. The values of the constants derived from 29 equations of condition, by least squares are $\alpha = 137' \, 52''.7$ east of north; $\beta = 7''.0$; and $\gamma = -0''.25$, the initial year being 1876·5.

In the same table 112, column 14, are given the observed values of the zero. The theoretical values derived from the above formula appear in column 15 and the departures of the theoretical from the observed are shown in column 16. These are charted respectively in figures II and IV in plate 4.

182. It will be noticed from the general run of the curve that we have to examine and explain two features, (1) the general rise of the zero curve from 1877 to 1890 and a fall thereafter, and (2) the minor fluctuations superposed upon the former, from year to year which are more or less periodic, and recur with fair persistence every two years.

183. The general run of the curve and the fluctuations are of such a character, that under ordinary conditions of instruments often disturbed by adjustments, their accurate registration would have, in all probability, been impossible. But in the Colaba magnetograph the magnet, the mirrors and the suspension skein have been allowed to remain absolutely undisturbed in a dry and constant attenuated atmosphere, and it is fairly justifiable under such conditions to expect that the instrument, thus left alone, would faithfully and accurately reproduce the finer fluctuations of the regular secular change whatever be its origin.

184. On the assumption then that the zero curve as recorded is not due to fortuitous circumstances but indicates some real phenomenon it is interesting to inquire into the cause or causes which may co-operate in giving to the values of zero the peculiar features now under examination. If (1) the probable errors of the annual means of absolute declination are negligibly small; if (2) there is no creep in the zero due to loss of torsional elasticity of the silk skein which carries the magnet; if (3) the march of the absolute declination from year to year is identically similar both at the eletrometer tower and the underground room where the magnetograph is located; and if (4) no extraneous error or instrumental defects affect the absolute determinations, then the values of the zeros should all be the same and lie on the same horizontal line. These points hence fall to be discussed in the first instance with reference to the dominant feature of the curve referred to above.

185. The probable errors of the annual means (*vide* Chapter I, para. 49) it is obvious could not give to the values of the zero the characteristic secular curve under examination. That the creep of the zero due to loss of elasticity of the silk threads must be a contributory factor in producing the curve, is obvious; but that it could give to the zero curve the double effect of increase and decrease of scale reading without the co-operation of some other cause or causes is not conceivable. It may be noted in passing that the torsion coefficient is very small and the change of absolute declination which during the period was less than 1° varied from about 55′ E to 10′ E only.

186. Of the two other causes which remain now for consideration, to take the last one first, it appears equally difficult as in the other factors, to conceive of any instrumental change or other extraneous source of error which operating on the results of the absolute Kew unifilar magnetometer alone, may explain the phenomenon noted.

187. The consideration of the third factor hence becomes unavoidably pertinent. The effect if due to this cause may be the result of either artificial and fortuitous circumstances or to natural causes. Special care has been taken to exclude any possible effects of the introduction of iron fittings or structure in the vicinity of either building such as may unequally affect the magnetic indications at the two places, iron or other magnetic substance of any kind being strictly prohibited within effective distance. Any change of the quantity of iron in the equipment of the battery in the adjoining compound, it may be contended, may constitute a disturbing cause unequally affecting the instruments in the two buildings which are at unequal distances (both of them are more than 250 feet away from the nearest point of the battery compound, the magnetograph being nearer by about 25 feet); but it does not seem likely that any possible maximum variation in the quantity of iron at say 600 feet – the average distance of the grounds of the battery—would be large enough to produce effects comparable to anything like a differential change of 1 minute of arc.

The regularity of the phenomenon is besides a noteworthy factor which is not what one would expect if the cause lay in this direction.

188. The inference then that this minute secular variation of zero is due to some natural magnetic cause which somehow does not influence the absolute declination at the tower is unavoidable. The existence of such regular secular change of a large period has not been noticed in the results of the horizontal force magnetograph zero already discussed, though the short period irregular movements in the latter noted every year, have been suspected as being due to the operation of some such cause. It is not improbable however that long period movements may exist there also, but being completely masked by the very large creep of the zero they have remained undetected.

189. The curve in figure VI denotes the ground temperature at Colaba. It will be seen that the annual temperature of the ground remained practically the same at about 84° F. from the date of the commencement of the observations, 1857, to about 1884. But after this it has steadily risen by more than 4° to over 88° F. This could hardly have any appreciable influence on the phenomenon, but the existence of an appreciably large local magnetic factor which produces as experiments have lately shown a difference of about 58γ in force between the ground floor and the top floor observations at the electrometer tower, may, it is conceivable, contribute a minute secular change—and there is no reason why that factor should be considered to remain constant as is ordinarily supposed—due to some possible *indirect* effects of temperature which, if large enough, may produce a small and steady secular deviation of the zero of instruments near the ground. This effect combined with that of torsion in the silk skein may, by co-operation, result in giving to the zero of the instrument the peculiar movement indicated in figure V.

In order to see if any such action of the magnetic rocks (basalts) which abound in the vicinity, was at all possible, some experiments were attempted; the density of the rock was determined experimentally and found to be about 2·9; it was also ascertained that they were distinctly magnetic and all specimens examined invariably showed this action. Large boulders in the ground were also tested in their natural position and were found to be distinctly polarised, the north end being also invariably found lying about the north direction. Deflection experiments were specially performed on the Kew Unifilar magnet (1) by the standard magnet the moment of which was known to be about 2900γ and (2) by a typical boulder about 300 cubic inches in size. The experiment showed that roughly the strength of the boulder compared with that of the magnet was about $\frac{1}{270}$ of the standard magnet; attempts to secure the temperature coefficient of the rock with the instruments available were made but proved futile owing to their incapability to measure very minute changes. Rough and incomplete though the data are, it seems problematic whether any direct action of the rocks would at all be appreciably large so as to explain this phenomenon.

190. Referring now to the irregular movements which occur every year and which may be supposed to be superposed upon the dominant curve we are somewhat on safer ground. These are charted in figure IV, plate 4. Side by side in figure III is also given a similar difference zero curve derived from Grubb's variation declinometer (*vide* Chapter V), an instrument of a different type of construction. The parallel run of the curves here and also that noticed previously in the similar zero curves of the force instruments leave little room for doubt at least about the common origin of the phenomenon. It will be noticed that more or less persistent two yearly oscillations, are exhibited in both the declination curves and the magnitude even of some movements* are roughly comparable. This parallelism excludes the irregular creep of the zero from being ascribed to instrumental causes, for such irregularities cannot run alike in two instruments year after year. The other arguments adduced in the previous paragraph apply equally to these irregular oscillations to a greater or less extent.

191. Whatever be the true explanation it is clear that either of the two views, a minute natural magnetic variation affecting the instruments nearer the ground but not influencing the absolute values at the tower, or some unrecognised defect in the absolute instrument which apparently affects the indications of both the variation instruments simultaneously, is admissible though perhaps one is inclined from the evidence before us to favour the former view.

192. Resuming the consideration of the annual variation of the magnetograph zero as disclosed in the last row but one in table 112 which gives the mean monthly values of the zeros, it must be noted that the variation is in the first instance just about as small in magnitude as the annual variation of absolute declination; and secondly that it curiously exhibits a movement which is strikingly parallel to the ground temperature curve (reversed). The small decrease in October (*vide* figures VII and VIII, plate 4) corresponding to the usual small seasonal rise of temperature during that month is also clearly indicated. The variation is of course very minute and it may be taken as being accidental and thus dismissed at once from consideration. If so with equal reason may the annual variation of absolute declination be regarded in the same light. Presumably such an assumption would not be unreasonable and under ordinary circumstances considering that we are dealing with very minute fluctuations in both cases it may be justifiable to pass them over without speculating upon the results. On the other hand, the peculiar circumstances already disclosed in the Colaba record throughout may be regarded as a sufficient incentive to further investigation and consideration.

It is not easy to see in what way could any temperature or other meteorological effects influence the indications at least of a declination magnetograph and that too so regularly in its incidence; and specially when the instrument has been working in a sealed enclosure under a constant and dry attenuated atmosphere. The effects of moisture, etc., referred to in Chapter II affecting the tabulation results may

* The contrary movement at some places in the Grubb's instrument is explained in Chapter V.

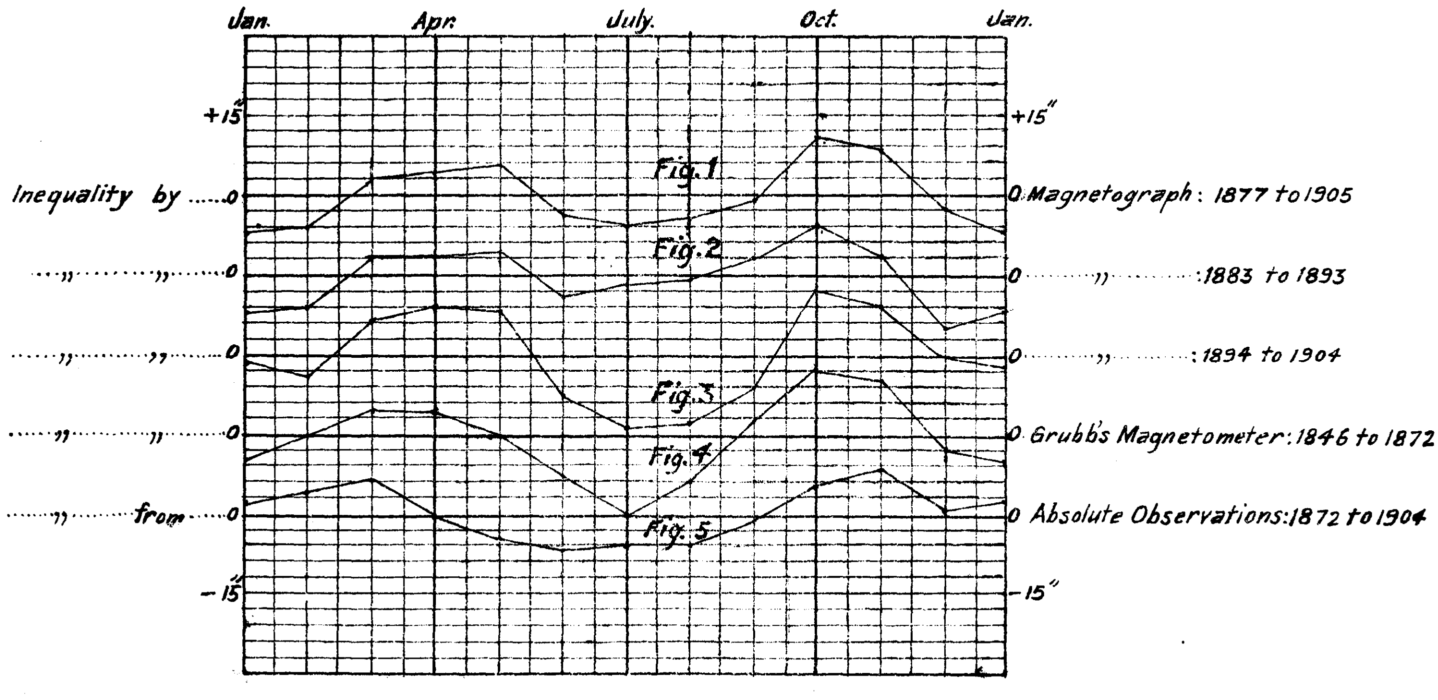
be one of the possible causes ; but these effects it has been ascertained are very small, and the character of the variation in that case would have been quite different. It is equally difficult to see in what manner or way the absolute determinations by the Kew unifilar could possibly be affected by temperature conditions. The reference meridian mark used for absolute reductions is the Tardeo Chimney about four miles away which could hardly be expected to have any movement caused by temperature or any other similar effects. One is thus again in this instance too, driven to the conclusion that the zero of this differential instrument in its annual march is presumably also affected by some minute magnetic change set up in some *indirect* way by the interaction of meteorological causes. In this connection figure VII the curve of which represents the annual march of zero is charted for comparison with figure VIII which denotes the march of temperature at Colaba 9 inches below the ground. Whether any real inter-relation between the two exists may be open to considerable doubt, but the parallelism in any case is suggestive. If as shown by the researches of Elster, Geitle and Rutherford the ionising action of the emanations from the radio-active substances in the surface crust of the earth does exist as a source of supply to the atmosphere, however insignificant in amount the emanations be, it is conceivable that they may form an appreciably large disturbing factor in some indirect way in the phenomenon generally.

Accepting the fluctuation of the zero of the instrument for the moment as being due to magnetic causes and not to instrumental defect, it is interesting to see how the annual variation of declination marches in the underground chamber, in the overground room and at the electrometer tower.

Figure I given below shows the march of the annual variation as registered by the instrument, from 1877 to 1905, *i.e.*, the annual variation of the absolute values plus the fluctuation of the zero indicated in table 112. Similar curves are also given below for the two 11-year cycles of 1883 to 1893 and 1894 to 1904, as figures 2 and 3.

193. It will be noted that when compared with the annual march of absolute declination shown in figure 5 the similarity in the character of the curves is still fairly preserved. Figure 4, which gives the annual variation as registered by Grubb's instrument for the period 1846 to 1872 duly corrected for instrumental defects due to moisture, etc. (*vide* Chapter V), is also given side by side to show the similarity of the character of all these variations.

Annual Inequalities.



5. Use of the magnetograph for the derivation of the daily means.

194. Having secured full data for the monthly means given in Table 111, the derivation of the daily means becomes simple. In Table 113 are given step by step the operations involved leading up to the final means :—

TABLE 113.—*Calculations for the reductions of the daily means of declination.*

August 1904.

Date.	Mean daily ordinate of declination magneto-grams.	Mean ordinate in column 2 corrected for progressive change $\frac{1}{48}(a_{10}-a_{10})$	Mean ordinate in column 3 converted in arc.	Column 4 subtracted from mean monthly observed zero in column 7, table 111, or daily mean declination in arc.	Date.	Mean daily ordinate of declination magneto-grams.	Mean ordinate in column 2 corrected for progressive change $\frac{1}{48}(a_{10}-a_{10})$	Mean ordinate in column 3 converted in arc.	Column 4 subtracted from mean monthly observed zero in column 7, table 111, or daily mean declination in arc.
1	2	3	4	5	1	2	3	4	5
	c.m.	c.m.	′ ″	′ ″		c.m.	c.m.	′ ″	′ ″
1	10·918	10·919	123 30	15 1	16	10·880	10·881	123 4	15 27
2	10·932	10·930	123 38	14 53	17	10·887	10·888	123 9	15 22
3	10·886	10·887	123 8	15 23	18	10·908	10·906	123 21	15 10
4	10·897	10·897	123 15	15 16	19	10·874	10·877	123 2	15 29
5	10·903	10·903	123 19	15 12	20	10·887	10·890	123 10	15 21
6	10·930	10·931	123 58	14 33	21	10·953	10·951	123 52	14 39
7	10·899	10·899	123 17	15 14	22	10·902	10·899	123 17	15 14
8	10·872	10·872	122 58	15 33	23	10·898	10·900	123 17	15 14
9	10·859	10·859	122 49	15 42	24	10·916	10·917	123 29	15 2
10	10·903	10·903	123 19	15 12	25	10·911	10·910	123 24	15 7
11	10·906	10·909	123 23	15 8	26	10·906	10·903	123 19	15 12
12	10·917	10·914	123 27	15 4	27	10·902	10·906	123 21	15 10
13	10·919	10·921	123 32	14 59	28	10·933	10·932	123 59	14 32
14	10·919	10·917	123 29	15 2	29	10·926	10·924	123 54	14 37
15	10·901	10·900	123 17	15 14	30	10·902	10·902	123 19	15 12
					31	10·910	10·909	123 23	15 8
					Monthly mean...	10·906	10·906	123 23	15 8

In column 2 are collected the crude daily means as derived from the tabulations. Column 3 gives the mean corrected for the progressive change $\frac{1}{48}(a_{10}-a_{10})$. Column 4 contains the tabulations converted into arc by the scale co-efficient. In column 5 appear the daily means derived by subtracting the ordinates in arc in column 4 from the value in arc of the datum indicated in column 7 of table 111. No further corrections have been attempted as it will be seen that the instrument behaves in a remarkably uniform manner and no refinement in the result is called forth.

These daily means have been collected in tables 114 to 125.

6.—Diurnal variation of declination by the declination magnetograph.

195. The diurnal variations are tabulated and entered every day from 10 a.m. to 10 a.m. of the following day, as in other magnetograph forms, and the sums and means are derived in the usual way, the variation in arc being thence derived finally for the month by the scale co-efficient.

For this element there is no appreciable correction for non-cyclic change and none has been applied.

Results of the diurnal inequalities for each month and year so derived are given in tables 126 to 159 from 1872 to 1905 and in table 160 for 1871.

TABLES 114 & 115.—*Daily means of Declination (Magnetograph).*

1894.

Unity = 1 minute of arc.

1894. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	40.7	40.2	40.7	40.2	39.8	39.2	38.4	39.3	39.2	39.1	39.5	39.0
2 ...	40.5	40.7	40.3	39.6	39.3	39.2	39.0	39.3	39.4	38.9	39.1	38.9
3 ...	41.1	40.7	40.6	39.9	39.7	39.2	38.9	39.0	39.4	39.2	39.0	38.8
4 ...	40.9	40.5	41.0	39.2	39.5	39.1	38.8	39.2	39.7	39.0	39.0	38.7
5 ...	41.1	40.6	40.4	39.0	39.2	38.9	39.0	39.1	39.2	39.5	38.8	39.0
6 ...	40.7	40.5	40.4	39.9	39.1	39.1	38.6	39.2	38.9	39.3	39.0	39.1
7 ...	40.8	40.8	40.1	39.6	38.3	38.6	38.3	39.5	39.4	39.4	39.2	38.8
8 ...	40.7	40.2	40.1	39.6	39.3	38.6	39.0	38.9	39.3	39.2	39.8	39.0
9 ...	40.6	40.5	40.2	39.6	39.2	39.7	39.0	39.0	39.2	39.4	39.1	38.9
10 ...	40.7	40.0	40.4	39.1	39.1	40.0	38.6	39.3	39.6	39.2	39.0	38.9
11 ...	40.1	40.0	40.0	39.0	38.8	39.5	38.6	39.0	39.4	39.3	39.0	38.7
12 ...	40.7	40.4	39.8	39.1	39.2	39.3	38.8	39.1	39.6	39.0	39.0	38.9
13 ...	40.4	39.9	39.5	39.8	39.4	39.1	39.0	39.2	39.4	39.4	39.9	38.8
14 ...	40.8	40.0	39.9	39.5	39.8	39.3	38.9	39.5	39.4	39.4	39.8	38.7
15 ...	40.6	40.2	40.3	39.5	39.6	39.3	38.6	39.5	40.2	39.4	39.3	39.2
16 ...	40.7	40.4	40.2	39.3	39.6	39.3	38.8	39.2	39.7	39.4	39.7	39.3
17 ...	40.8	40.0	39.9	39.6	39.7	38.8	38.8	38.9	39.5	39.5	39.5	39.0
18 ...	40.9	40.2	40.1	39.7	39.2	39.6	39.0	39.0	39.2	39.4	39.8	38.9
19 ...	40.8	40.6	40.0	39.7	39.3	38.8	39.1	39.5	39.9	39.4	39.8	38.8
20 ...	40.5	40.4	40.0	39.6	39.3	39.0	40.2	42.3	40.1	39.3	39.4	38.6
21 ...	40.6	41.7	40.5	39.7	39.3	39.1	40.3	39.9	39.6	39.4	39.2	39.0
22 ...	40.9	40.0	40.4	39.6	39.5	39.4	39.4	39.8	39.7	39.4	39.1	39.0
23 ...	40.8	40.8	39.9	39.6	39.1	39.3	39.1	39.5	39.6	39.5	39.7	40.1
24 ...	40.7	40.8	39.7	39.7	39.2	39.0	39.1	39.4	39.2	39.4	39.4	38.8
25 ...	40.8	42.0	39.9	39.4	38.7	39.0	39.9	39.5	39.6	39.6	39.0	38.5
26 ...	40.7	41.2	39.9	39.5	39.0	38.8	39.3	39.5	39.4	39.5	39.1	38.6
27 ...	41.0	40.8	39.5	39.3	39.0	38.8	39.5	39.6	39.7	39.5	39.0	38.5
28 ...	40.8	41.4	39.8	39.0	39.2	38.6	38.8	39.4	39.6	39.2	39.1	38.5
29 ...	40.7	...	39.7	38.9	39.3	38.8	39.1	39.1	39.2	38.9	39.0	38.8
30 ...	40.8	...	41.1	39.3	39.0	38.6	39.3	38.6	39.4	39.0	39.0	38.6
31 ...	40.8	...	41.1	...	39.1	...	38.7	39.0	...	39.3	...	38.7
Monthly Mean ...	40.7	40.5	40.2	39.5	39.3	39.1	39.0	39.4	39.5	39.3	39.3	38.9

1895.

Unity = 1 minute of arc.

1895. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	38.8	38.5	37.8	37.6	37.4	37.4	37.2	36.6	36.3	36.6	36.9	36.3
2 ...	38.9	38.5	37.8	37.4	37.0	37.7	37.2	36.4	36.1	36.4	36.8	36.2
3 ...	38.4	38.2	38.2	37.6	37.4	37.3	37.0	36.8	36.4	36.7	36.5	35.9
4 ...	38.8	37.9	37.9	37.3	37.3	37.7	37.2	36.5	36.7	36.8	36.5	36.2
5 ...	38.2	38.3	37.8	37.9	37.3	37.3	37.0	36.4	36.9	36.7	36.8	36.1
6 ...	38.5	38.6	38.1	37.4	37.4	37.7	37.2	36.4	36.4	36.8	36.5	36.3
7 ...	38.6	38.4	37.7	37.5	37.2	37.6	36.6	36.2	36.7	36.3	36.4	36.2
8 ...	38.5	38.4	38.4	37.5	36.9	37.5	36.7	36.5	36.7	36.5	36.3	36.7
9 ...	38.5	38.4	38.5	37.7	37.1	37.1	36.7	36.2	36.5	36.2	36.6	36.4
10 ...	38.5	38.4	38.2	37.6	37.3	36.9	36.6	37.2	36.8	35.9	36.6	36.2
11 ...	38.5	38.4	38.0	38.1	37.4	37.0	36.4	36.6	36.5	35.6	36.9	36.3
12 ...	38.5	38.2	37.8	37.9	37.5	37.2	36.8	36.9	36.5	36.3	36.8	35.8
13 ...	38.6	38.1	38.5	37.6	37.4	37.2	37.2	36.3	36.3	36.1	37.0	36.1
14 ...	38.5	38.4	38.6	37.7	37.1	36.9	37.3	36.8	36.1	36.2	36.5	35.9
15 ...	38.2	39.0	38.1	38.0	37.6	36.6	36.9	36.5	36.1	36.1	36.8	35.8
16 ...	38.3	38.6	38.4	37.8	37.3	36.8	36.6	36.4	36.5	36.6	36.6	35.8
17 ...	38.7	38.2	38.4	38.0	37.3	37.2	36.6	36.5	36.3	36.9	36.7	36.0
18 ...	38.5	38.6	38.3	37.7	37.5	37.2	36.6	36.4	36.5	36.3	36.8	36.0
19 ...	38.5	38.7	38.0	37.7	37.3	36.9	36.5	36.2	36.4	36.5	36.5	36.1
20 ...	38.6	38.8	38.1	37.5	37.1	37.0	36.7	36.5	36.7	36.1	36.3	36.1
21 ...	38.6	38.6	38.1	37.6	36.9	36.2	36.6	36.3	36.3	36.0	36.3	35.8
22 ...	38.3	38.6	38.1	37.4	37.2	36.7	36.7	36.2	36.5	36.1	36.1	36.5
23 ...	38.3	38.5	38.2	37.7	37.2	36.7	36.8	35.9	36.1	36.3	36.8	36.3
24 ...	38.5	38.6	37.8	37.5	37.0	37.0	36.6	35.9	36.1	36.4	36.7	36.4
25 ...	38.3	38.2	37.5	37.2	37.2	36.7	36.5	36.2	36.0	36.2	36.5	36.1
26 ...	38.3	38.3	38.0	37.3	37.1	36.5	36.5	36.1	36.4	35.7	36.1	35.8
27 ...	38.5	38.2	37.9	37.3	36.9	36.5	36.6	36.7	36.3	36.4	36.4	36.0
28 ...	38.3	38.3	38.2	37.1	37.0	36.4	36.6	36.2	36.1	36.2	36.4	36.0
29 ...	38.4	...	37.6	37.0	36.8	36.7	36.7	36.1	36.2	36.4	36.5	35.8
30 ...	38.9	...	38.0	36.8	37.9	37.0	36.6	36.3	37.2	36.5	36.5	35.9
31 ...	38.5	...	37.8	...	37.6	...	36.2	36.4	...	36.5	...	35.9
Monthly Mean ...	38.5	38.4	38.1	37.6	37.2	37.0	36.8	36.4	36.4	36.3	36.6	36.1

TABLES 116 & 117.—*Daily means of Declination (Magnetograph).*

1896.

Unity = 1 minute of arc.

1896. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	35.6	35.9	35.3	35.2	35.0	34.7	34.7	34.4	35.2	34.6	34.4	34.2
2 ...	35.6	35.8	35.4	35.5	36.4	34.7	34.7	34.1	35.2	34.6	34.3	34.3
3 ...	35.9	35.6	35.4	35.6	36.7	34.5	34.5	34.5	35.1	35.0	34.6	34.2
4 ...	36.3	36.3	36.1	35.8	35.6	34.7	34.6	34.4	35.2	34.7	34.4	34.8
5 ...	36.0	35.5	35.2	35.7	35.6	34.7	34.6	33.8	35.1	34.7	34.4	34.8
6 ...	35.8	35.5	35.3	35.6	35.3	34.6	35.0	34.2	35.4	34.7	34.8	34.6
7 ...	36.0	35.3	35.5	35.0	35.5	34.7	35.0	34.4	35.1	34.9	35.2	34.7
8 ...	36.1	35.6	35.4	35.1	35.3	34.3	34.8	34.1	35.0	34.5	35.3	34.2
9 ...	35.8	35.6	35.2	35.0	35.4	34.5	34.2	34.5	34.9	34.8	35.0	34.4
10 ...	36.0	35.6	35.2	35.0	35.4	34.9	34.6	34.3	34.7	34.6	34.8	34.2
11 ...	35.9	35.6	34.7	34.8	35.3	34.8	34.7	33.7	35.1	34.9	34.6	34.3
12 ...	35.9	35.7	35.6	34.8	35.5	34.5	34.9	34.3	35.0	35.4	34.5	34.0
13 ...	35.9	35.0	35.3	34.9	35.2	34.6	34.9	34.3	35.2	35.0	34.4	34.7
14 ...	35.7	35.8	35.3	34.6	35.3	34.6	34.7	33.9	35.0	35.1	34.4	34.2
15 ...	35.6	35.6	35.4	34.9	35.3	34.7	34.6	33.7	35.2	35.0	34.3	34.0
16 ...	35.4	35.5	35.2	34.8	34.7	34.7	34.5	33.9	35.2	35.0	34.1	34.0
17 ...	35.7	35.9	35.3	34.9	35.2	34.8	34.3	34.2	35.1	35.0	33.9	33.8
18 ...	35.8	35.7	35.4	34.5	35.5	34.9	34.2	34.6	35.0	34.8	34.3	33.6
19 ...	35.9	35.4	35.3	34.6	35.6	34.7	34.3	34.4	35.2	35.1	34.3	33.6
20 ...	35.8	35.2	35.8	34.2	35.5	34.7	33.9	34.4	35.9	35.0	34.4	33.6
21 ...	35.8	35.4	35.3	35.2	35.7	34.6	33.9	35.0	35.5	34.7	34.2	33.6
22 ...	35.7	35.7	35.3	35.1	35.2	34.5	34.7	34.3	35.3	34.7	33.8	33.6
23 ...	35.5	35.6	35.4	35.0	35.2	34.5	34.5	34.5	35.1	34.9	34.2	33.8
24 ...	35.5	35.2	35.2	35.4	35.3	34.4	34.6	34.4	35.4	34.7	34.2	33.8
25 ...	35.9	35.5	35.7	35.2	35.3	34.2	34.3	34.6	35.3	34.8	34.0	33.5
26 ...	35.7	35.5	35.7	35.3	34.9	34.0	34.0	34.4	35.5	34.7	33.9	33.5
27 ...	35.5	35.8	35.8	35.0	35.3	34.5	34.4	34.6	35.4	34.6	34.1	34.3
28 ...	35.5	35.6	35.5	34.8	35.0	34.4	34.1	34.2	35.0	34.3	34.0	33.7
29 ...	35.4	36.0	35.4	35.0	35.1	34.0	33.9	34.1	35.2	34.3	34.0	33.8
30 ...	35.3	...	35.2	34.9	34.9	34.3	34.1	34.3	35.0	34.4	34.0	33.7
31 ...	35.8	...	35.7	...	34.7	...	34.2	34.2	...	34.3	...	33.5
Monthly Mean ...	35.7	35.6	35.4	35.0	35.4	34.6	34.5	34.3	35.2	34.8	34.4	34.0

1897.

Unity = 1 minute of arc.

1897. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	33.6	33.6	33.8	33.7	33.3	33.0	32.9	32.3	32.1	31.9	31.8	31.5
2 ...	35.5	33.7	33.8	33.7	33.3	33.1	33.0	32.2	31.9	31.7	31.7	31.6
3 ...	34.7	33.8	34.0	33.5	33.1	33.0	32.8	32.1	32.2	31.7	31.5	31.5
4 ...	34.5	33.8	34.1	33.2	33.2	33.0	32.8	31.9	32.0	31.6	31.3	31.4
5 ...	33.8	33.7	34.5	33.4	33.2	33.0	32.8	31.8	31.9	31.7	31.3	31.5
6 ...	34.0	33.8	34.1	33.5	33.4	33.0	32.7	31.9	31.9	31.7	31.5	31.5
7 ...	33.7	34.0	33.9	33.5	33.2	32.9	32.8	31.8	32.1	31.5	31.4	31.6
8 ...	33.8	33.8	34.4	33.4	33.3	32.6	32.8	31.7	32.2	31.4	31.4	31.4
9 ...	33.6	33.4	34.4	33.1	33.1	32.8	32.8	31.8	31.9	31.8	31.4	31.2
10 ...	33.9	33.6	33.8	33.6	33.2	32.7	32.6	32.1	31.7	32.3	31.2	31.7
11 ...	33.9	33.4	33.9	33.5	33.1	32.8	32.8	32.0	32.2	32.1	31.2	32.2
12 ...	34.0	33.5	33.6	33.3	32.9	32.5	32.8	32.1	32.1	32.1	31.3	32.1
13 ...	34.0	33.3	33.8	33.5	32.8	32.4	32.6	31.7	32.3	32.1	31.2	31.9
14 ...	33.9	33.6	33.7	33.6	33.2	32.6	32.9	32.0	32.0	32.3	31.8	31.6
15 ...	34.0	33.2	33.8	33.1	33.2	32.7	32.5	31.5	32.1	31.9	31.8	31.3
16 ...	33.4	33.1	33.7	33.7	32.9	33.2	32.7	31.9	32.0	32.0	31.6	31.3
17 ...	33.6	33.3	33.5	33.5	33.2	32.5	32.6	31.5	31.9	32.0	31.4	31.3
18 ...	33.5	33.2	33.5	33.8	33.0	32.7	32.3	32.1	31.8	32.1	31.5	31.3
19 ...	33.8	33.4	33.5	33.6	33.2	32.8	32.4	31.9	31.9	31.9	31.5	31.1
20 ...	33.4	33.4	33.6	33.9	33.5	32.6	32.5	32.2	32.1	31.6	31.6	31.9
21 ...	33.6	33.8	33.5	33.8	33.3	32.7	32.6	32.5	31.7	31.6	31.4	31.5
22 ...	33.6	34.0	33.5	33.7	33.4	32.5	32.7	32.2	31.7	31.6	31.4	31.6
23 ...	33.7	33.7	33.6	34.2	33.0	32.7	32.2	31.8	32.1	32.0	31.3	31.4
24 ...	33.9	33.5	33.2	33.8	33.2	32.7	32.2	31.9	32.4	31.9	31.4	31.5
25 ...	33.8	33.1	33.4	33.6	33.1	32.7	32.2	31.9	32.2	31.7	31.4	31.4
26 ...	33.8	33.4	33.4	33.7	32.9	32.6	32.0	31.7	31.7	31.8	31.7	31.0
27 ...	33.5	34.0	33.5	33.6	33.1	32.8	32.5	31.8	31.7	32.1	31.4	31.1
28 ...	33.1	33.2	33.5	33.5	33.1	32.4	32.5	32.2	31.5	32.4	31.2	31.0
29 ...	33.6	...	33.5	33.2	33.2	32.7	32.6	32.0	31.7	32.2	31.1	31.2
30 ...	33.8	...	33.4	33.9	33.1	32.4	32.0	31.9	31.7	32.2	30.8	31.1
31 ...	33.9	...	34.0	...	33.3	...	33.1	31.8	...	32.0	...	31.0
Monthly Mean ...	33.8	33.5	33.7	33.6	33.2	32.8	32.6	31.9	32.0	31.9	31.4	31.4

TABLES 118 & 119.—*Daily means of Declination (Magnetograph).*

1898.

Unity = 1 minute of arc.

1898. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	30·8	30·3	31·0	30·2	29·8	30·3	29·7	29·5	29·1	28·6	28·7	27·9
2 ...	30·7	30·5	31·4	30·2	30·0	30·4	29·9	29·7	29·2	28·7	28·8	27·7
3 ...	30·7	30·5	30·9	30·1	30·0	30·3	29·6	29·6	29·8	28·9	29·0	28·1
4 ...	30·8	30·6	30·8	29·9	29·9	30·1	29·7	29·9	29·2	29·2	29·0	27·9
5 ...	30·9	30·8	30·9	29·9	29·8	30·1	29·9	29·6	29·2	28·9	28·7	28·0
6 ...	31.0	30·9	31·0	29·9	29·6	30·2	30·0	29·5	29·1	28·9	28·6	27·6
7 ...	31·0	30·6	30·9	30·2	29·7	29·7	29·5	29·2	29·0	29·2	28·5	28·0
8 ...	31·1	31·2	31·1	30·2	30·0	30·0	29·4	29·4	28·8	28·9	28·4	27·8
9 ...	31·2	30·9	30·9	30·3	30·0	30·4	29·6	29·4	30·7	28·7	28·8	28·0
10 ...	31·2	30·5	30·9	30·1	29·6	29·8	29·7	29·0	30·4	28·7	28·7	27·9
11 ...	31·1	30·8	31·5	30·1	29·7	29·9	29·3	29·0	29·6	28·8	28·5	28·0
12 ...	30·8	30·8	31·0	30·8	29·9	29·7	29·4	29·6	29·5	28·8	28·8	27·8
13 ...	31·0	30·5	30·6	30·0	30·2	29·6	29·3	29·7	29·4	28·8	28·9	27·7
14 ...	31·0	31·1	31·1	30·1	29·8	29·9	29·6	29·6	30·0	28·8	28·8	28·4
15 ...	30·7	30·8	32·1	30·3	30·0	29·8	29·2	29·4	29·8	29·1	28·4	28·1
16 ...	30·8	31·2	32·1	30·3	29·9	30·0	29·3	30·0	29·5	29·0	28·4	28·3
17 ...	31·1	31·3	31·4	30·4	29·8	29·6	29·6	29·7	29·4	29·2	28·8	28·3
18 ...	31·0	31·0	31·4	30·3	29·6	29·9	29·4	29·5	29·4	29·2	28·8	28·1
19 ...	30·9	30·5	31·1	30·0	29·5	29·7	29·4	29·5	29·3	29·0	28·4	28·0
20 ...	30·9	30·3	31·2	30·0	29·5	30·0	29·6	29·4	29·2	29·2	28·3	28·0
21 ...	30·8	30·6	31·0	29·7	29·7	29·8	29·4	29·7	28·9	29·1	28·5	27·8
22 ...	30·9	30·9	30·7	30·1	29·5	29·4	29·3	29·5	28·9	29·2	28·7	27·7
23 ...	30·8	30·7	30·8	30·4	29·5	29·4	29·1	29·0	29·0	28·9	28·9	27·8
24 ...	30·6	31·0	30·7	30·0	29·6	29·6	29·3	29·2	29·1	28·8	28·5	27·7
25 ...	30·7	30·9	31·0	30·1	29·3	29·3	29·5	29·4	29·0	29·1	28·4	27·9
26 ...	30·8	31·0	31·2	30·1	29·3	29·5	29·3	29·2	28·9	29·2	28·4	27·4
27 ...	30·8	31·1	31·0	29·8	29·4	29·7	29·5	28·9	29·0	29·0	28·2	27·6
28 ...	31·0	31·1	30·8	30·1	29·6	29·6	29·3	29·4	29·4	29·2	28·3	27·6
29 ...	30·7	...	31·0	30·0	29·6	29·6	29·3	29·4	29·5	29·9	28·3	27·5
30 ...	30·6	...	30·7	29·9	29·9	29·6	29·2	29·4	29·2	29·1	28·3	27·5
31 ...	30·1	...	30·6	...	29·5	...	29·4	29·3	...	28·9	...	27·5
Monthly Mean ...	30·9	30·8	31·1	30·1	29·7	29·8	29·5	29·4	29·3	29·0	28·6	27·9

1899.

Unity = 1 minute of arc.

1899. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	28·1	27·6	27·6	26·9	27·6	27·0	26·7	26·0	25·9	26·1	25·5	25·4
2 ...	27·8	27·6	27·2	27·1	27·1	27·1	26·6	26·0	25·9	25·9	25·7	25·4
3 ...	27·8	27·6	27·4	27·1	27·2	26·9	26·6	25·9	25·9	26·2	25·5	25·2
4 ...	28·0	27·8	27·2	27·2	27·7	27·2	26·5	26·2	25·6	26·3	26·0	25·2
5 ...	28·1	27·7	27·1	27·1	27·5	27·0	26·3	26·3	25·6	26·4	25·9	25·1
6 ...	28·0	27·6	27·0	27·2	27·1	26·7	26·2	25·9	25·7	26·1	25·8	25·2
7 ...	27·5	27·2	27·3	27·1	27·1	26·5	26·2	26·1	25·7	26·1	25·7	25·1
8 ...	27·6	27·6	27·0	27·2	27·3	26·8	26·2	26·0	25·6	26·1	26·0	25·6
9 ...	27·5	27·5	27·0	27·3	27·1	26·8	26·4	26·1	25·6	25·9	25·8	25·4
10 ...	27·7	27·6	27·1	27·3	27·0	26·8	26·1	25·9	25·6	26·0	25·7	25·5
11 ...	27·5	27·2	27·4	27·2	26·7	27·0	26·5	25·8	25·6	26·0	25·4	25·4
12 ...	27·9	28·9	27·4	27·2	27·1	26·7	26·3	26·1	25·7	26·1	25·3	25·7
13 ...	27·7	28·1	27·4	26·9	26·7	27·0	26·3	25·7	25·6	26·2	25·3	25·5
14 ...	27·4	28·3	27·2	26·9	26·8	26·9	26·0	25·8	25·5	25·8	26·0	25·3
15 ...	27·8	27·8	27·2	26·6	27·3	26·7	26·1	25·6	25·6	26·4	25·9	25·1
16 ...	28·1	27·7	26·9	27·0	27·1	26·6	26·2	25·9	25·6	26·3	25·7	25·1
17 ...	27·8	27·6	26·9	27·0	27·1	26·7	26·4	26·1	25·7	26·5	25·5	25·3
18 ...	27·7	27·4	27·0	28·2	27·2	27·1	26·2	25·8	25·6	26·3	25·5	25·3
19 ...	27·9	27·6	27·1	27·6	27·1	26·9	26·1	25·6	25·6	26·0	25·5	25·5
20 ...	27·7	27·8	27·1	27·4	27·1	26·7	26·1	26·3	25·8	26·0	25·6	25·3
21 ...	27·9	27·7	27·4	27·1	26·8	26·7	26·2	26·3	25·7	25·9	25·5	25·4
22 ...	27·8	27·6	27·2	27·1	26·9	26·7	26·5	26·1	25·5	26·1	25·6	25·2
23 ...	27·7	28·0	28·2	26·9	26·7	26·5	26·2	26·2	25·2	26·2	25·6	25·3
24 ...	27·6	27·8	27·7	26·8	26·7	26·5	26·1	26·2	25·4	26·3	25·7	25·2
25 ...	27·8	27·9	27·8	27·1	26·9	26·8	26·4	26·0	25·2	26·6	25·5	24·9
26 ...	27·7	27·9	27·6	26·9	26·6	26·5	26·4	26·2	25·4	26·3	25·7	24·9
27 ...	27·5	27·5	27·3	26·8	26·7	26·4	26·6	26·2	25·7	26·4	25·5	25·1
28 ...	27·7	27·6	27·2	26·7	26·8	26·5	26·6	25·8	25·6	26·1	25·5	25·4
29 ...	28·1	...	27·2	26·5	26·7	26·9	26·4	26·1	25·7	25·8	25·5	25·1
30 ...	27·8	...	26·9	26·9	26·9	26·9	26·5	26·3	25·7	25·6	25·3	25·3
31 ...	27·6	...	27·0	...	26·3	...	26·3	26·1	...	25·8	...	25·3
Monthly Mean ...	27·8	27·7	27·3	27·1	27·0	26·8	26·3	26·0	25·6	26·1	25·6	25·3

TABLES 120 & 121.—*Daily means of Declination (Magnetograph).*

1900.

Unity = 1 minute of arc.

1900. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	26·1	26·1	25·1	24·8	25·4	24·5	24·7	24·5	23·9	23·4	24·0	23·2
2 ...	25·9	25·8	25·3	25·1	25·0	24·7	24·7	24·2	23·9	23·7	23·9	23·3
3 ...	26·0	25·9	25·2	24·8	25·0	24·6	24·8	24·5	23·8	23·5	23·8	23·5
4 ...	25·7	26·1	25·0	24·6	24·6	24·2	24·6	24·4	23·7	23·4	23·8	23·6
5 ...	26·1	26·2	25·0	24·9	25·7	24·3	24·8	24·3	23·9	23·9	23·5	23·5
6 ...	26·0	26·3	25·3	24·7	25·5	24·4	24·8	24·4	23·7	23·5	23·7	23·2
7 ...	26·1	26·1	24·8	25·0	25·4	24·3	24·6	23·9	23·8	23·7	23·5	23·4
8 ...	25·9	25·6	25·6	24·9	25·1	24·4	24·6	24·3	23·6	24·0	23·6	23·3
9 ...	25·4	25·9	25·7	24·8	24·8	24·1	24·4	24·4	23·6	23·9	23·7	23·1
10 ...	25·7	26·0	25·5	24·9	24·9	24·7	24·6	24·2	23·7	23·8	23·5	23·3
11 ...	25·6	25·9	25·6	25·0	25·1	24·4	24·5	24·2	23·7	23·7	23·6	23·3
12 ...	25·8	26·2	25·7	24·9	24·6	24·3	24·2	24·6	23·8	23·6	23·8	23·3
13 ...	26·2	25·9	27·1	24·9	24·8	24·4	24·3	24·0	23·5	23·5	23·7	23·3
14 ...	26·1	26·1	25·7	24·8	24·9	24·4	24·4	24·3	23·8	24·1	23·6	23·2
15 ...	26·3	26·1	25·7	24·7	25·1	24·3	24·2	24·2	23·8	23·7	23·3	23·1
16 ...	25·8	26·2	25·3	24·9	24·7	24·6	24·4	24·2	23·6	23·6	23·5	23·2
17 ...	25·9	26·1	25·2	24·9	24·9	24·5	24·5	24·1	23·4	23·7	23·5	23·1
18 ...	25·7	25·8	25·4	25·0	24·5	24·5	24·5	24·3	23·4	23·9	23·7	22·8
19 ...	26·2	25·8	25·4	24·9	24·8	24·0	24·6	24·3	23·3	24·0	23·6	23·3
20 ...	26·0	25·5	25·2	24·6	24·7	24·4	24·6	24·4	23·2	23·8	23·5	23·1
21 ...	26·1	25·8	25·1	24·8	24·6	24·6	24·5	24·2	23·3	24·0	23·5	22·9
22 ...	25·6	25·6	25·0	25·0	24·8	24·3	24·5	24·3	23·8	23·7	23·5	23·3
23 ...	25·6	25·5	25·1	25·1	24·8	24·5	24·4	24·3	23·6	23·4	23·6	23·3
24 ...	25·5	25·7	25·1	24·9	24·7	24·3	24·3	24·0	23·5	23·0	23·7	23·2
25 ...	25·5	25·6	25·1	24·7	24·6	24·2	24·4	24·1	24·0	23·7	23·7	23·2
26 ...	25·6	25·8	25·2	24·5	24·6	24·6	24·3	24·0	23·9	23·5	23·6	23·0
27 ...	25·7	26·1	25·3	25·1	24·7	24·3	24·4	24·1	23·6	23·8	23·5	23·3
28 ...	25·6	25·8	25·0	24·7	24·7	24·5	24·2	24·2	23·8	23·7	23·5	23·4
29 ...	26·0	...	25·1	24·6	24·6	24·4	24·2	24·2	23·9	23·8	23·7	23·4
30 ...	25·8	...	25·4	24·6	24·9	24·7	24·1	23.8	23·9	23·8	23·6	23·3
31 ...	25·9	...	25·1	...	24·7	...	24·1	24·0	...	23·5	...	23·5
Monthly Mean ...	25·9	25·9	25·3	24·8	24·9	24·4	24·4	24·2	23·7	23·7	23·6	23·3

1901.

Unity = 1 minute of arc.

1901. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	22·7	23·0	21·9	22·5	22·4	22·1	22·2	21·8	20·7	21·2	21·6	20·8
2 ...	23·1	23·1	21·8	22·4	22·3	22·1	22·0	21·5	21·1	21·2	21·3	21·3
3 ...	23·0	23·1	22·1	22·3	22·2	22·3	21·8	21·2	21·1	21·1	21·4	21·4
4 ...	22·5	23·0	22·1	22·2	22·2	21·9	22·0	21·3	20·6	21·0	21·6	21·3
5 ...	22·9	23·0	21·9	22·3	22·4	21·7	21·9	21·5	21·0	21·3	21·3	21·3
6 ...	22·9	22·7	22·0	22·3	22·3	21·7	21·8	21·5	21·0	21·3	21·2	21·0
7 ...	22·9	22·8	22·0	22·3	22·4	22·3	21·9	21·5	21·0	20·8	21·2	20·9
8 ...	22·5	23·0	21·8	22·4	21·9	22·1	22·0	21·5	21·1	21·0	21·2	20·8
9 ...	22·6	23·0	22·0	22·5	21·8	21·8	21·7	21·8	20·9	21·3	21·0	20·9
10 ...	22·9	22·7	22·1	22·3	21·8	22·1	21·9	21·6	21·2	21·3	21·2	21·0
11 ...	22·9	22·5	22·1	22·0	22·2	22·1	21·8	21·6	21·6	21·1	21·2	20·9
12 ...	23·1	22·8	22·0	22·2	22·2	22·1	22·0	21·3	21·4	21·0	21·0	21·1
13 ...	22·6	22·8	22·2	22·3	22·1	21.8	21·5	21·6	21·8	21·0	20·9	21·1
14 ...	22·9	22·6	22·0	22·4	22·1	22·0	21·5	21·4	21·5	21·1	21·1	21·0
15 ...	22·6	22·5	21·9	22·4	22·1	22·4	21·9	21·8	21·5	20·9	21·1	20·9
16 ...	22·8	22·6	22·0	22·0	22·2	22·2	21·8	21·7	21·2	20·9	21·4	21·2
17 ...	22·7	22·7	22·3	22·3	22·2	22·0	21·9	21·5	21·4	21·3	21·4	21·0
18 ...	22·6	22·5	22·4	22·4	22·2	21·9	22·0	21·6	21·7	21·2	21·2	21·0
19 ...	22·4	22·6	22·4	22·2	22·4	22·0	21·7	21·5	21·7	21·3	21·2	20·9
20 ...	22·8	23·1	22·3	22·1	22·1	21·6	21·7	21·5	21·7	21·1	21·3	21·0
21 ...	22·7	22·8	22·3	22·1	21·9	21·8	21·7	21·6	21·6	21·4	21·2	20·9
22 ...	22·8	22·8	22·3	22·3	22·0	21·9	21·7	21·5	21·6	21·2	21·7	20·9
23 ...	23·0	22·6	22·1	22·4	22·0	22·2	21·3	21·8	21·5	21·3	21·5	20·8
24 ...	23·0	22·6	23·0	22·3	22·1	21·9	21·6	21·5	21·6	21·2	21·5	21·0
25 ...	23·0	22·6	22·3	22·3	21·8	22·0	21·4	21·5	21·5	21·6	21·4	21·0
26 ...	22·9	22·8	22·5	22·4	21·8	22·0	21·7	21·6	21·4	21·6	21·2	21·1
27 ...	22·7	22·9	22·3	22·3	22·1	21·5	21·7	21·6	21·3	21·2	21·1	20·8
28 ...	22·8	22·8	22·3	22·1	21·9	21·8	21·5	21·4	21·3	21·4	21·1	21·4
29 ...	22.7	...	22·2	22·0	22·0	21·6	21·6	21·3	21·0	21·4	21·2	20·7
30 ...	22·9	...	22·1	21·9	22·0	21·7	21·6	21·6	20·9	21·5	21·1	21·1
31 ...	23·1	...	22·3	...	21·8	...	21·6	21·6	...	21·2	...	21·3
Monthly Mean ...	22·8	22·8	22·2	22·3	22·1	21·9	21·8	21·5	21·3	21·2	21·3	21·0

TABLES 122 & 123.—*Daily means of Declination (Magnetograph).*

1902.

Unity = 1 minute of arc.

1902. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	21·1	20·6	20·4	20·2	20·0	19·9	19·5	19·3	19·1	18·6	18·5	17·9
2 ...	21·0	20·5	20·6	20·2	20·1	19·6	19·1	19·2	19·2	18·3	18·5	17·8
3 ...	20·9	20·7	20·4	20·2	20·2	19·6	19·2	18·9	18·9	18·7	18·2	17·7
4 ...	21·0	20·9	20·3	20·2	20·1	19·5	19·2	19·3	19·0	18·5	17·9	17·9
5 ...	21·0	20·7	20·3	20·0	19·9	19·4	19·4	19·0	18·9	18·5	18·2	18·3
6 ...	21·2	20·4	20·7	20·2	19·9	19·2	19·5	19·1	19·0	18·5	18·3	17·9
7 ...	21·0	20·8	20·6	20·0	20·0	19·4	19·1	18·7	18·9	18·4	18·5	17·8
8 ...	21·1	20·8	20·5	19·8	20·0	19·4	18·9	18·8	18·8	18·5	18·4	17·9
9 ...	21·1	20·7	20·3	20·0	20·6	19·4	19·1	18·7	18·8	18·6	17·9	17·9
10 ...	21·0	20·5	20·5	20·2	19·9	19·0	19·3	19·1	19·2	18·4	18·0	18·0
11 ...	21·0	20·6	20·1	20·5	20·1	19·0	19·1	19·0	19·0	18·9	18·1	17·7
12 ...	20·8	20·6	20·4	20·4	19·9	19·1	19·4	19·0	19·0	18·9	18·0	17·6
13 ...	21·0	20·6	20·3	20·3	19·9	19·4	19·2	18·8	19·0	18·6	18·0	17·8
14 ...	20·9	20·6	20·4	20·1	19·9	19·6	19·1	19·0	18·7	18·7	18·0	17·6
15 ...	20·7	20.5	20·3	20·1	19·8	19·3	19·4	18·9	19·2	18·6	18·1	17·6
16 ...	20·7	20·9	20·5	20·2	20·0	19·4	19·2	18·4	18·8	18·6	18·2	18·1
17 ...	20·4	20·8	20·4	20·2	19·6	19·3	19·4	18·7	18·4	18·3	18·3	18·0
18 ...	20·5	20·6	20·3	20·1	19·6	19·3	19·3	18·8	18·9	18·3	18·2	18·1
19 ...	20·4	20·5	20·3	20·5	19·7	19·5	19·3	18·4	18·8	18·5	18·5	18·1
20 ...	20·7	20·5	20·1	20·6	19·8	19·4	18·9	18·6	18·9	18·4	18·4	18·0
21 ...	20·1	20·6	20·3	20·4	19·7	19·6	19·1	18·6	18·9	18·4	18·3	17·9
22 ...	20·5	20·6	20·4	20·4	20·0	19·5	19·3	19·0	19·0	18·6	17·7	17·7
23 ...	20·0	20·8	20·4	20·2	19·6	19·3	19·1	19·1	19·1	18·8	18·2	18·3
24 ...	20·4	20·7	20·6	20·3	19·6	19·3	19·2	18·9	18·9	19·0	18·5	18·1
25 ...	20·4	20·6	20·4	20·3	19·6	19·7	19·5	18·9	19·1	19·2	18·3	17·9
26 ...	20·6	20·8	20·6	20·5	20·0	19·3	19·4	19·0	18·9	18·9	18·1	17·7
27 ...	20·5	20·5	20·4	20·3	19·3	19·3	19·5	18·9	18·9	18·8	18·2	17·7
28 ...	20·6	20·5	20·3	20·2	19·5	19·4	19·3	19·2	18·9	18·6	17·9	17·8
29 ...	20·4	...	20·5	20·1	19·8	19·3	19·1	18·8	18·5	18·9	17·8	17·7
30 ...	20·5	...	20.6	20·2	19·8	18·9	19·3	18·8	18·7	18·8	18·0	17·7
31 ...	20·2	...	20·5	...	19·6	...	19·2	18·9	...	19·6	...	17·8
Monthly Mean ...	20·7	20·6	20·4	20·2	19·9	19·4	19·2	18·9	18·9	18·7	18·2	17·9

1903.

Unity = 1 minute of arc.

1903. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	18·8	18·2	18·5	17·2	17·5	17·2	18·1	17·6	17·3	16·9	17·8	16·9
2 ...	18·8	18·4	18·6	17·4	17·3	17·7	18·1	17·6	17·2	16·9	17·6	17·1
3 ...	18·9	18·6	18·4	17·9	17·4	17·5	18·0	17·7	17·0	16·9	17·6	17·0
4 ...	18·8	18·4	18·4	17·5	17·4	17·5	17·7	17·7	16·9	16·8	17·4	16·9
5 ...	18·9	18·1	18·5	17·4	17·5	17·4	17·7	17·8	16·8	16·8	17·3	16·7
6 ...	19·1	17·9	18·6	18·1	17·1	17·5	17·9	17·6	17·0	17·1	17·1	16·7
7 ...	19·3	18·0	18·6	18·4	17·1	17·4	17·5	17·6	16·8	17·0	17·1	16·7
8 ...	19·1	18·5	18·4	18·1	17·1	17·2	17·5	18·0	16·9	16·9	17·0	16·7
9 ...	18·9	18·5	18·4	18·1	17·3	17·2	17·8	17·8	16·7	17·0	16·9	16·8
10 ...	19·0	18·5	18·6	18·1	17·3	17·4	17·6	17·6	16·9	16·7	17·2	16·7
11 ...	19·2	18·1	18·6	17·8	17·2	17·3	17·4	17·4	17·1	16·8	17·1	16·6
12 ...	18·9	18·2	18·2	17·9	17·1	17·2	17·5	17·6	17·4	17·3	16·9	16·6
13 ...	18·8	18·1	18·4	18·0	17·2	16·7	17·7	17·6	17·0	17·7	16·8	17·6
14 ...	18·9	18·2	18·3	17·7	17·1	16·8	17·8	17·5	17·1	17·7	17·0	17·2
15 ...	18·6	18·2	18·8	18·1	17·3	17·3	17·7	17·2	17·1	17·4	16·9	17·0
16 ...	18·8	18·2	18·7	17·8	16·8	17·2	17·4	17·3	16·9	17·3	16·9	16·7
17 ...	18·5	18·1	18·8	17·9	16·8	17·2	17·6	17·4	16·9	17·3	16·9	16·6
18 ...	18·7	17·8	18·2	18·0	16·9	16·9	17·6	17·3	17·0	17·4	16·7	16·5
19 ...	18·6	18·0	18·2	18·0	17·1	17·1	17·5	17·4	17·3	17·4	17·2	16·2
20 ...	18·8	18·0	18·3	18·0	17·0	17·2	17·6	17·7	17·0	17·1	17·1	16·8
21 ...	18·7	18·0	18·3	17·8	16·9	17·5	17·8	17·4	17·3	17·2	16·9	16·7
22 ...	18·8	18·2	18·5	17·6	6·9	17·5	17·9	17·8	17·1	17·1	17·2	16·6
23 ...	18·8	18·1	18·3	17·6	17·0	17·1	17·8	17·7	16·9	17·4	17·1	16·4
24 ...	18·9	18·1	18·6	17·5	17·1	17·1	17·6	17·5	17·1	17·4	16·9	16·4
25 ...	18·9	18·2	18·6	17·6	17·3	17·3	17·3	17·5	17·1	16·9	16·7	16·2
26 ...	18·8	18·4	18·5	17·7	17·1	17·1	17·5	17·9	17·3	17·6	16·7	16·2
27 ...	18·7	18·4	18·3	17·6	17·0	16·9	17·6	17·5	16·9	17·3	16·4	16·1
28 ...	18·7	18·4	18·3	17·5	17·0	17·1	17·7	17·5	17·0	17·3	16·4	16·2
29 ...	18·6	...	18·6	17·7	17·3	17·4	17·5	17·6	17·3	17·5	16·6	16·0
30 ...	18·7	...	18·2	17·4	16·9	17·5	17·4	17·5	17·1	16·8	16·6	16·8
31 ...	18·7	...	18·2	...	17·0	...	17·5	17·5	...	20·9	...	16·7
Monthly Mean ...	18·8	18·2	18·4	17·8	17·1	17·2	17·7	17·6	17·0	17·3	17·0	16·7

TABLES 124 & 125.—*Daily means of Declination (Magnetograph).*

1904.

Unity = 1 minute of arc.

1904. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	16.9	16.6	16.5	16.7	15.6	15.9	14.8	15.0	14.6	14.5	15.5	14.9
2 ...	16.7	16.7	16.5	16.4	15.5	16.1	15.5	14.9	14.5	14.9	14.5	14.8
3 ...	16.9	16.3	16.7	16.4	15.6	15.9	15.5	15.4	14.8	14.7	14.4	15.1
4 ...	16.9	16.0	16.9	16.1	15.5	15.4	15.5	15.3	14.5	14.3	14.9	14.9
5 ...	17.1	16.3	16.7	16.3	15.3	15.4	15.8	15.2	14.5	14.4	14.7	15.0
6 ...	16.8	16.5	16.8	16.3	14.8	15.5	15.7	14.5	14.5	14.3	14.5	14.9
7 ...	16.5	16.5	16.7	16.7	15.2	15.7	16.1	15.2	14.6	14.8	14.3	14.8
8 ...	16.3	16.6	16.7	16.3	15.3	15.7	16.0	15.5	14.4	14.8	14.3	14.6
9 ...	16.5	16.7	16.6	16.1	15.4	15.3	15.9	15.7	14.5	14.9	14.3	14.5
10 ...	16.8	16.6	16.2	16.3	15.3	15.3	15.9	15.2	14.4	14.6	14.5	14.6
11 ...	17.2	16.6	16.0	16.4	15.8	15.5	16.0	15.1	14.7	14.4	14.4	14.8
12 ...	16.7	16.8	16.6	16.0	15.9	15.5	16.4	15.1	14.7	14.5	14.5	14.5
13 ...	17.0	16.5	16.6	16.1	16.2	15.6	15.9	15.0	14.4	14.8	14.4	14.4
14 ...	16.8	16.7	16.4	16.1	16.1	15.3	15.8	15.0	14.5	15.1	14.4	14.6
15 ...	16.5	16.0	16.7	16.2	15.8	15.2	15.5	15.2	14.3	14.7	14.3	14.6
16 ...	17.1	16.0	16.6	16.1	15.5	15.5	15.5	15.4	14.8	14.6	14.8	14.5
17 ...	16.9	16.3	16.5	15.9	15.5	15.6	16.1	15.4	14.7	14.8	14.6	14.4
18 ...	16.6	16.3	16.6	16.1	15.7	15.7	15.6	15.2	14.9	14.6	14.6	14.5
19 ...	16.4	16.0	16.5	16.0	15.8	15.5	15.2	15.5	14.8	14.3	14.2	14.5
20 ...	16.6	16.1	16.7	16.9	15.4	15.5	14.9	15.3	14.6	14.2	14.1	14.7
21 ...	16.6	16.1	16.7	16.0	15.7	15.6	15.2	14.6	14.8	15.0	13.8	14.9
22 ...	16.8	16.0	16.6	15.8	15.5	15.3	15.1	15.2	15.0	14.9	14.0	14.5
23 ...	16.8	16.1	16.2	15.9	15.5	15.3	15.0	15.2	15.0	14.9	14.1	14.7
24 ...	16.7	16.2	16.4	15.6	15.9	15.4	15.1	15.0	14.8	14.6	13.8	14.6
25 ...	16.5	16.0	16.2	15.6	15.6	15.4	15.3	15.1	14.3	15.1	14.1	14.3
26 ...	16.8	16.0	16.6	16.2	15.8	14.9	15.1	15.2	14.9	14.9	14.4	14.6
27 ...	16.6	16.1	16.5	15.9	15.4	15.1	15.3	15.2	15.0	14.9	14.2	14.8
28 ...	16.7	16.2	16.4	16.1	15.7	15.5	15.3	14.5	15.1	15.1	14.2	14.4
29 ...	17.2	16.4	16.5	15.9	15.1	15.3	15.4	14.6	14.9	14.8	13.9	14.5
30 ...	16.6	...	16.1	16.1	15.6	15.0	15.3	15.2	15.1	14.6	14.2	14.5
31 ...	16.1	...	16.0	...	15.5	...	15.2	15.1	...	15.1	...	14.4
Monthly Mean ...	16.7	16.3	16.5	16.1	15.6	15.5	15.5	15.1	14.7	14.7	14.3	14.6

1905.

Unity = 1 minute of arc.

1905. Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1 ...	14.2	14.0	14.1	14.7	14.3	14.8	13.8	14.0	13.9	14.0	13.1	13.6
2 ...	14.1	13.8	14.5	14.7	14.1	14.8	13.8	14.5	13.8	13.9	13.3	13.8
3 ...	14.0	14.8	14.5	14.2	13.9	14.6	13.9	14.2	13.8	13.8	13.3	13.6
4 ...	14.2	14.8	14.2	14.5	13.8	14.7	13.6	14.1	13.9	13.9	13.8	13.9
5 ...	14.3	14.8	14.1	14.6	13.9	15.1	14.0	13.9	13.7	13.9	13.7	13.7
6 ...	14.5	13.9	13.7	14.4	13.6	14.8	13.3	13.8	13.6	13.8	13.4	13.6
7 ...	14.3	14.1	14.2	14.4	13.5	14.8	14.0	14.2	13.8	13.9	13.3	13.4
8 ...	14.1	13.5	14.1	14.4	13.7	14.7	13.5	14.5	14.0	13.9	13.3	13.6
9 ...	13.7	14.2	14.2	14.5	13.8	14.7	14.1	14.2	13.9	14.0	13.3	13.4
10 ...	14.1	13.5	14.0	14.8	14.0	14.9	13.8	14.0	14.3	13.9	13.5	13.1
11 ...	14.2	14.3	13.9	14.6	14.0	14.7	13.5	14.2	13.9	13.7	13.3	13.0
12 ...	14.4	14.1	14.3	14.4	13.6	14.4	13.6	13.7	14.1	13.5	14.5	13.0
13 ...	14.4	14.3	14.3	14.0	13.7	14.4	13.8	14.0	14.0	13.8	13.8	13.9
14 ...	14.7	14.1	14.4	14.3	14.3	14.4	13.8	14.2	13.5	13.8	13.7	13.5
15 ...	14.4	14.3	14.3	14.3	14.4	14.6	13.8	13.9	13.6	13.6	13.8	13.1
16 ...	14.5	14.3	14.3	14.1	14.2	14.4	13.5	13.9	13.6	13.5	14.2	13.3
17 ...	14.4	13.9	14.1	14.3	13.9	14.4	13.7	13.6	13.8	13.5	13.7	13.7
18 ...	14.5	14.1	14.2	14.3	14.0	14.4	13.7	13.7	13.9	13.4	13.7	13.6
19 ...	14.2	14.0	14.0	14.2	14.4	14.2	13.5	13.8	14.1	13.6	13.8	13.7
20 ...	14.3	14.0	13.9	14.1	14.4	14.2	13.2	13.8	13.8	13.6	13.6	13.7
21 ...	14.3	13.8	14.2	14.8	14.2	14.1	12.9	13.6	14.1	13.9	13.5	13.6
22 ...	14.8	13.8	14.1	14.2	13.9	14.5	13.7	13.6	13.8	13.8	13.2	13.3
23 ...	14.0	14.6	14.0	14.2	13.6	14.4	13.3	13.3	13.5	13.8	13.8	13.4
24 ...	14.1	14.1	13.8	14.3	14.0	14.4	13.6	13.8	14.0	13.7	13.5	13.4
25 ...	14.3	14.2	14.1	14.7	14.0	14.3	13.4	14.3	14.0	13.9	13.2	13.3
26 ...	14.5	14.3	14.1	14.6	14.2	14.1	13.9	14.0	14.2	13.9	13.0	13.2
27 ...	14.2	14.4	14.7	14.5	14.1	13.9	13.5	14.0	14.2	13.6	13.4	13.6
28 ...	14.4	13.9	14.0	14.5	13.6	14.0	13.7	13.8	14.2	14.0	13.3	13.4
29 ...	14.3	...	13.4	14.1	13.7	14.0	13.4	14.2	14.4	13.9	13.4	13.9
30 ...	14.3	...	13.7	14.3	13.7	14.1	14.2	14.3	14.5	13.8	13.3	13.6
31 ...	14.0	...	13.6	...	14.1	...	13.8	14.3	...	13.6	...	13.2
Monthly Mean ...	14.3	14.1	14.1	14.4	14.0	14.5	13.6	14.0	13.9	13.8	13.5	13.5

TABLES 126 & 127.—*Declination Magnetograph—showing the mean diurnal inequalities for each month of the years 1872 and 1873 and for the whole years.*

1872.

Unity = 1 minute of arc.

1872. Bombay Civil Time. H. m.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·23	+0·55	+0·20	+0·47	+0·28	+0·20	+0·05	−0·05	+0·40	+0·20	+0·28	+0·20	+0·25
1 18	+0·17	+0·47	+0·23	+0·47	+0·35	+0·40	+0·32	+0·15	+0·48	+0·15	+0·23	+0·20	+0·30
2 18	+0·03	+0·28	+0·12	+0·48	+0·48	+0·48	+0·47	+0·28	+0·43	+0·17	+0·17	+0·15	+0·30
3 18	−0·23	0·00	−0·08	+0·37	+0·43	+0·55	+0·57	+0·47	+0·43	−0·05	−0·15	0·00	+0·18
4 18	−0·47	−0·40	−0·20	+0·20	+0·55	+0·57	+0·63	+0·47	−0·37	−0·20	−0·48	−0·20	+0·07
5 18	−0·75	−0·63	−0·25	+0·40	+1·12	+0·97	+1·12	+1·00	+0·52	−0·17	−0·72	−0·43	+0·18
6 18	−0·88	−0·72	+0·35	+1·52	+2·58	+2·38	+2.38	+2·52	+1·92	+0·35	**−0·87**	−0·55	+0·92
7 18	**−1·28**	0·47	+1·38	**+2·55**	**+3·02**	**+2·72**	**+2·83**	**+3·38**	**+3·10**	+1·40	−0·60	−0·67	+1·45
8 18	−0·43	0·47	**+1·95**	+2·40	+2·43	+2·27	+2·27	+2·78	+2·78	**+1·52**	+0·28	−0·17	**+1·55**
9 18	+0·97	**1·38**	+1·47	+1·38	+0·75	+0·75	+0·72	+1·15	+1·28	+1·07	**+0·68**	+0·48	+1·00
10 18	**+1·32**	1·28	+0·28	+0·23	−0·95	−0·55	−0·63	−0·55	−0·60	−0·03	+0·20	−0·03	0·00
11 18	+0·83	0·52	−0·87	−1·27	−2·27	−1·83	−1·95	−2·00	−2·47	−1·15	−0·52	**−0·77**	−1·15
12 18	+0·48	−0·08	**−1·55**	−2·18	**−2·98**	**−2·35**	**−2·50**	**−2·78**	**−3·42**	**−1·52**	−0·20	−0·55	**−1·62**
13 18	+0·32	−0·03	−1·43	**−2·20**	−2·55	−2·18	−2·38	−2·72	−3·07	−0·95	+0·35	+0·20	−1·38
14 18	−0·17	−0·08	−0·52	−1·58	−1·63	−1·78	−1·67	−1·92	−1·80	−0·25	+0·57	+0·75	−0·83
15 18	−0·35	−0·52	+0·17	−0·80	−0·55	−1·12	−0·80	−0·92	−0·60	+0·23	+0·47	**+0·83**	−0·33
16 18	−0·05	−0·63	+0·23	−0·20	−0·20	−0·47	−0·28	−0·12	+0·03	+0·12	+0·17	+0·55	−0·03
17 18	−0·15	−0·77	−0·17	−0·20	−0·20	+0·05	+0·20	+0·28	0·00	−0·52	−0·25	−0·20	−0·13
18 18	−0·32	**−0·83**	−0·68	−0·52	−0·05	+0·15	+0·17	+0·12	−0·17	−0·32	−0·12	−0·03	−0·22
19 18	+0·08	0·35	−0·32	−0·65	−0·55	−0·40	−0·40	−0·32	−0·20	−0·05	+0·05	+0·12	−0·25
20 18	+0·05	0·35	−0·28	−0·52	−0·40	−0·48	−0·52	−0·47	+0·03	+0·03	0·00	+0·08	−0·23
21 18	0·05	−0·23	−0·25	−0·28	−0·20	−0·35	−0·35	−0·43	0·00	−0·15	+0·03	+0·03	−0·18
22 18	0·17	+0·52	−0·03	+0·03	0·00	−0·15	−0·28	−0·37	+0·15	0·00	+0·15	+0·08	+0·02
23 18	0·20	+0·35	+0·20	+0·17	+0·05	+0·08	−0·08	−0·25	+0·23	+0·15	+0·25	+0·20	+0·13
Range ...	2·00	2·21	3·50	4·75	0.00	5·07	5·33	6·16	6·52	3·04	1·55	1·60	3·17

1873.

Unity = 1 minute of arc.

1873. Bombay Civil Time. H. m.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·23	+0·25	+0·17	+0·32	+0·40	+0·23	+0·17	+0·08	+0·20	+0·35	+0·35	+0·20	+0·25
1 18	+0·20	+0·28	+0·12	+0·52	+0·63	+0·37	+0·32	+0·23	+0·17	+0·32	+0·32	+0·15	+0·30
2 18	+0·08	+0·32	+0·08	+0·47	+0·60	+0·48	+0·48	+0·37	+0·28	+0·32	+0·23	+0·12	+0·32
3 18	−0·20	+0·17	+0·05	+0·28	+0·63	+0·47	+0·47	+0·55	+0·35	+0·20	0·00	−0·08	+0·23
4 18	−0·57	0·00	−0·05	+0·08	+0·60	+0·47	+0·55	+0·60	+0·37	0·00	−0·25	−0·23	+0·13
5 18	−0·72	−0·25	−0·08	+0·08	+0·87	+0·72	+1·03	+1·03	+0·52	−0·08	−0·48	−0·40	+0·18
6 18	−0·88	−0·37	+0·17	+1·03	+1·92	+1·63	+2·15	+2·35	+1·58	+0·08	**−0·72**	−0·55	+0·70
7 18	−0·63	+0·08	+1·23	+1·98	**+2·40**	**+2·43**	**+2·78**	**+2·98**	**+2·52**	**+0·63**	−0·67	**−0·88**	+1·23
8 18	+0·15	+0·83	**+1·83**	**+2·47**	+1·95	+2·27	+2·43	+2·38	+1·95	+0·55	−0·23	−0·25	**+1·37**
9 18	**+1·18**	**+0·88**	+1·80	+2·07	+0·67	+1·18	+1·15	+0·77	+0·55	0·03	0·00	**+0·43**	+0·90
10 18	+0·92	+0·08	+0·80	+0·72	−0·77	−0·12	−0·37	−0·77	−0·88	−0·63	−0·12	+0·15	−0·08
11 18	−0·12	−0·57	−0·75	−1·00	−1·92	−1·08	−1·52	−1·98	−2·15	−1·28	−0·40	−0·28	−1·08
12 18	**−0·95**	**−0·72**	**−1·68**	−1·92	**−2·52**	**−1·75**	−2·12	**−2·67**	**−2·72**	**−1·28**	−0·12	−0·37	**−1·57**
13 18	−0·43	−0·25	−1·38	**−2·03**	−2·03	−1·67	**−2·18**	−2·52	−2·20	−0·75	+0·37	−0·12	−1·27
14 18	−0·40	+0·03	−0·52	−1·40	−1·43	−1·28	−1·68	−1·92	−1·00	−0·03	**+0·40**	+0·15	−0·75
15 18	−0·12	+0·28	+0·12	−0·80	−0·68	−0·88	−1·08	−0·77	+0·20	+0·57	+0·17	+0·17	−0·23
16 18	+0·23	+0·23	+0·12	−0·43	−0·08	−0·80	−0·48	+0·08	+0·68	+0·48	−0·03	+0·20	+0·02
17 18	+0·17	−0·37	−0·47	−0·37	+0·08	−0·35	−0·15	+0·35	+0·32	−0·15	−0·08	+0·15	−0·07
18 18	+0·20	−0·55	−0·95	−0·68	−0·25	−0·35	−0·12	+0·05	−0·20	−0·17	+0·12	+0·15	−0·23
19 18	+0·48	−0·12	−0·55	−0·72	−0·63	−0·63	−0·47	−0·32	−0·15	+0·05	+0·23	+0·23	−0·22
20 18	+0·43	−0·05	−0·15	−0·48	−0·48	−0·68	−0·52	−0·35	−0·15	−0·03	+0·23	+0·23	−0·17
21 18	+0·37	−0·12	−0·15	−0·35	−0·23	−0·48	−0·47	−0·28	−0·08	0·00	+0·28	+0·12	−0·12
22 18	+0·37	+0·03	−0·15	+0·03	−0·03	−0·17	−0·25	−0·15	−0·05	+0·20	+0·32	+0·17	+0·03
23 18	+0·37	+0·12	+0·08	+0·17	+0·20	0·00	−0·05	0·00	+0·08	+0·32	+0·37	+0·25	+0·15
Range ...	2·13	1·60	3·51	4·50	4·92	4·18	4·96	5·65	5·24	1·91	1·12	1·31	2·04

TABLES 128 & 129.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1874 and 1875 and for the whole years.*

1874.

Unity = 1 minute of arc.

Bombay Civil Time (1874). H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·32	+0·47	+0·17	+0·37	+0·25	+0·23	+0·20	+0·15	+0·28	+0·20	+0·28	+0·03	+0·25
1 18	+0·23	+0·37	+0·15	+0·40	+0·32	+0·37	+0·28	+0·25	+0·35	+0·32	+0·20	+0·05	+0·27
2 18	+0·05	+0·23	+0·12	+0·35	+0·32	+0·37	+0·40	+0·28	+0·35	+0·32	+0·08	−0·03	+0·23
3 18	−0·20	−0·03	−0·05	+0·28	+0·32	+0·32	+0·43	+0·23	+0·32	+0·17	−0·05	−0·17	+0·13
4 18	−0·28	−0·25	−0·20	+0·25	+0·32	+0·35	+0·40	+0·28	+0·28	0·00	−0·20	−0·37	+0·05
5 18	−0·63	−0·48	−0·32	+0·20	+0·48	+0·57	+0·68	+0·60	+0·40	−0·03	−0·40	−0·55	+0·05
6 18	−0·87	−0·67	−0·15	+0·88	+1·48	+1·52	+1·60	+1·68	+1·52	+0·12	−0·60	−0·57	+0·50
7 18	**−1·03**	**−0·72**	+0·60	**+1·78**	**+2·15**	**+1·98**	**+2·03**	**+2·50**	**+2·47**	+0·75	−0·35	**−0·75**	+0·95
8 18	−0·37	−0·05	+1·27	+1·75	+2·12	+1·90	+1·92	+2·20	+2·10	**+0·95**	+0·08	−0·43	**+1·12**
9 18	+0·52	+0·63	**+1·52**	+1·08	+1·12	+1·27	+1·32	+1·00	+0·80	+0·48	+0·12	+0·15	+0·83
10 18	**+1·00**	**+0·92**	+1·03	−0·05	−0·25	+0·35	+0·15	−0·52	−0·67	−0·20	−0·40	+0·05	+0·12
11 18	+0·47	+0·72	−0·08	−1·27	−1·32	−0·87	−0·88	−1·68	−1·98	−1·03	**−0·77**	−0·32	−0·75
12 18	0·00	+0·32	−1·00	**−1·90**	**−1·95**	−1·68	−1·55	**−2·20**	**−2·58**	**−1·28**	−0·43	+0·20	**−1·17**
13 18	−0·05	+0·08	**−1·18**	−1·75	−1·92	**−1·83**	**−1·83**	−2·00	−2·35	−0·83	+0·05	+0·37	−1·10
14 18	−0·03	−0·05	−0·67	−1·23	−1·38	−1·47	−1·55	−1·52	−1·40	−0·20	+0·20	+0·52	−0·73
15 18	−0·15	−0·37	−0·12	−0·55	−0·68	−0·97	−0·87	−0·63	−0·35	+0·25	**+0·37**	+0·52	−0·30
16 18	−0·08	−0·43	−0·05	−0·03	−0·17	−0·52	−0·35	+0·05	+0·28	+0·35	+0·35	**+0·57**	0·00
17 18	−0·05	−0·43	−0·17	0·00	−0·03	−0·23	−0·15	+0·25	+0·25	−0·12	+0·05	+0·32	0·03
18 18	+0·03	−0·43	−0·32	−0·23	−0·12	−0·15	−0·12	+0·08	−0·03	−0·23	+0·12	+0·23	−0·10
19 18	+0·23	−0·12	−0·28	−0·25	−0·40	−0·52	−0·57	−0·28	−0·05	−0·12	+0·17	+0·15	−0·17
20 18	+0·23	+0·05	−0·17	−0·25	−0·32	−0·52	−0·57	−0·37	−0·03	−0·08	+0·17	+0·03	−0·15
21 18	+0·23	+0·05	−0·05	−0·15	−0·20	−0·37	−0·43	−0·23	−0·03	−0·05	+0·17	+0·03	−0·08
22 18	+0·25	+0·17	0·00	+0·08	0·00	−0·23	−0·28	−0·08	+0·08	0·00	+0·23	+0·03	+0·02
23 18	+0·25	+0·35	+0·12	+0·25	+0·15	−0·03	0·00	+0·05	+0·23	+0·23	+0·28	+0·05	+0·17
Range ...	2·03	1·64	2·70	3·68	4·10	3·81	3·86	4·70	5·05	2·23	1·14	1·32	2·29

1875.

Unity = 1 minute of arc.

Bombay Civil Time (1875). H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·20	+0·20	+0·15	+0·23	+0·35	+0·25	+0·12	+0·17	+0·23	+0·17	+0·20	+0·17	+0·20
1 18	+0·12	+0·15	+0·08	+0·28	+0·37	+0·37	+0·32	+0·25	+0·20	+0·23	+0·15	+0·05	+0·22
2 18	0·00	+0·08	0·00	+0·23	+0·43	+0·48	+0·40	+0·37	+0·32	+0·20	+0·05	−0·05	+0·22
3 18	−0·15	−0·03	−0·08	+0·15	+0·37	+0·47	+0·43	+0·40	+0·28	+0·20	−0·03	−0·20	+0·15
4 18	−0·32	−0·17	−0·20	+0·03	+0·35	+0·52	+0·47	+0·43	+0·32	+0·12	−0·17	−0·35	+0·08
5 18	−0·48	−0·37	−0·25	−0·03	+0·52	+0·68	+0·60	+0·63	+0·43	+0·05	−0·28	−0·48	+0·08
6 18	−0·67	−0·40	−0·28	+0·48	+1·58	+1·47	+1·32	+1·67	+1·32	+0·25	−0·37	−0·63	+0·48
7 18	−0·43	−0·25	+0·32	+1·32	**+2·18**	**+2·00**	**+1·75**	**+2·30**	**+2·15**	**+0·75**	−0·20	**−0·87**	+0·92
8 18	+0·20	−0·17	+0·83	**+1·43**	+1·90	+1·92	+1·67	+1·92	+1·75	+0·72	+0·12	−0·52	**+1·00**
9 18	+0·57	−0·23	**+1·00**	+0·83	+0·72	+1·12	+1·07	+0·52	+0·55	+0·17	+0·08	−0·03	+0·53
10 18	+0·05	−0·28	+0·75	+0·08	−0·48	−0·05	+0·17	−0·72	−0·75	−0·60	−0·35	−0·05	−0·18
11 18	−0·80	−0·75	+0·08	−0·80	−1·58	−1·00	−0·77	−1·63	−2·10	−1·18	**−0·83**	−0·15	−0·97
12 18	**−0·80**	**−0·87**	−0·75	−1·47	**−2·32**	−1·68	−1·23	**−2·10**	**−2·67**	**−1·27**	−0·72	−0·08	**−1·33**
13 18	−0·23	−0·23	**−1·03**	**−1·52**	−2·07	**−1·78**	**−1·40**	−1·90	−2·00	−0·68	−0·08	+0·17	−1·02
14 18	+0·32	+0·47	−0·57	−0·95	−1·43	−1·52	−1·27	−1·27	−0·92	−0·03	+0·32	+0·32	−0·55
15 18	**+0·83**	+0·80	+0·20	−0·25	−0·68	−0·88	−0·80	−0·47	+0·03	+0·55	**+0·47**	+0·28	0·00
16 18	+0·77	**+0·87**	+0·37	+0·15	−0·05	−0·40	−0·48	+0·17	+0·55	+0·57	+0·40	+0·28	+0·27
17 18	+0·12	+0·28	−0·03	+0·28	+0·23	−0·25	−0·43	+0·25	+0·37	+0·05	+0·20	+0·32	+0·12
18 18	0·00	+0·03	−0·28	−0·08	−0·03	−0·28	−0·37	−0·23	−0·08	−0·05	+0·17	**+0·35**	−0·07
19 18	+0·15	+0·20	−0·20	−0·32	−0·32	−0·48	−0·52	−0·28	−0·12	−0·20	+0·17	+0·25	−0·13
20 18	+0·12	+0·17	−0·12	−0·28	−0·25	−0·47	−0·52	−0·35	−0·08	−0·05	+0·15	+0·28	−0·12
21 18	+0·08	+0·05	−0·05	−0·12	−0·05	−0·35	−0·40	−0·25	+0·03	−0·08	+0·12	+0·20	−0·07
22 18	+0·08	+0·12	0·00	+0·03	+0·12	−0·12	−0·20	−0·12	+0·08	+0·03	+0·17	+0·17	+0·03
23 18	+0·15	+0·15	+0·08	+0·12	+0·25	+0·08	−0·03	−0·03	+0·20	+0·12	+0·23	+0·23	+0·13
Range ...	1·63	1·74	2·03	2·95	4·50	3·78	3·15	4·40	4·82	2·02	1·30	1·22	2·33

TABLES 130 & 131.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1876 and 1877 and for the whole years.*

1876.

Unity = 1 minute of arc.

1876. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·15	+0·08	+0·17	+0·17	+0·25	+0·25	+0·28	+0·08	+0·17	+0·25	+0·32	+0·15	+0·20
1 18	+0·08	+0·08	+0·12	+0·28	+0·32	+0·35	+0·40	+0·20	+0·20	+0·28	+0·25	+0·03	+0·22
2 18	−0·03	−0·03	+0·05	+0·28	+0·37	+0·43	+0·47	+0·32	+0·23	+0·23	+0·20	−0·03	+0·20
3 18	−0·17	−0·12	−0·08	+0·23	+0·35	+0·43	+0·48	+0·32	+0·32	+0·17	+0·05	−0·12	+0·15
4 18	−0·35	−0·25	−0·12	+0·15	+0·35	+0·40	+0·55	+0·43	+0·23	+0·03	−0·08	−0·32	+0·08
5 18	−0·55	−0·48	−0·23	+0·15	+0·57	+0·75	+0·87	+0·63	+0·40	−0·03	−0·25	−0·43	+0·12
6 18	−0·68	−0·48	−0·05	+0·57	+1·43	+1·67	+1·80	+1·68	+1·08	+0·12	−0·48	−0·60	+0·48
7 18	−0·75	−0·40	+0·52	+1·28	+1·92	+2·18	+2·15	+2·32	+3·07	+0·67	−0·47	−0·92	+0·97
8 18	+0·08	−0·03	+0·95	+1·28	+1·55	+1·87	+1·78	+2·00	+2·00	+0·77	−0·05	−0·57	+0·97
9 18	+0·80	+0·08	+0·87	+0·92	+0·32	+0·87	+0·67	+0·80	+0·80	+0·40	+0·15	−0·05	+0·55
10 18	+0·60	−0·08	+0·47	+0·08	−1·12	−0·28	−0·57	−0·63	−0·57	−0·32	−0·15	+0·05	−0·22
11 18	+0·03	−0·23	−0·23	−0·88	−1·90	−1·38	−1·47	−1·60	−1·75	−1·20	−0·67	−0·08	−0·95
12 18	−0·15	−0·23	−0·88	−1·47	−2·03	−2·00	−1·83	−2·10	−2·35	−1·55	−0·57	+0·05	−1·27
13 18	−0·05	+0·12	−0·97	−1·32	−1·58	−1·95	−1·83	−2·00	−2·18	−1·07	−0·12	+0·32	−1·05
14 18	−0·15	+0·40	−0·43	−0·83	0·68	−1·48	−1·35	−1·47	−1·15	−0·32	+0·03	+0·25	−0·60
15 18	+0·05	+0·57	+0·23	−0·23	+0·03	−0·87	−0·68	−0·60	−0·20	+0·32	+0·20	+0·23	−0·08
16 18	+0·23	+0·60	+0·35	+0·08	+0·47	0·23	−0·15	+0·05	+0·28	+0·40	+0·28	+0·35	+0·23
17 18	+0·12	+0·28	+0·12	+0·05	+0·43	0·00	+0·05	+0·32	+0·12	+0·05	+0·17	+0·32	+0·17
18 18	+0·03	0·00	−0·08	−0·23	−0·12	−0·15	−0·12	+0·03	−0·15	0·00	+0·23	+0·28	−0·02
19 18	+0·12	+0·03	−0·20	−0·32	0·35	−0·43	−0·43	−0·28	−0·23	+0·03	+0·20	+0·23	−0·13
20 18	+0·08	−0·03	−0·23	−0·32	−0·37	−0·35	−0·43	−0·35	−0·23	+0·15	+0·20	+0·17	−0·15
21 18	+0·08	−0·08	−0·17	−0·17	−0·25	−0·25	−0·32	−0·23	−0·15	+0·15	+0·20	+0·15	−0·08
22 18	+0·08	0·00	−0·12	−0·03	−0·05	−0·08	−0·15	−0·08	−0·05	+0·20	+0·28	+0·17	+0·02
23 18	+0·12	+0·08	+0·03	+0·08	+0·15	+0·12	+0·05	0·00	+0·05	+0·28	+0·28	+0·15	+0·12
Range ...	1·55	1·08	1·92	2·75	3·95	4·18	3·98	4·42	5·42	2·32	0·99	1·27	2·24

1877.

Unity = 1 minute of arc.

1877. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·15	+0·17	+0·05	+0·17	+0·28	+0·25	+0·35	+0·28	+0·17	+0·23	+0·25	+0·08	+0·20
1 18	+0·17	+0·12	0·00	+0·20	+0·28	+0·40	+0·48	+0·35	+0·25	+0·20	+0·17	+0·05	+0·22
2 18	+0·12	+0·12	0·00	+0·20	+0·35	+0·48	+0·55	+0·35	+0·28	+0·15	+0·05	−0·03	+0·22
3 18	−0·12	−0·05	−0·03	+0·15	+0·32	+0·52	+0·57	+0·43	+0·28	+0·03	−0·03	−0·12	+0·17
4 18	−0·37	−0·17	−0·08	+0·03	+0·35	+0·48	+0·60	+0·48	+0·32	0·00	−0·17	−0·23	+0·10
5 18	−0·57	−0·28	−0·08	+0·03	+0·48	+0·75	+0·72	+0·72	+0·52	−0·03	−0·32	−0·32	+0·13
6 18	−0·75	−0·37	+0·03	+0·57	+1·28	+1·48	+1·68	+1·83	+1·28	+0·08	−0·47	−0·37	+0·52
7 18	−0·80	−0·28	+0·52	+1·48	+1·90	+2·00	+2·32	+2·58	+2·15	+0·63	−0·43	−0·25	+0·98
8 18	+0·08	+0·05	+0·83	+1·60	+1·75	+1·90	+2·10	+2·32	+2·00	+0·80	−0·35	+0·25	+1·12
9 18	+0·97	+0·23	+0·80	+1·00	+0·75	+0·87	+1·00	+0·80	+0·77	+0·40	−0·32	+0·25	+0·63
10 18	+0·55	+0·08	+0·37	+0·37	−0·48	−0·35	−0·35	−0·75	−0·75	−0·32	−0·40	−0·40	−0·20
11 18	−0·28	−0·32	−0·37	−0·88	−1·52	−1·47	−1·60	−2·15	−2·18	−1·15	−0·55	−0·83	−1·10
12 18	−0·25	−0·55	−1·03	−1·78	−2·03	−2·12	−2·07	−2·62	−2·70	−1·28	−0·17	−0·47	−1·42
13 18	+0·08	−0·17	−1·08	−1·68	−1·87	−1·90	−1·98	−2·35	−2·07	−0·75	+0·40	+0·15	−1·03
14 18	0·00	+0·08	−0·52	−1·18	−1·15	−1·27	−1·52	−1·60	−1·00	−0·17	+0·45	+0·37	−0·62
15 18	+0·15	+0·28	+0·23	−0·43	−0·43	−0·68	−0·88	−0·68	+0·08	+0·37	+0·43	+0·55	−0·08
16 18	+0·28	+0·40	+0·57	+0·12	+0·12	−0·28	−0·35	+0·12	+0·67	+0·48	+0·32	+0·48	+0·25
17 18	+0·08	+0·23	+0·40	+0·08	+0·23	−0·03	−0·12	+0·35	+0·47	+0·15	+0·25	+0·23	+0·20
18 18	+0·03	+0·03	+0·03	−0·08	−0·08	−0·15	−0·17	+0·0[illegible]	−0·12	+0·03	+0·25	+0·20	0·00
19 18	+0·08	+0·08	−0·15	−0·20	−0·32	−0·28	−0·43	−0·2[illegible]	−0·17	−0·05	+0·08	+0·17	−0·12
20 18	+0·03	+0·05	−0·12	0·17	−0·28	−0·25	−0·40	−0·20	−0·15	−0·03	+0·12	+0·12	−0·10
21 18	+0·08	+0·03	−0·08	−0·08	−0·15	−0·17	−0·28	−0·0[illegible]	−0·03	+0·05	+0·0[illegible]	+0·05	−0·05
22 18	+0·17	+0·08	−0·05	+0·05	−0·03	0·00	−0·05	+0·0[illegible]	+0·03	+0·15	+0·2[illegible]	+0·05	+0·05
23 18	+0·12	+0·15	0·00	+0·12	+0·17	+0·15	+0·17	+0·1[illegible]	+0·15	+0·20	+0·2[illegible]	+0·12	+0·15
Range ...	1·77	0·95	1·91	3·38	3·93	4·12	4·39	5·20	4·85	2·08	1·03	1·38	2·54

TABLES 132 & 133.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1878 and 1879 and for the whole years.*

1878.

Unity = 1 minute of arc.

1878. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·05	+0·03	+0·08	+0·25	+0·28	+0·28	+0·23	+0·17	+0·25	+0·20	+0·12	+0·20	+0·18
1 18	0·00	−0·03	+0·05	+0·32	+0·37	+0·35	+0·32	+0·23	+0·28	+0·17	+0·05	+0·15	+0·18
2 18	−0·12	−0·12	0·00	+0·25	+0·40	+0·37	+0·32	+0·28	+0·28	+0·20	+0·03	0·00	+0·15
3 18	−0·25	−0·20	−0·05	+0·15	+0·35	+0·37	+0·35	+0·32	+0·28	+0·15	−0·12	−0·15	+0·10
4 18	−0·40	−0·28	−0·17	+0·05	+0·32	+0·37	+0·37	+0·37	+0·23	+0·12	−0·20	−0·25	+0·05
5 18	−0·52	−0·35	−0·15	+0·08	+0·37	+0·63	+0·57	+0·55	+0·32	+0·15	−0·35	−0·37	+0·08
6 18	−0·55	−0·32	−0·03	+0·68	+1·08	+1·52	+1·40	+1·40	+1·07	+0·32	**−0·48**	−0·40	+0·47
7 18	−0·32	−0·15	+0·55	+1·47	**+1·68**	**+1·95**	**+1·80**	**+1·90**	**+1·78**	+0·68	−0·47	−0·43	+0·87
8 18	+0·55	+0·32	**+1·03**	**+1·72**	+1·67	+1·72	+1·67	+1·60	+1·48	+0·55	−0·12	−0·12	**+1·00**
9 18	**+0·87**	+0·35	+0·97	+1·15	+0·75	+0·75	+0·97	+0·57	+1·47	−0·08	−0·03	−0·20	+0·55
10 18	+0·35	+0·05	+0·47	+0·12	−0·52	−0·37	+0·08	−0·57	−0·67	−0·80	−0·08	−0·83	−0·23
11 18	−0·48	−0·40	−0·57	−1·15	−1·38	−1·27	−0·97	−1·32	−1·63	**−1·35**	−0·40	**−0·97**	−0·98
12 18	**−0·60**	**−0·55**	**−1·20**	**−1·80**	**−1·87**	**−1·74**	−1·55	**−1·63**	**−2·03**	−1·23	−0·08	−0·55	**−1·23**
13 18	−0·25	−0·25	−1·08	−1·58	−1·55	−1·60	**−1·78**	−1·60	−1·75	−0·55	+0·43	+0·15	−0·95
14 18	+0·03	+0·15	−0·43	−1·00	−0·83	−1·15	−1·40	−1·12	−0·88	+0·25	**+0·57**	+0·57	−0·43
15 18	+0·35	+0·48	+0·32	−0·37	−0·32	−0·67	−0·77	−0·40	0·00	**+0·75**	+0·52	**+0·72**	+0·05
16 18	+0·48	**+0·48**	+0·47	+0·05	0·00	−0·17	−0·15	+0·15	+0·43	+0·60	+0·43	+0·60	+0·28
17 18	+0·25	+0·17	+0·17	+0·12	−0·03	−0·12	−0·03	+0·23	+0·25	−0·03	+0·15	+0·35	+0·12
18 18	+0·17	+0·03	−0·08	−0·17	−0·25	−0·28	−0·20	−0·12	−0·05	−0·17	+0·08	+0·32	−0·07
19 18	+0·17	+0·05	−0·17	−0·32	−0·37	−0·52	−0·47	−0·35	−0·15	−0·15	+0·08	+0·32	−0·15
20 18	+0·12	+0·03	−0·12	−0·23	−0·32	−0·35	−0·47	−0·37	−0·12	−0·05	+0·03	+0·28	−0·13
21 18	+0·08	0·00	−0·05	−0·05	−0·17	−0·23	−0·32	−0·23	−0·05	−0·03	+0·03	+0·25	−0·07
22 18	+0·08	+0·05	+0·03	+0·05	0·00	−0·03	−0·15	−0·12	+0·05	+0·05	+0·03	+0·25	+0·02
23 18	+0·08	+0·08	+0·08	+0·15	+0·15	+0·20	+0·05	+0·03	+0·17	+0·15	+0·08	+0·25	+0·12
Range ...	1·47	1·03	2·23	3·52	3·55	3·69	3·58	3·53	3·81	2·10	1·05	1·69	2·23

1879.

Unity = 1 minute of arc.

1879. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·20	+0·05	+0·08	+0·08	+0·32	+0·25	+0·23	+0·20	+0·23	+0·15	+0·25	+0·25	+0·18
1 18	+0·12	0·00	+0·03	+0·12	+0·37	+0·35	+0·28	+0·28	+0·25	+0·17	+0·23	+0·20	+0·20
2 18	+0·05	−0·05	0·00	+0·08	+0·35	+0·37	+0·32	+0·37	+0·25	+0·15	+0·12	+0·08	+0·17
3 18	−0·12	−0·17	−0·08	+0·05	+0·35	+0·35	+0·35	+0·40	+0·23	+0·05	0·00	−0·08	+0·10
4 18	−0·23	−0·25	−0·15	+0·03	+0·32	+0·35	+0·37	+0·43	+0·28	−0·03	−0·17	−0·32	+0·05
5 18	−0·35	−0·35	−0·15	+0·05	+0·57	+0·67	+0·63	+0·67	+0·43	−0·08	−0·28	−0·48	+0·12
6 18	−0·40	**−0·48**	−0·12	+0·63	+1·47	+1·63	+1·58	+1·67	+1·12	+0·12	−0·40	−0·67	+0·52
7 18	−0·32	−0·47	+0·37	**+1·32**	**+1·92**	**+2·15**	**+2·03**	**+2·27**	**+1·92**	+0·75	−0·37	**−1·03**	+0·88
8 18	+0·17	+0·12	+0·80	+1·23	+1·67	+1·95	+1·90	+1·95	+1·63	**+0·95**	−0·12	−0·77	**+0·95**
9 18	**+0·60**	**+0·47**	**+0·87**	+0·83	+0·52	+0·87	+0·88	+0·77	+0·48	+0·35	−0·15	−0·32	+0·52
10 18	+0·35	+0·37	+0·72	+0·03	−0·75	−0·35	−0·12	−0·75	−0·68	−0·40	−0·55	−0·20	−0·20
11 18	−0·67	−0·17	+0·03	−0·87	−1·75	−1·60	−1·43	−1·87	−1·75	−1·15	**−0·92**	−0·25	−1·03
12 18	**−0·87**	−0·23	−0·80	**−1·27**	**−2·15**	**−2·23**	**−2·12**	**−2·30**	**−2·32**	**−1·18**	−0·48	−0·05	**−1·33**
13 18	−0·40	0·00	**−1·12**	−1·20	−1·78	−2·00	−2·03	−2·12	−2·00	−0·68	+0·17	+0·47	−1·05
14 18	−0·05	+0·20	−0·63	−0·67	−1·07	−1·35	−1·43	−1·35	−0·97	0·00	+0.52	**+0·63**	−0·52
15 18	+0·17	+0·43	0·00	−0·12	−0·28	−0·68	−0·67	−0·40	+0·03	+0·52	**+0·67**	+0·47	+0·02
16 18	+0·37	+0·43	+0·32	+0·32	+0·32	−0·08	−0·08	+0·28	+0·57	+0·47	+0·40	+0·43	+0·32
17 18	+0·28	+0·08	+0·17	+0·20	+0·35	+0·12	+0·08	+0·40	+0·40	+0·03	+0·12	+0·35	+0·22
18 18	+0·25	−0·03	−0·05	−0·05	−0·08	−0·12	−0·08	−0·03	−0·00	−0·08	+0·15	+0·23	0·00
19 18	+0·23	0·00	−0·17	−0·23	−0·25	−0·37	−0·43	−0·25	−0·17	−0·12	+0·12	+·020	−0·12
20 18	+0·20	0·00	−0·15	−0·28	−0·25	−0·35	−0·40	−0·32	−0·17	−0·12	+0·12	+0·17	−0·13
21 18	+0·17	0·00	−0·05	−0·17	−0·08	−0·23	−0·25	−0·20	−0·05	−0·03	+0·12	+0·17	−0·05
22 18	+0·17	+0·05	−0·03	−0·08	+0·08	0·00	−0·05	−0·05	+0·05	+0·05	+0·17	+0·17	+0·05
23 18	+0·17	+0·05	+0·05	0·00	+0·20	+0·15	+0·12	+0·05	+0·15	+0·12	+0·23	+0·20	+0·12
Range ...	1·47	·95	1·99	2·59	4·07	4·38	4·15	4·57	4·24	2·13	1·59	1·66	2·28

TABLES 134 & 135—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1880 and 1881 and for the whole years.*

1880.

Unity = 1 minute of arc.

1880. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·12	+0·05	+0·08	+0·25	+0·23	+0·28	+0·17	+0·32	+0·17	+0·23	+0·28	+0·28	+0·20
1 18	+0·05	+0·05	+0·03	+0·35	+0·32	+0·37	+0·25	+0·40	+0·23	+0·17	+0·17	+0·20	+0·22
2 18	-0·08	+0·03	-0·05	+0·28	+0·35	+0·43	+0·35	+0·40	+0·28	+0·12	+0·05	+0·12	+0·18
3 18	-0·20	-0·08	-0·20	+0·23	+0·32	+0·40	+0·40	+0·47	+0·23	-0·15	-0·17	-0·20	+0·08
4 18	-0·35	-0·17	-0·35	+0·15	+0·28	+0·37	+0·43	+0·43	+0·20	-0·28	-0·37	-0·40	0·00
5 18	-0·55	-0·32	-0·47	+0·08	+0·47	+0·63	+0·68	+0·67	+0·25	-0·28	-0·48	-0·67	0·00
6 18	-0·67	-0·40	-0·55	+0·43	+1·35	+1·52	+1·68	+1·58	+1·08	0·00	**-0·63**	-0·75	+0·38
7 18	**-0·92**	-0·15	+0·15	+1·20	**+1·83**	**+2·10**	**+2·12**	**+2·30**	+2·00	+0·80	-0·32	**-0·95**	+0·85
8 18	-0·63	+0·35	+0·95	**+1·48**	+1·68	+2·03	+1·83	+2·00	**+2·03**	**+1·20**	+0·23	-0·52	**+1·05**
9 18	-0·08	**+0·83**	**+1·32**	+1·28	+0·68	+1·08	+0·83	+0·88	+0·97	+0·75	**+0·40**	-0·05	+0·73
10 18	+0·25	+0·72	+1·18	+0·40	-0·52	-0·08	-0·20	-0·43	-0·47	-0·05	+0·08	-0·12	+0·07
11 18	+0·12	+0·03	+0·37	-0·83	-1·38	-1·35	-1·18	-1·58	-1·78	-0·88	-0·35	-0·35	-0·77
12 18	-0·03	**-0·47**	-0·60	-1·68	**-1·90**	-2·15	**1·68**	**-2·15**	**-2·35**	**-1·20**	-0·28	-0·17	**-1·22**
13 18	+0·28	-0·37	**-0·80**	**-1·72**	-1·68	**-2·18**	-1·67	-2·12	-2·10	-0·77	-0·03	+0·20	-1·08
14 18	+0·40	-0·15	-0·43	-1·20	-1·07	-1·63	-1·32	-1·60	-1·15	-0·25	-0·05	+0·35	-0·67
15 18	+0·43	+0·12	+0·15	-0·48	-0·40	-0·87	-0·72	-0·83	-0·17	+0·25	+0·03	+0·37	-0·18
16 18	**+0·47**	+0·28	+0·25	+0·08	+0·03	-0·23	-0·25	-0·35	+0·35	+0·32	+0·12	**+0·43**	+0·12
17 18	+0·35	+0·08	-0·15	+0·20	+0·17	0·00	-0·08	0·00	+0·17	-0·12	-0·08	+0·25	+0·07
18 18	+0·28	-0·12	-0·40	-0·12	-0·08	-0·05	-0·15	-0·05	-0·12	-0·20	+0·05	+0·35	-0·05
19 18	+0·25	-0·03	-0·37	-0·28	-0·28	-0·28	-0·48	-0·35	-0·12	-0·03	+0·12	+0·35	-0·13
20 18	+0·23	-0·03	-0·17	-0·20	-0·25	-0·28	-0·55	-0·28	-0·05	-0·08	+0·20	+0·28	-0·10
21 18	+0·15	-0·03	-0·12	-0·03	-0·15	-0·20	-0·47	-0·15	0·00	0·00	+0·25	+0·32	-0·03
22 18	+0·17	0·00	-0·05	+0·05	+0·05	-0·05	-0·25	0·00	+0·05	+0·08	+0·28	+0·35	+0·05
23 18	+0·15	+0·05	+0·03	+0·20	+0·17	+0·15	-0·12	+0·17	+0·08	+0·20	+0·37	+0·32	+0·15
Range ...	1·39	1·30	2·12	3·20	3·73	4·28	3·80	4·45	4·38	2·40	1·03	1·38	2·27

1881.

Unity = 1 minute of arc.

1881. Bombay. Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·28	+0·25	+0·08	+0·08	+0·20	+0·25	0·00	+0·15	+0·43	+0·20	+0·20	+0·25	+0·20
1 18	+0·25	+0·20	+0·05	+0·20	+0·23	+0·35	+0·17	+0·20	+0·48	+0·17	+0·15	+0·17	+0·22
2 18	+0·08	+0·12	0·00	+0·23	+0·23	+0·40	+0·23	+0·25	+0·55	+0·12	+0·05	+0·03	+0·18
3 18	-0·12	-0·03	-0·05	+0·15	+0·20	+0·37	+0·28	+0·28	+0·47	-0·03	-0·15	-0·20	+0·10
4 18	-0·35	-0·23	-0·12	+0·12	+0·28	+0·37	+0·40	+0·35	+0·37	-0·15	-0·25	-0·40	+0·03
5 18	-0·47	-0·48	-0·25	+0·17	+0·63	+0·80	+0·87	+0·67	+0·43	-0·17	-0·40	-0·63	+0·10
6 18	-0·60	**-0·55**	-0·15	+0·80	+1·80	+2·12	+2·12	+2·03	+1·40	+0·32	-0·57	-0·77	+0·67
7 18	-0·43	-0·43	+0·67	+1·67	**+2·38**	**+2·72**	**+2·67**	**+2·87**	**+2·50**	+1·18	-0·43	**-1·00**	+1·20
8 18	+0·40	+0·32	+1·35	**+1·83**	+2·03	+2·32	+2·20	+2·50	+2·23	**+1·52**	+0·08	-0·48	**+1·35**
9 18	**+0·88**	**+0·87**	**+1·52**	+1·12	+0·72	+1·08	+0·83	+1·07	+0·88	+0·87	+0·32	+0·17	+0·87
10 18	+0·43	+0·75	+0·95	+0·03	-0·92	-0·23	-0·47	-0·48	-0·43	-0·08	-0·08	+0·32	-0·02
11 18	-0·52	+0·03	-0·12	-1·12	-2·12	-1·63	-1·58	-1·80	-1·90	-1·15	**-0·60**	+0·03	-1·03
12 18	**-0·87**	-0·52	-0·95	**-1·83**	**-2·62**	**-2·52**	**-2·07**	**-2·50**	**-2·75**	**-1·48**	-0·43	+0·03	**-1·53**
13 18	-0·60	-0·48	**-1·00**	-1·72	-2·12	-2·50	-1·95	-2·47	-2·58	-1·00	+0·17	**+0·40**	-1·32
14 18	-0·28	-0·23	-0·57	-1·08	-1·15	-1·92	-1·43	-1·78	-1·60	-0·20	+0·37	+0·37	-0·80
15 18	-0·03	+0·05	-0·08	-0·37	-0·17	-1·03	-0·67	-0·80	-0·55	+0·25	**+0·52**	+0·25	-0·22
16 18	+0·17	+0·03	+0·03	+0·20	+0·52	-0·23	0·00	+0·08	+0·08	+0·28	+0·48	+0·20	+0·15
17 18	+0·12	-0·17	-0·25	+0·17	+0·48	+0·08	+0·37	+0·32	+0·03	-0·23	+0·05	+0·08	+0·08
18 18	+0·08	-0·20	-0·47	-0·15	+0·05	-0·05	+0·23	+0·03	-0·08	-0·32	+0·17	+0·08	-0·05
19 18	+0·23	+0·03	-0·28	-0·32	-0·32	-0·47	-0·43	-0·35	-0·15	-0·17	+0·20	+0·20	-0·15
20 18	+0·23	+0·12	-0·17	-0·28	-0·32	-0·35	-0·48	-0·40	-0·15	-0·03	+0·05	+0·17	-0·13
21 18	+0·25	+0·17	-0·12	-0·12	-0·15	-0·17	-0·43	-0·32	-0·03	-0·05	+0·08	+0·15	-0·07
22 18	+0·23	+0·17	-0·03	-0·08	-0·03	-0·03	-0·28	-0·15	+0·08	+0·03	+0·17	+0·05	+0·02
23 18	+0·28	+0·20	+0·03	+0·03	+0·08	+0·08	-0·20	-0·03	+0·35	+0·17	+0·15	+0·20	+0·12
Range ...	1·75	1·42	2·52	3·66	5·00	5·24	4·74	5·37	5·25	3·00	1·12	1·40	2·88

TABLES 136 & 137.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1882 and 1883 and for the whole years.*

1882.

Unity = 1 minute of arc.

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·05	+0·17	+0·17	+0·25	+0·30	+0·32	+0·15	+0·33	+0·25	+0·18	+0·23	+0·23	+0·22
1 18	+0·03	+0·12	+0·15	+0·37	+0·35	+0·48	+0·28	+0·38	+0·25	+0·22	+0·28	+0·12	+0·25
2 18	+0·03	+0·05	+0·12	+0·35	+0·48	+0·53	+0·28	+0·37	+0·23	+0·15	+0·10	+0·02	+0·23
3 18	−0·15	−0·08	0·00	+0·20	+0·52	+0·52	+0·35	+0·30	+0·12	−0·07	−0·20	−0·12	+0·12
4 18	−0·35	−0·20	−0·12	+0·12	+0·43	+0·48	+0·42	+0·28	+0·07	−0·07	−0·45	−0·32	+0·02
5 18	−0·55	−0·35	−0·20	+0·08	+0·62	+0·88	+0·68	+0·50	+0·13	−0·03	−0·55	−0·47	+0·07
6 18	**−0·63**	−0·37	−0·15	+0·68	+1·72	+1·87	+1·55	+1·63	+1·10	+0·43	**−0·98**	−0·63	+0·52
7 18	−0·63	−0·23	+0·47	+1·48	**+2·22**	**+2·33**	**+1·88**	**+2·45**	**+2·00**	**+1·05**	−0·62	**−0·92**	+0·95
8 18	+0·17	+0·67	+1·23	**+1·87**	+1·93	+2·00	+1·72	+2·25	+1·93	+0·90	+0·22	−0·48	**+1·20**
9 18	**+0·92**	**+1·18**	**+1·47**	+1·60	+0·93	+1·13	+1·08	+1·12	+0·97	+0·30	+0·22	+0·08	+0·92
10 18	+0·68	+1·00	+1·03	+0·55	−0·28	+0·02	−0·03	−0·37	−0·25	−0·57	−0·13	+0·27	+0·17
11 18	−0·03	+0·12	−0·05	−0·87	−1·52	−1·30	−1·08	−1·58	−1·30	−1·42	−0·62	−0·07	−0·82
12 18	−0·12	−0·60	−1·23	−1·90	**−2·27**	**−1·97**	**−1·57**	**−2·22**	**−1·98**	**−1·47**	−0·37	−0·02	**−1·30**
13 18	+0·12	**−0·67**	**−1·40**	**−1·92**	−2·17	−1·90	−1·47	−2·15	−1·77	−0·77	+0·30	+0·28	−1·12
14 18	+0·17	−0·52	−0·87	−1·20	−1·68	−1·38	−1·03	−1·78	−1·00	−0·02	**+0·48**	+0·28	−0·72
15 18	+0·17	−0·23	−0·05	−0·52	−0·85	−0·93	−0·57	−1·13	−0·22	+0·57	+0·50	+0·28	−0·25
16 18	+0·17	−0·12	+0·23	−0·12	−0·12	−0·58	−0·32	−0·43	+0·12	+0·53	+0·37	**+0·30**	0·00
17 18	−0·05	−0·20	−0·15	−0·08	+0·20	−0·37	−0·27	+0·03	−0·07	−0·22	+0·20	+0·08	−0·07
18 18	−0·12	−0·32	−0·43	−0·20	+0·08	−0·32	−0·23	+0·08	−0·28	−0·13	+0·18	+0·13	−0·13
19 18	+0·05	+0·03	−0·28	−0·23	−0·35	−0·68	−0·60	−0·18	−0·32	−0·02	+0·08	+0·23	−0·18
20 18	+0·03	+0·05	−0·17	−0·23	−0·38	−0·58	−0·53	−0·22	−0·13	+0·03	+0·13	+0·17	−0·15
21 18	−0·05	+0·03	−0·08	−0·12	−0·22	−0·47	−0·42	−0·10	−0·05	+0·05	+0·07	+0·15	−0·10
22 18	0·00	+0·05	+0·05	+0·03	−0·05	−0·18	−0·22	+0·15	+0·02	+0·17	+0·15	+0·17	+0·03
23 18	0·00	+0·15	+0·15	+0·12	+0·12	+0·08	−0·05	+0·25	+0·17	+0·25	+0·37	+0·22	+0·15
Range ...	1·55	1·85	2·87	3·79	4·49	4·30	3·45	4·67	3·98	2·52	1·46	1·22	2·50

1883.

Unity = 1 minute of arc.

Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·22	+0·28	+0·18	+0·12	+0·23	+0·22	+0·17	+0·12	+0·17	+0·28	+0·22	+0·23	+0·20
1 18	+0·17	+0·32	+0·18	+0·25	+0·33	+0·28	+0·32	+0·20	+0·22	+0·25	+0·22	+0·23	+0·25
2 18	+0·08	+0·27	+0·15	+0·28	+0·37	+0·37	+0·37	+0·25	+0·18	+0·23	+0·13	+0·17	+0·23
3 18	−0·12	+0·13	+0·03	+0·22	+0·37	+0·43	+0·33	+0·25	+0·13	+0·07	−0·03	0·00	+0·15
4 18	−0·30	−0·17	−0·10	+0·18	+0·38	+0·55	+0·43	+0·28	+0·17	−0·10	−0·22	−0·20	+0·08
5 18	−0·40	−0·43	−0·13	+0·33	+0·72	+0·98	+0·87	+0·55	+0·38	−0·17	−0·32	−0·40	+0·17
6 18	−0·47	−0·60	−0·20	+1·03	+1·77	+2·15	+2·00	+1·62	+1·57	+0·08	−0·42	−0·33	+0·68
7 18	−0·37	**−0·62**	+0·32	+1·78	**+2·30**	**+2·68**	**+2·55**	**+2·35**	**+2·67**	+0·95	−0·30	−0·30	+1·17
8 18	+0·40	+0·17	+0·92	**+1·83**	+1·98	+2·25	+2·18	+2·07	+2·30	**+1·40**	+0·12	+0·48	**+1·33**
9 18	**+1·07**	**+0·83**	**+1·15**	+1·27	+0·83	+0·88	+1·10	+0·98	+0·90	+0·98	+0·13	**+0·97**	+0·92
10 18	+0·75	+0·83	+0·80	+0·05	−0·70	−0·48	−0·28	−0·28	−0·60	+0·20	−0·33	−0·07	−0·02
11 18	−0·37	+0·28	−0·25	−1·33	−1·92	−1·65	−1·48	−1·15	−1·93	−0·85	**−0·78**	**−0·68**	−1·02
12 18	**−0·88**	−0·27	−0·98	**−2·05**	**−2·43**	**−2·38**	−2·10	−1·82	**−2·53**	**−1·32**	−0·42	−0·57	**−1·48**
13 18	−0·55	−0·28	**−1·03**	−1·72	−2·05	−2·35	**−2·22**	**−2·10**	−2·10	−1·00	+0·42	−0·17	−1·27
14 18	−0·23	−0·38	−0·47	−1·00	−1·28	−1·77	−1·90	−1·73	−1·10	−0·43	**+0·62**	+0·03	−0·80
15 18	+0·07	−0·23	+0·10	−0·23	−0·48	−0·97	−1·07	−0·82	−0·10	+0·12	+0·47	+0·25	−0·23
16 18	+0·23	0·23	+0·20	+0·22	+0·08	−0·23	−0·25	−0·05	+0·48	+0·18	+0·23	+0·23	+0·10
17 18	−0·07	−0·25	−0·12	+0·13	+0·17	+0·05	+0·17	+0·23	+0·33	−0·30	−0·13	−0·23	0·00
18 18	0·00	−0·27	−0·30	−0·30	−0·10	−0·03	+0·17	+0·05	−0·23	−0·38	−0·07	−0·03	−0·12
19 18	+0·17	−0·08	−0·27	−0·47	−0·32	−0·40	−0·38	−0·33	−0·28	−0·22	+0·05	+0·12	−0·20
20 18	+0·17	+0·07	−0·13	−0·33	−0·28	−0·40	−0·37	−0·30	−0·30	−0·15	+0·05	+0·07	−0·17
21 18	+0·10	+0·15	−0·07	−0·20	−0·12	−0·23	−0·35	−0·22	−0·25	−0·12	+0·02	−0·02	−0·10
22 18	+0·12	+0·22	−0·05	−0·07	+0·02	−0·05	−0·15	−0·12	−0·13	+0·05	+0·12	+0·05	0·00
23 18	+0·17	+0·25	+0·03	0·00	+0·15	+0·10	−0·02	−0·02	+0·03	+0·23	+0·23	+0·15	+0·12
Range ...	1·95	1·45	2·18	3·88	4·73	5·06	4·77	4·45	5·20	2·72	1·40	1·65	2·81

TABLES 138 & 139.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1884 and 1885 and for the whole years.*

1884.

Unity = 1 minute of arc.

1884. Bombay Civil Time.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0·02	+0·15	+0·07	+0·28	+0·17	+0·17	+0·03	+0·03	+0·25	+0·22	+0·22	+0·23	+0·15
1 18	+0·07	+0·17	+0·13	+0·35	+0·28	+0·25	+0·17	+0·15	+0·25	+0·18	+0·15	+0·15	+0·18
2 18	+0·05	+0·05	+0·08	+0·27	+0·30	+0·30	+0·30	+0·25	+0·32	+0·12	+0·03	−0·02	+0·17
3 18	−0·15	−0·10	−0·07	+0·12	+0·27	+0·33	+0·37	+0·35	+0·25	−0·02	−0·18	−0·15	+0·08
4 18	−0·37	−0·35	−0·22	+0·03	+0·32	+0·50	+0·53	+0·48	+0·18	−0·15	−0·40	−0·43	+0·02
5 18	−0·58	−0·65	−0·22	+0·08	+0·55	+0·95	+1·03	+0·85	+0·37	−0·27	−0·70	−0·67	+0·07
6 18	**−0·60**	**−0·68**	+0·23	+1·17	+1·73	+2·22	+2·02	+2·27	+1·40	−0·02	**−1·02**	−0·85	+0·65
7 18	−0·32	−0·62	+1·13	+2·23	**+2·37**	**+2·63**	**+2·53**	**+3·02**	**+2·33**	+0·78	−0·72	**−0·87**	+1·22
8 18	+0·77	+0·43	**+1·80**	**+2·35**	+2·02	+2·17	+2·08	+2·43	+2·23	**+1·28**	+0·25	+0·03	**+1·48**
9 18	**+1·60**	+1·50	+1·48	+1·53	+0·67	+0·70	+0·82	+0·70	+1·12	+0·87	**+0·77**	**+1·05**	+1·07
10 18	+1·17	**+1·87**	+0·72	+0·13	−0·98	−0·67	−0·50	−1·07	−0·42	+0·05	+0·73	+0·80	+0·15
11 18	+0·13	+1·10	−0·45	−1·50	−2·15	−1·87	−1·62	−2·43	−1·97	−0·85	+0·03	+0·22	−0·95
12 18	−0·33	+0·23	−1·32	**−2·48**	**−2·45**	**−2·40**	**−2·07**	**−2·70**	**−2·85**	**−1·15**	−0·17	+0·05	**−1·47**
13 18	−0·35	−0·22	**−1·38**	−2·35	−1·93	−2·20	−2·02	−2·40	−2·58	−0·95	+0·08	+0·07	−1·35
14 18	−0·28	−0·62	−0·65	−1·57	−0·97	−1·55	−1·35	−1·58	−1·48	−0·32	−0·13	−0·13	−0·88
15 18	−0·10	−0·65	−0·05	−0·55	−0·17	−0·78	−0·63	−0·47	−0·30	+0·13	−0·20	−0·25	−0·33
16 18	+0·02	−0·50	+0·17	+0·20	+0·33	−0·08	−0·13	+0·38	+0·47	+0·32	+0·10	−0·12	+0·15
17 18	−0·22	−0·47	−0·18	+0·25	+0·37	+0·27	+0·17	+0·55	+0·43	−0·13	+0·02	−0·03	+0·08
18 18	−0·37	−0·53	−0·52	−0·05	+0·10	+0·08	+0·05	+0·15	−0·02	−0·23	+0·07	+0·02	−0·10
19 18	−0·03	−0·13	−0·32	−0·27	−0·28	−0·38	−0·43	−0·12	−0·07	−0·10	+0·17	+0·17	−0·15
20 18	−0·02	0·00	−0·18	−0·22	−0·28	−0·37	−0·48	−0·32	−0·08	−0·05	+0·23	+0·17	−0·13
21 18	−0·07	−0·03	−0·17	−0·18	−0·18	−0·23	−0·48	−0·28	−0·05	−0·03	+0·22	+0·18	−0·12
22 18	−0·05	−0·07	−0·12	0·00	−0·10	−0·08	−0·28	−0·17	+0·05	+0·13	+0·22	+0·18	−0·02
23 18	−0·02	+0·08	+0·02	+0·15	+0·03	+0·03	−0·12	−0·05	+0·17	+0·22	+0·23	+0·23	+0·08
Range ...	2·20	2·55	3·18	4·83	4·82	5·03	4·60	5·72	5·18	2·43	1·79	1·92	2·95

1885.

Unity = 1 minute of arc.

1885. Bombay. Civil Time.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0·15	+0·07	+0·17	+0·25	+0·23	+0·22	+0·05	−0·10	+0·13	+0·27	+0·32	+0·08	+0·15
1 18	+0·02	+0·15	+0·17	+0·28	+0·32	+0·37	+0·20	0·00	+0·32	+0·23	+0·27	+0·05	+0·20
2 18	−0·10	+0·10	+0·12	+0·30	+0·32	+0·47	+0·30	+0·13	+0·30	+0·18	+0·15	−0·07	+0·18
3 18	−0·37	+0·02	+0·03	+0·20	+0·32	+0·50	+0·45	+0·30	+0·25	+0·07	−0·07	−0·20	+0·12
4 18	−0·65	−0·12	−0·03	+0·10	+0·35	+0·62	+0·52	+0·43	+0·27	−0·10	−0·30	−0·38	+0·05
5 18	−0·82	−0·18	−0·10	+0·08	+0·63	+0·98	+1·00	+1·02	+0·48	−0·18	−0·48	−0·58	+0·15
6 18	**−0·92**	−0·22	−0·12	+0·72	+1·87	+2·17	+2·18	+2·40	+1·45	−0·15	**−0·78**	−0·83	+0·65
7 18	−0·88	−0·15	+0·45	+1·52	**+2·30**	**+2·48**	**+2·58**	**+3·08**	**+2·32**	+0·38	−0·73	**−1·00**	+1·03
8 18	+0·07	+0·17	+0·88	**+1·70**	+1·93	+2·12	+2·22	+2·40	+2·12	**+0·73**	−0·23	−0·38	**+1·15**
9 18	**+1·22**	+0·13	**+0·93**	+1·40	+0·78	+0·72	+1·00	+0·45	+0·83	+0·57	+0·05	+0·43	+0·72
10 18	+1·18	−0·10	+0·72	+0·45	−0·73	−0·72	−0·52	−1·33	−0·77	+0·13	−0·10	+0·37	−0·12
11 18	+0·07	−0·60	−0·03	−0·98	−1·93	−1·82	−1·65	−2·47	−2·07	−0·62	−0·52	+0·02	−1·03
12 18	−0·37	**−0·70**	−1·13	−2·00	**−2·45**	**−2·45**	**−2·30**	**−2·85**	**−2·57**	**−1·12**	−0·33	+0·22	**−1·50**
13 18	−0·02	−0·18	**−1·60**	**−2·02**	−2·05	−2·40	−2·30	−2·33	−2·25	−0·75	+0·15	**+0·47**	−1·27
14 18	+0·15	+0·23	−0·98	−1·25	−1·20	−1·78	−1·68	−1·35	−1·27	−0·28	+0·43	+0·27	−0·75
15 18	+0·22	+0·50	+0·12	−0·42	−0·43	−0·95	−0·70	−0·13	−0·22	+0·18	**+0·45**	+0·15	−0·10
16 18	+0·43	**+0·53**	+0·58	+0·03	+0·12	−0·17	+0·05	+0·75	+0·48	+0·25	+0·33	+0·22	+0·30
17 18	+0·15	+0·08	+0·25	−0·02	+0·35	+0·15	+0·28	+0·80	+0·23	−0·17	+0·13	+0·08	+0·20
18 18	−0·03	−0·12	−0·23	−0·22	+0·03	+0·15	−0·05	+0·10	−0·17	−0·13	+0·13	+0·15	−0·03
19 18	+0·12	+0·05	−0·18	−0·28	−0·32	−0·23	−0·48	−0·30	−0·10	−0·07	+0·18	+0·23	−0·12
20 18	+0·07	+0·07	−0·12	−0·18	−0·27	−0·23	−0·47	−0·30	−0·05	+0·05	+0·17	+0·17	−0·08
21 18	+0·03	+0·05	+0·03	−0·08	−0·18	−0·15	−0·37	−0·28	−0·03	+0·07	+0·23	+0·17	−0·05
22 18	+0·12	+0·07	0·00	+0·15	−0·05	−0·08	−0·23	−0·20	+0·02	+0·23	+0·25	+0·18	+0·03
23 18	+0·15	+0·08	+0·10	+0·23	+0·07	+0·07	−0·08	−0·20	+0·20	+0·25	+0·30	+0·17	+0·12
Range ...	2·14	1·23	2·53	3·72	4·75	4·93	4·88	5·93	4·89	1·85	1·23	1·47	2·65

TABLES 140 & 141.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1886 and 1887 and for the whole years.*

1886.

Unity = 1 minute of arc.

1886. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·17	+0·23	+0·17	+0·30	+0·20	+0·22	+0·10	+0·12	+0·42	+0·28	+0·28	+0·17	+0·22
1 18	-0·03	+0·20	+0·23	+0·33	+0·38	+0·35	+0·28	+0·23	+0·43	+0·33	+0·23	+0·15	+0·27
2 18	-0·17	+0·05	+0·18	+0·27	+0·43	+0·42	+0·38	+0·33	+0·42	+0·15	+0·20	-0·03	+0·22
3 18	-0·30	-0·20	+0·02	+0·22	+0·43	+0·43	+0·40	+0·33	+0·42	+0·08	-0·03	-0·23	+0·13
4 18	-0·48	-0·38	-0·08	+0·15	+0·48	+0·48	+0·45	+0·43	+0·38	-0·08	-0·30	-0·38	+0·05
5 18	-0·73	-0·62	-0·23	+0·18	+0·92	+0·77	+0·70	+0·73	+0·42	-0·25	-0·40	-0·63	+0·07
6 18	-0·93	-0·82	0·00	+0·98	+1·93	+1·75	+1·80	+1·87	+1·23	-0·02	-0·57	-0·78	+0·53
7 18	**-1·03**	**-0·88**	+0·55	**+1·73**	**+2·30**	**+2·38**	**+2·35**	**+2·42**	**+1·90**	+0·67	-0·62	**-1·10**	+0·88
8 18	-0·18	-0·20	**+1·02**	+1·70	+1·87	+2·20	+2·05	+1·97	+1·63	**+0·97**	-0·43	-0·67	**+1·00**
9 18	+0·72	+0·63	+0·95	+1·05	+0·50	+1·32	+1·10	+0·68	+0·62	+0·65	-0·47	-0·13	+0·63
10 18	**+1·03**	**+0·90**	+0·43	+0·07	-0·88	0·00	0·00	-0·55	-0·50	-0·02	-0·67	-0·02	-0·02
11 18	+0·47	+0·65	-0·40	-1·13	-1·82	-1·20	-0·93	-1·68	-1·72	-1·08	**-0·82**	-0·03	-0·80
12 18	-0·02	+0·40	-1·00	**-1·75**	**-2·23**	**-2·00**	-1·45	**-2·25**	**-2·40**	**-1·52**	-0·42	-0·03	**-1·22**
13 18	-0·02	+0·35	**-1·07**	-1·68	-2·00	-2·00	**-1·67**	-2·12	-2·22	-1·13	+0·30	+0·20	-1·08
14 18	-0·02	+0·08	-0·57	-1·23	-1·17	-1·55	-1·45	-1·47	-1·33	-0·45	**+0·57**	+0·30	-0·68
15 18	-0·07	-0·25	+0·07	-0·55	-0·40	-0·95	-0·98	-0·58	-0·32	+0·17	+0·55	+0·37	-0·25
16 18	+0·05	-0·35	+0·18	+0·03	+0·12	-0·52	-0·57	+0·12	+0·25	+0·40	+0·47	**+0·57**	+0·07
17 18	+0·12	-0·23	0·00	0·00	+0·13	-0·28	-0·27	+0·38	+0·23	+0·08	+0·30	+0·48	+0·08
18 18	+0·17	-0·13	-0·28	-0·28	-0·18	-0·25	-0·28	-0·02	-0·12	-0·05	+0·43	+0·47	-0·05
19 18	+0·32	0·00	-0·13	-0·30	-0·47	-0·50	-0·60	-0·25	-0·15	0·00	+0·23	+0·40	-0·12
20 18	+0·25	+0·05	-0·10	-0·27	-0·37	-0·52	-0·62	-0·35	-0·10	+0·05	+0·20	+0·30	-0·12
21 18	+0·20	+0·10	-0·10	-0·08	-0·22	-0·38	-0·43	-0·25	+0·07	+0·15	+0·32	+0·25	-0·03
22 18	+0·22	+0·15	0·00	+0·05	-0·10	-0·20	-0·30	-0·15	+0·20	+0·27	+0·32	+0·22	+0·05
23 18	+0·28	+0·25	+0·17	+0·22	+0·08	0·00	-0·05	-0·02	+0·27	+0·35	+0·32	+0·22	+0·17
Range...	2·06	1·78	2·09	3·48	4·53	4·38	4·02	4·67	4·30	2·49	1·39	1·67	2·22

1887.

Unity = 1 minute of arc.

1887. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·15	+0·18	+0·10	+0·28	+0·33	+0·23	+0·18	+0·07	-0·02	+0·30	+0·32	+0·17	+0·18
1 18	+0·07	+0·10	+0·05	+0·30	+0·43	+0·35	+0·32	+0·07	+0·07	+0·30	+0·25	+0·15	+0·20
2 18	-0·05	+0·02	-0·07	+0·37	+0·52	+0·42	+0·42	+0·17	+0·13	+0·17	+0·10	-0·03	+0·18
3 18	-0·20	-0·02	-0·18	+0·25	+0·50	+0·47	+0·40	+0·23	+0·20	+0·08	-0·08	-0·25	+0·12
4 18	-0·35	-0·23	-0·32	+0·17	+0·55	+0·47	+0·50	+0·43	+0·32	-0·07	-0·30	-0·43	+0·07
5 18	-0·62	-0·47	-0·37	+0·18	+0·82	+0·77	+0·83	+0·87	+0·58	-0·12	-0·48	-0·67	+0·12
6 18	-0·73	-0·60	-0·18	+0·77	+1·80	+1·68	+1·90	+2·07	+1·43	-0·07	**-0·73**	-0·82	+0·55
7 18	-0·67	**-0·67**	+0·52	+1·57	**+2·12**	**+2·12**	**+2·38**	**+2·68**	**+2·25**	+0·48	-0·72	**-1·03**	+0·92
8 18	+0·27	-0·22	+1·23	**+1·73**	+1·60	+1·83	+2·13	+2·12	+1·75	**+0·70**	-0·38	-0·58	**+1·02**
9 18	+1·08	+0·32	**+1·27**	+1·20	+0·18	+0·73	+0·92	+0·70	+0·30	+0·32	-0·27	+0·07	+0·57
10 18	**+0·85**	**+0·47**	+0·75	+0·12	-1·27	-0.42	-0·50	-0·95	-1·03	-0·37	-0·33	**+0·38**	-0·18
11 18	-0·13	+0·15	-0·22	-1·07	-2·02	-1·57	-1·70	-2·28	-2·13	-1·18	-0·63	+0·20	-1·05
12 18	**-0·57**	-0·15	**-0·93**	**-1·88**	**-2·38**	**-2·12**	**-2·30**	**-2·67**	**-2·57**	**-1·27**	-0·13	+0·30	**-1·38**
13 18	-0·45	-0·13	-0·87	-1·78	-1·92	-1·85	-2·25	-2·35	-2·10	-0·83	+0·48	+0·35	-1·13
14 18	-0·33	0·00	-0·30	-1·15	-1·12	-1·37	-1·57	-1·47	-0·92	-0·20	**+0·62**	+0·28	-0·63
15 18	-0·18	+0·17	+0·23	-0·45	-0·37	-0·82	-0·78	-0·37	+0·25	+0·40	+0·48	+0·02	-0·12
16 18	+0·15	+0·23	+0·23	+0·02	+0·23	-0·27	-0·07	+0·48	+0·90	+0·62	+0·37	+0·13	+0·25
17 18	+0·30	+0·07	-0·12	-0·02	+0·35	+0·02	+0·17	+0·65	+0·62	+0·23	+0·15	+0·25	+0·22
18 18	+0·23	+0·10	-0·32	-0·27	-0·12	-0·02	-0·02	+0·02	+0·10	+0·08	+0·20	+0·32	+0·03
19 18	+0·35	+0·08	-0·25	-0·27	-0·23	-0·30	-0·40	-0·22	+0·02	+0·02	+0·18	+0·28	-0·07
20 18	+0·25	+0·08	-0·17	-0·18	-0·18	-0·25	-0·30	-0·12	-0·05	-0·02	+0·15	+0·27	-0·05
21 18	+0·18	+0·10	-0·10	-0·07	-0·10	-0·17	-0·23	-0·10	-0·03	+0·03	+0·20	+0·27	0·00
22 18	+0·18	+0·13	-0·02	+0·07	+0·05	-0·07	-0·12	-0·08	-0·02	+0·13	+0·20	+0·23	+0·05
23 18	+0·22	+0·27	+0·03	+0·13	+0·22	+0·10	+0·05	+0·02	-0·02	+0·27	+0·33	+0·20	+0·15
Range...	1·42	1·14	2·20	3·61	4·50	4·24	4·68	5·35	4·82	1·97	1·35	1·41	2·40

TABLES 142 & 143.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1888 and 1889 and for the whole years.*

1888.

Unity = 1 minute of arc.

1888. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·28	+0·18	+0·12	+0·17	+0·20	+0·22	+0·17	+0·15	+0·15	+0·23	+0·13	+0·18	+0·18
1 18	+0·15	+0·12	+0·12	+0·17	+0·33	+0·33	+0·30	+0·17	+0·18	+0·22	+0·10	+0·10	+0·18
2 18	−0·10	+0·13	+0·07	+0·23	+0·42	+0·50	+0·37	+0·25	+0·18	+0·10	+0·03	0·00	+0·18
3 18	−0·23	−0·03	−0·05	+0·17	+0·42	+0·43	+0·42	+0·32	+0·10	−0·02	−0·05	−0·17	+0·10
4 18	−0·35	−0·17	−0·12	+0·12	+0·48	+0·45	+0·55	+0·38	+0·10	−0·12	−0·22	−0·30	+0·07
5 18	−0·65	−0·28	−0·23	+0·17	+0·70	+0·78	+0·82	+0·67	+0·22	−0·20	−0·35	−0·48	+0·10
6 18	−0·68	−0·27	−0·30	+0·87	+1·43	+1·60	+1·70	+1·67	+1·05	−0·18	−0·40	−0·60	+0·48
7 18	**−0·72**	−0·23	+0·35	+1·67	**+1·77**	**+2·08**	**+2·20**	**+2·18**	+1·98	+0·42	−0·52	**−0·92**	+0·85
8 18	+0·17	−0·05	+0·92	**+1·73**	+1·42	+1·93	+2·10	+1·88	**+2·00**	**+0·80**	−0·25	−0·53	**+1·02**
9 18	**+0·75**	−0·03	**+1·15**	+1·03	+0·38	+0·95	+1·12	+0·68	+1·02	+0·53	−0·27	−0·13	+0·60
10 18	+0·27	−0·15	+0·98	−0·03	−0·78	−0·23	−0·22	−0·62	−0·32	−0·12	−0·38	−0·07	−0·13
11 18	−0·58	−0·45	+0·12	−1·13	−1·48	−1·27	−1·48	−1·73	−1·77	−0·93	**−0·67**	−0·22	−0·97
12 18	−0·55	**−0·53**	−0·85	−1·78	**−1·75**	**−2·12**	**−2·08**	**−2·18**	**−2·27**	**−1·23**	−0·33	−0·20	**−1·32**
13 18	−0·22	−0·17	**−1·28**	**−1·80**	−1·42	−1·97	−2·02	−2·03	−1·90	−0·87	+0·18	+0·10	−1·12
14 18	−0·10	+0·28	−0·83	−1·02	−0·82	−1·42	−1·58	−1·38	−0·97	−0·25	+0·55	+0·42	−0·60
15 18	+0·18	**+0·82**	−0·05	−0·22	−0·25	−0·88	−0·95	−0·52	−0·13	+0·33	**+0·62**	+0·45	−0·05
16 18	+0·53	+0·58	+0·33	+0·25	+0·08	−0·37	−0·32	+0·20	+0·38	+0·48	+0·45	**+0·47**	+0·25
17 18	+0·25	+0·17	+0·05	+0·15	+0·07	−0·12	+0·02	+0·42	+0·23	+0·15	+0·25	+0·33	+0·17
18 18	+0·22	+0·02	−0·17	−0·08	−0·15	−0·20	−0·10	+0·10	−0·08	+0·07	+0·32	+0·33	+0·02
19 18	+0·32	−0·03	−0·18	−0·27	−0·40	−0·32	−0·32	−0·22	−0·12	+0·08	+0·20	+0·35	−0·07
20 18	+0·33	−0·02	−0·13	−0·30	−0·35	−0·25	−0·37	−0·22	−0·07	+0·07	+0·15	+0·23	−0·08
21 18	+0·22	0·00	−0·07	−0·20	−0·28	−0·20	−0·27	−0·10	−0·05	+0·08	+0·12	+0·22	−0·05
22 18	+0·23	+0·05	+0·02	−0·02	−0·10	−0·03	−0·12	−0·10	+0·02	+0·13	+0·12	+0·27	+0·03
23 18	+0·27	+0·12	+0·10	+0·05	+0·08	+0·12	+0·07	+0·02	+0·05	+0·25	+0·15	+0·20	+0·12
Range...	1·47	1·35	2·43	3·53	3·52	4·20	4·28	4·36	4·27	2·03	1·29	1·39	2·34

1889.

Unity = 1 minute of arc.

1889. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	0·00	+0·13	+0·10	+0·22	+0·23	+0·25	+0·13	+0·07	+0·12	+0·22	+0·15	+0·03	+0·13
1 18	−0·08	+0·13	+0·17	+0·23	+0·23	+0·33	+0·18	+0·12	+0·18	+0·10	+0·10	−0·07	+0·13
2 18	−0·15	+0·12	+0·08	+0·32	+0·28	+0·47	+0·23	+0·20	+0·22	+0·08	+0·02	−0·18	+0·13
3 18	−0·33	+0·07	0·00	+0·23	+0·22	+0·45	+0·32	+0·20	+0·15	0·00	−0·15	−0·27	+0·07
4 18	−0·47	−0·08	+0·02	+0·20	+0·27	+0·53	+0·38	+0·30	+0·23	−0·07	−0·28	−0·40	+0·05
5 18	−0·57	−0·15	−0·02	+0·30	+0·58	+0·82	+0·62	+0·65	+0·37	−0·12	−0·37	−0·47	+0·13
6 18	**−0·70**	−0·20	+0·08	+1·02	+1·50	+1·53	+1·38	+1·72	+1·10	+0·02	−0·53	**−0·52**	+0·53
7 18	−0·67	−0·17	+0·48	+1·87	**+1·97**	**+1·80**	**+1·87**	**+2·32**	**+1·92**	+0·67	−0·53	−0·50	+0·92
8 18	+0·10	+0·25	**+0·77**	**+1·98**	+1·68	+1·53	+1·75	+1·93	+1·80	**+0·97**	−0·13	+0·17	**+1·07**
9 18	**+0·70**	+0·23	+0·63	+1·22	+0·58	+0·65	+1·12	+0·63	+0·72	+0·52	−0·13	**+0·50**	+0·62
10 18	+0·55	−0·03	+0·18	−0·07	−0·62	−0·40	+0·13	−0·67	−0·47	−0·22	−0·35	+0·08	−0·15
11 18	−0·10	−0·65	−0·55	−1·52	−1·57	−1·32	−0·97	−1·72	−1·65	−1·02	**−0·70**	−0·38	−1·02
12 18	−0·17	**−0·83**	−1·12	**−2·15**	**−1·90**	**−1·90**	−1·57	**−2·18**	**−2·27**	**−1·33**	−0·38	−0·15	**−1·33**
13 18	+0·05	−0·48	**−1·20**	−2·07	−1·68	−1·80	**−1·58**	−1·98	−2·05	−0·87	+0·12	+0·08	−1·12
14 18	+0·23	−0·03	−0·58	−1·30	−0·93	−1·30	−1·18	−1·35	−1·10	−0·02	+0·40	+0·13	−0·58
15 18	+0·45	+0·35	+0·18	−0·47	−0·27	−0·58	−0·65	−0·45	−0·08	+0·38	+0·40	+0·23	−0·03
16 18	+0·52	**+0·50**	+0·48	+0·20	+0·22	−0·12	−0·22	+0·30	+0·55	+0·45	**+0·50**	+0·38	+0·32
17 18	+0·22	+0·23	+0·28	+0·28	+0·27	−0·03	−0·17	+0·55	+0·38	+0·20	+0·32	+0·28	+0·23
18 18	+0·15	+0·08	+0·02	−0·05	−0·15	−0·17	−0·20	+0·18	+0·05	−0·02	+0·25	+0·28	+0·03
19 18	+0·07	+0·12	−0·03	−0·25	−0·38	−0·33	−0·48	−0·18	−0·03	−0·13	+0·32	+0·20	−0·10
20 18	+0·10	+0·10	−0·03	−0·23	−0·35	−0·35	−0·47	−0·28	−0·12	−0·07	+0·30	+0·22	−0·10
21 18	+0·02	+0·08	−0·02	−0·10	−0·27	−0·23	−0·42	−0·18	−0·05	+·02	+0·23	+0·15	−0·07
22 18	+0·07	+0·10	+0·03	+0·02	−0·05	−0·02	−0·22	−0·10	+0·02	+0·10	+0·25	+0·10	+0·02
23 18	+0·02	+0·13	+0·03	+0·13	+0·12	+0·12	−0·05	−0·05	+0·05	+0·13	+0·23	+0·05	+0·08
Range...	1·40	1·33	1·97	4·13	3·87	3·70	3·45	4·50	4·19	2·30	1·20	1·02	2·40

TABLES 144 & 145.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1890 and 1891 and for the whole years.*

1890.

Unity = 1 minute of arc.

1890. Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0.17	+0.13	+0.10	+0.32	+0.20	+0.23	+0.13	+0.13	+0.27	+0.22	+0.15	+0.23	+0.18
1 18	+0.07	+0.08	+0.07	+0.35	+0.23	+0.33	+0.27	+0.18	+0.25	+0.18	+0.08	+0.12	+0.18
2 18	0.00	+0.08	+0.03	+0.35	+0.23	+0.35	+0.35	+0.30	+0.37	+0.15	+0.02	-0.05	+0.18
3 18	-0.18	+0.02	+0.02	+0.27	+0.22	+0.33	+0.37	+0.37	+0.33	+0.02	-0.15	-0.23	+0.12
4 18	-0.32	-0.13	-0.12	+0.23	+0.28	+0.43	+0.45	+0.45	+0.32	-0.03	-0.27	-0.43	+0.07
5 18	-0.52	-0.37	-0.12	+0.25	+0.65	+0.73	+0.78	+0.73	+0.47	-0.13	-0.47	-0.60	+0.12
6 18	-0.65	-0.48	-0.03	+0.83	+1.57	+1.65	+1.68	+1.87	+1.35	-0.05	**-0.70**	-0.70	+0.53
7 18	**-0.78**	**-0.53**	+0.47	**+1.47**	**+1.93**	**+1.98**	**+1.97**	**+2.33**	**+2.03**	+0.42	-0.62	**-0.87**	+0.82
8 18	-0.10	+0.22	**+0.82**	+1.35	+1.45	+1.72	+1.57	+1.85	+1.65	+0.63	-0.10	-0.25	**+0.90**
9 18	**+0.70**	+0.78	+0.82	+0.65	+0.13	+0.77	+0.55	+0.45	+0.52	+0.15	+0.10	+0.35	+0.50
10 18	+0.55	**+0.85**	+0.42	-0.37	-1.02	-0.28	-0.63	-0.97	-0.75	-0.47	-0.05	**+0.45**	-0.18
11 18	-0.28	+0.32	-0.35	-1.40	-1.72	-1.33	-1.50	-2.02	-1.88	-1.23	-0.45	0.00	-0.98
12 18	-0.27	-0.38	-0.87	**-1.80**	**-1.88**	**-1.85**	**-1.92**	**-2.30**	**-2.47**	**-1.23**	-0.18	-0.10	**-1.27**
13 18	-0.03	-0.47	**-0.92**	-1.57	-1.38	-1.72	-1.83	-2.07	-2.25	-0.65	+0.32	+0.08	-1.03
14 18	-0.07	-0.25	-0.42	-0.97	-0.63	-1.17	-1.25	-1.30	-1.15	+0.13	+0.38	+0.20	-0.53
15 18	+0.03	-0.20	+0.12	-0.28	+0.03	-0.48	-0.47	-0.27	0.00	+0.65	**+0.42**	+0.18	-0.02
16 18	+0.28	+0.05	+0.30	+0.22	+0.43	+0.05	+0.12	+0.42	+0.58	**+0.68**	+0.38	+0.25	+0.32
17 18	+0.28	+0.05	+0.10	+0.22	+0.28	+0.12	+0.28	+0.52	+0.32	+0.15	+0.20	+0.17	+0.22
18 18	+0.17	0.00	-0.08	-0.10	-0.18	-0.23	+0.10	+0.07	+0.03	+0.08	+0.25	+0.20	+0.02
19 18	+0.15	+0.03	-0.17	-0.23	-0.37	-0.55	-0.27	-0.20	-0.12	-0.03	+0.17	+0.18	-0.12
20 18	+0.20	+0.02	-0.12	-0.15	-0.33	-0.52	-0.33	-0.28	-0.12	+0.03	+0.12	+0.18	-0.10
21 18	+0.22	-0.02	-0.10	-0.03	-0.20	-0.40	-0.28	-0.23	-0.02	+0.05	+0.10	+0.17	-0.07
22 18	+0.20	+0.03	-0.03	+0.12	-0.03	-0.17	-0.13	-0.08	+0.07	+0.10	+0.13	+0.23	+0.03
23 18	+0.20	+0.13	+0.08	+0.23	+0.10	0.00	+0.02	+0.03	+0.13	+0.20	+0.15	+0.22	+0.12
Range ...	1.48	1.38	1.74	3.27	3.81	3.83	3.89	4.63	4.50	1.91	1.12	1.32	2.17

1891.

Unity = 1 minute of arc.

1891. Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0.05	+0.15	+0.05	+0.27	+0.30	+0.07	+0.12	+0.08	+0.10	+0.22	+0.35	+0.18	+0.17
1 18	-0.02	+0.08	+0.07	+0.20	+0.45	+0.15	+0.17	+0.08	+0.05	+0.12	+0.22	+0.18	+0.15
2 18	-0.07	+0.03	+0.02	+0.22	+0.48	+0.30	+0.27	+0.17	+0.07	+0.10	+0.13	+0.08	+0.15
3 18	-0.23	-0.08	-0.10	+0.13	+0.42	+0.27	+0.27	+0.22	+0.13	-0.02	-0.05	-0.05	+0.07
4 18	-0.38	-0.15	-0.22	+0.10	+0.43	+0.32	+0.32	+0.35	+0.28	-0.07	-0.27	-0.30	+0.03
5 18	-0.52	-0.28	-0.15	+0.05	+0.82	+0.77	+0.73	+0.73	+0.65	-0.20	-0.48	-0.53	+0.13
6 18	**-0.62**	-0.35	+0.17	+0.78	+1.73	+1.87	+1.80	+1.95	+1.83	+0.15	**-0.68**	-0.70	+0.67
7 18	-0.57	-0.32	+0.85	+1.63	**+2.27**	**+2.38**	**+2.30**	**+2.68**	**+2.52**	+0.97	-0.62	**-0.92**	+1.10
8 18	+0.50	+0.07	**+1.43**	**+1.78**	+1.98	+2.07	+2.05	+2.22	+2.10	**+1.27**	0.00	-0.25	**+1.27**
9 18	**+1.33**	+0.28	+1.32	+1.12	+0.62	+0.85	+0.95	+0.77	+0.70	+0.85	+0.27	+0.15	+0.77
10 18	+0.70	+0.23	+0.65	+0.03	-1.05	-0.42	-0.25	-0.83	-0.92	-0.08	+0.08	+0.12	-0.15
11 18	-0.35	-0.27	-0.40	-1.13	-2.20	-1.53	-1.52	-2.08	-2.48	-1.18	-0.40	-0.13	-1.13
12 18	-0.47	**-0.43**	-1.28	**-1.83**	**-2.57**	**-2.10**	**-2.20**	**-2.58**	**-2.88**	**-1.70**	-0.32	0.00	**-1.53**
13 18	-0.23	-0.07	**-1.37**	-1.60	-2.17	-1.90	-2.13	-2.32	-2.35	-1.15	+0.08	**+0.47**	-1.23
14 18	-0.13	+0.28	-0.67	-1.02	-1.30	-1.33	-1.58	-1.50	-1.22	-0.30	+0.33	+0.45	-0.67
15 18	+0.03	**+0.47**	+0.02	-0.52	-0.47	-0.67	-0.80	-0.55	+0.02	+0.32	**+0.40**	+0.25	-0.12
16 18	+0.30	+0.38	+0.27	+0.02	+0.22	-0.02	-0.15	+0.18	+0.77	+0.50	+0.18	+0.08	+0.23
17 18	+0.17	+0.02	+0.03	+0.08	+0.20	+0.15	+0.17	+0.52	+0.52	+0.02	-0.05	-0.02	+0.15
18 18	+0.07	-0.10	-0.17	-0.17	+0.12	-0.08	+0.17	+0.22	+0.02	-0.03	+0.07	+0.13	+0.02
19 18	+0.12	-0.03	-0.23	-0.27	-0.18	-0.40	-0.22	-0.08	-0.02	+0.05	+0.13	+0.23	-0.07
20 18	+0.08	-0.03	-0.25	-0.13	-0.22	-0.35	-0.20	-0.10	+0.02	+0.02	+0.10	+0.17	-0.07
21 18	+0.12	-0.03	-0.22	-0.05	-0.10	-0.23	-0.18	-0.07	0.00	-0.02	+0.02	+0.15	-0.05
22 18	+0.08	+0.05	+0.07	+0.07	+0.07	-0.10	-0.05	-0.07	+0.07	+0.07	+0.18	+0.12	+0.05
23 18	+0.05	+0.13	+0.08	+0.25	+0.13	-0.03	+0.02	0.00	-0.03	+0.18	+0.30	+0.15	+0.10
Range ...	1.95	0.90	2.80	3.61	4.84	4.48	4.50	5.26	5.40	2.97	1.09	1.39	2.80

TABLES 146 & 147.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1892 and 1893 and for the whole years.*

1892.

Unity = 1 minute of arc.

1892. Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0·15	+0·22	+0·25	+0·15	+0·37	+0·15	−0·03	+0·03	+0·03	+0·22	**+0·32**	+0·25	+0·17
1 18	+0·08	+0·20	+0·12	+0·28	+0·42	+0·30	+0·20	+0·03	+0·10	+0·10	+0·20	+0·18	+0·18
2 18	+0·02	+0·12	+0·07	+0·25	+0·45	+0·37	+0·37	+0·25	+0·15	+0·05	+0·17	+0·08	+0·20
3 18	−0·17	0·00	−0·20	+0·23	+0·38	+0·28	+0·27	+0·20	+0·03	−0·03	+0·02	−0·12	+0·07
4 18	−0·40	−0·20	−0·38	+0·20	+0·58	+0·40	+0·48	+0·38	+0·18	−0·10	−0·18	−0·42	+0·05
5 18	−0·55	−0·45	−0·37	+0·35	+0·85	+0·92	+0·93	+0·87	+0·48	−0·15	−0·35	−0·65	+0·15
6 18	**−0·70**	**−0·52**	−0·12	+1·15	+2·07	+2·23	+2·40	+2·57	+1·80	+0·33	**−0·55**	−0·77	+0·82
7 18	−0·57	−0·22	+0·75	+2·13	**+2·37**	**+2·42**	**+2·98**	**+3·28**	**+2·75**	+1·13	−0·43	**−0·95**	+1·30
8 18	+0·[illegible]2	+0·60	+1·55	**+2·23**	+1·63	+2·15	+2·52	+2·50	+2·32	**+1·45**	+0·12	−0·38	**+1·42**
9 18	**+0·92**	**+0·95**	**+1·63**	+1·35	+0·13	+0·98	+1·10	+0·62	+0·77	+0·92	+0·30	−0·03	+0·80
10 18	+0·58	+0·50	+0·93	−0·10	−1·32	−0·22	−0·15	−0·97	−0·68	+0·02	+0·13	+0·05	−0·10
11 18	−0·37	−0·23	−0·18	−1·50	−2·42	−1·45	−1·52	−2·28	−2·13	−1·17	−0·45	−0·05	−1·15
12 18	−0·55	−0·47	−1·00	**−2·22**	**−2·73**	−2·17	−2·27	**−2·83**	**−2·85**	**−1·63**	−0·27	+0·23	**−1·57**
13 18	−0·03	−0·25	**−1·05**	−1·97	−2·10	**−2·33**	**−2·32**	−2·57	−2·33	−1·25	+0·12	**+0·42**	−1·30
14 18	+0·12	−0·03	−0·40	−1·18	−1·00	−1·75	−1·95	−1·57	−1·05	−0·43	+0·08	+0·40	−0·73
15 18	+0·28	+0·23	−0·02	−0·38	−0·23	−1·08	−1·12	−0·37	+0·03	+0·23	+0·08	+0·25	−0·17
16 18	+0·37	+0·15	0·00	+0·20	+0·37	−0·38	−0·40	+0·48	+0·75	+0·50	+0·13	+0·28	+0·20
17 18	−0·03	−0·12	−0·2[illegible]	+0·15	+0·43	−0·02	+0·08	+0·52	+0·42	−0·10	−0·20	+0·08	+0·08
18 18	−0·08	−0·27	−0·5[illegible]	−0·13	+0·22	+0·10	+0·2[illegible]	+0·08	−0·17	−0·17	−0·05	+0·17	−0·05
19 18	+0·17	0·00	−0·4[illegible]	−0·47	−0·28	−0·40	−0·32	−0·33	−0·15	−0·03	+0·15	+0·23	−0·15
20 18	+0·15	−0·10	−0·2[illegible]	−0·43	−0·30	−0·30	−0·40	−0·37	−0·13	+0·02	+0·17	+0·17	−0·15
21 18	+0·12	−0·15	−0·1[illegible]	−0·22	−0·10	−0·25	−0·40	−0·32	−0·17	−0·07	+0·07	+0·13	−0·13
22 18	+0·10	+0·03	−0·0[illegible]	−0·10	+0·07	−0·03	−0·33	−0·17	−0·12	+0·02	+0·20	+0·20	−0·02
23 18	+0·05	+0·02	+0·10	−0·02	+0·17	+0·07	−0·33	−0·07	−0·03	+0·15	+0·23	+0·27	+0·05
Range ...	1·62	1·47	2·70	4·50	5·10	4·75	5·30	6·10	5·60	3·08	0·87	1·37	2·99

1893.

Unity = 1 minute of arc.

1893. Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0·28	+0·18	+0·2[illegible]	+0·23	+0·30	+0·20	+0·15	+0·10	+0·27	+0·33	+0·27	+0·37	+0·23
1 18	+0·25	+0·28	+0·23	+0·32	+0·38	+0·33	+0·28	+0·20	+0·40	+0·38	+0·23	+0·32	+0·30
2 18	+0·07	+0·18	+0·18	+0·35	+0·37	+0·35	+0·30	+0·35	+0·38	+0·25	+0·15	+0·20	+0·27
3 18	−0·02	+0·07	+0·05	+0·15	+0·33	+0·32	+0·32	+0·25	+0·35	+0·13	0·00	−0·02	+0·17
4 18	−0·23	−0·07	−0·02	+0·05	+0·33	+0·38	+0·47	+0·32	+0·32	−0·07	−0·17	−0·27	+0·08
5 18	−0·45	−0·13	+0·07	+0·05	+0·75	+0·85	+0·92	+0·72	+0·57	−0·13	−0·40	−0·53	+0·18
6 18	−0·58	−0·07	+0·47	+0·93	+1·88	+2·15	+1·33	+2·23	+1·73	+0·27	**−0·68**	−0·78	+0·73
7 18	−0·55	+0·27	+1·28	+1·88	**+2·43**	**+2·80**	**+2·70**	**+3·10**	**+2·58**	+0·93	−0·52	**−1·27**	+1·30
8 18	+0·27	**+0·73**	**+1·68**	**+1·98**	+2·18	+2·43	+2·22	+2·67	+2·25	**+1·17**	+0·08	−0·77	**+1·42**
9 18	+0·60	+0·63	+1·75	+1·48	+0·90	+1·13	+0·97	+0·98	+0·90	+0·88	**+0·37**	0·00	+0·88
10 18	−0·03	+0·20	+0·80	+0·43	−0·73	−0·43	−0·53	−0·62	−0·53	−0·03	+0·22	+0·35	−0·08
11 18	**−1·03**	−0·60	−0·63	−1·00	−2·12	−1·82	−1·70	−1·95	−2·15	−1·10	−0·18	+0·28	−1·17
12 18	−0·95	**−1·15**	−1·87	−2·00	**−2·82**	**−2·47**	−2·30	−2·90	**−2·92**	**−1·53**	−0·12	+0·25	**−1·73**
13 18	−0·30	−0·73	**−2·[illegible]2**	**−2·08**	−2·45	−2·43	**−2·33**	**−2·95**	−2·53	−1·13	+0·20	+0·40	−1·53
14 18	+0·23	+0·02	−1·28	−1·47	−1·60	−1·90	−1·77	−2·25	−1·45	−0·53	+0·07	+0·38	−0·97
15 18	**+0·68**	+0·43	−0·4[illegible]	−0·52	−0·52	−1·05	−0·98	−1·13	−0·23	+0·17	+0·02	+0·03	−0·30
16 18	+0·65	+0·47	−0·1[illegible]	+0·07	+0·2[illegible]	−0·23	−0·20	+0·07	+0·40	+0·30	+0·02	−0·02	+0·13
17 18	+0·07	−0·05	−0·20	+0·07	+0·45	+0·18	+0·33	+0·73	+0·18	−0·25	−0·25	0·00	+0·10
18 18	−0·03	−0·52	−0·37	−0·25	+0·25	+0·17	+0·43	+0·43	−0·17	−0·27	−0·03	−0·03	−0·03
19 18	+0·23	−0·07	−0·12	−0·40	−0·27	−0·38	−0·12	−0·02	−0·13	−0·02	+0·15	+0·13	−0·08
20 18	+0·23	−0·07	−0·05	−0·23	−0·28	−0·28	−0·25	−0·15	−0·18	−0·05	+0·15	+0·13	−0·08
21 18	+0·22	−0·08	+0·0[illegible]	−0·15	−0·1[illegible]	−0·22	−0·17	−0·10	−0·12	+0·02	+0·03	+0·15	−0·05
22 18	+0·17	−0·02	+0·03	0·00	0·00	−0·10	−0·08	−0·07	−0·03	+0·10	+0·15	+0·25	+0·03
23 18	+0·23	+0·08	+0·15	+0·10	+0·13	+0·03	0·00	+0·03	+0·12	+0·23	+0·25	**+0·42**	+0·15
Range ...	1·71	1·88	3·90	4·06	5·25	5·27	5·03	6·05	5·50	2·70	1·05	1·69	3·15

TABLES 148 & 149.—*Declination Magnetograph—showing the Mean Diurnal Inequalities for each month of the years 1894 and 1895 and for the whole years.*

1894.

Unity = 1 minute of arc.

1894. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·12	+0·40	+0·10	+0·28	+0·22	+0·02	−0·03	−0·07	+0·25	+0·27	**+0·38**	+0·17	+0·17
1 18	+0·12	+0·28	+0·13	+0·38	+0·30	+0·13	+0·05	+0·05	+0·33	+0·30	+0·35	+0·13	+0·22
2 18	+0·13	+0·37	+0·15	+0·32	+0·35	+0·17	+0·13	+0·10	+0·32	+0·35	+0·13	−0·02	+0·20
3 18	−0·03	+0·03	0·00	+0·22	+0·28	+0·27	+0·23	+0·22	+0·25	+0·20	−0·07	−0·20	+0·12
4 18	−0·35	−0·30	−0·10	+0·07	+0·33	+0·47	+0·55	+0·38	+0·18	+0·17	−0·28	−0·32	+0·07
5 18	−0·60	−0·48	−0·17	+0·03	+0·63	+0·93	+1·00	+0·82	+0·40	+0·07	−0·42	−0·48	+0·15
6 18	−0·77	**−0·72**	0·00	+0·78	+1·88	+2·07	+2·28	+2·15	+1·52	+0·28	−0·60	−0·58	+0·68
7 18	**−0·93**	−0·70	+0·83	+1·85	**+2·63**	**+2·60**	**+2·62**	**+2·83**	**+2·43**	+0·93	−0·43	**−0·90**	+1·15
8 18	−0·08	−0·12	+1·55	**+2·02**	+2·40	+2·33	+2·12	+2·35	+2·07	**+1·05**	−0·02	−0·33	**+1·27**
9 18	+1·03	+0·40	**+1·60**	+1·42	+1·13	+1·27	+0·90	+0·80	+0·73	+0·60	+0·08	+0·38	+0·87
10 18	**+1·32**	**+0·42**	+1·05	+0·50	−0·47	0·00	−0·40	−0·62	−0·67	−0·37	−0·02	**+0·73**	+0·12
11 18	+0·52	+0·20	−0·18	−0·77	−1·67	−1·37	−1·65	−1·60	−2·08	−1·42	**−0·62**	+0·37	−0·85
12 18	+0·17	−0·10	−1·17	−1·75	**−2·35**	−2·25	**−2·15**	−2·12	**−2·88**	**−1·48**	−0·42	+0·17	**−1·37**
13 18	+0·28	+0·05	**−1·30**	**−1·95**	−2·17	**−2·38**	−1·97	**−2·13**	−2·47	−0·90	+0·07	+0·25	−1·22
14 18	+0·05	+0·25	−0·68	−1·50	−1·55	−1·88	−1·40	−1·38	−1·33	−0·03	+0·23	+0·13	−0·75
15 18	−0·08	+0·23	0·00	−0·80	−0·82	−1·13	−0·67	−0·42	−0·23	+0·50	+0·23	+0·03	−0·27
16 18	−0·25	+0·12	+0·08	−0·22	−0·17	−0·40	−0·15	+0·23	+0·42	+0·43	+0·05	+0·12	+0·02
17 18	−0·33	−0·20	−0·15	−0·08	+0·12	+0·08	+0·15	+0·38	+0·35	−0·30	−0·22	−0·10	−0·02
18 18	−0·37	−0·42	−0·58	−0·27	+0·02	+0·13	+0·13	+0·03	+0·07	−0·42	+0·02	−0·05	−0·13
19 18	−0·03	−0·08	−0·43	−0·42	−0·37	−0·28	−0·43	−0·42	+0·05	−0·17	+0·27	+0·07	−0·18
20 18	+0·03	+0·03	−0·32	−0·27	−0·38	−0·28	−0·38	−0·52	+0·07	−0·17	+0·35	+0·07	−0·15
21 18	−0·02	−0·05	−0·22	−0·07	−0·28	−0·23	−0·43	−0·43	−0·02	−0·13	+0·28	+0·12	−0·12
22 18	0·00	+0·07	−0·20	+0·05	−0·12	−0·15	−0·32	−0·35	+0·08	+0·03	+0·32	+0·10	−0·03
23 18	+0·03	+0·37	0·00	+0·18	+0·07	−0·08	−0·17	−0·23	+0·15	+0·18	+0·33	+0·15	+0·08
Range ...	2·25	1·14	2·90	3·97	4·98	4·98	4·77	4·96	5·31	2·53	1·00	1·63	2·64

1895.

Unity = 1 minute of arc.

1895. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·02	+0·30	+0·15	+0·35	+0·28	+0·28	+0·10	+0·08	+0·13	+0·17	+0·23	+0·13	+0·18
1 18	0·00	+0·25	+0·13	+0·37	+0·37	+0·45	+0·23	+0·27	+0·18	+0·12	+0·10	+0·05	+0·22
2 18	−0·02	+0·17	+0·07	+0·22	+0·38	+0·45	+0·33	+0·37	+0·20	+0·12	+0·13	−0·03	+0·20
3 18	−0·18	+0·03	−0·05	+0·12	+0·42	+0·52	+0·38	+0·40	+0·18	+0·02	+0·07	−0·18	+0·15
4 18	−0·37	−0·25	−0·17	+0·10	+0·45	+0·55	+0·53	+0·52	+0·23	−0·03	−0·22	−0·28	+0·08
5 18	−0·57	−0·48	−0·07	+0·23	+0·83	+1·00	+0·97	+0·93	+0·47	−0·07	−0·37	−0·48	+0·20
6 18	**−0·70**	**−0·62**	+0·27	+1·30	+2·10	+2·33	+2·10	+2·13	+1·47	+0·10	**−0·67**	−0·72	+0·75
7 18	−0·35	−0·52	+1·00	+2·20	**+2·58**	**+3·03**	**+2·53**	**+2·78**	**+2·35**	+0·83	−0·65	**−0·82**	+1·25
8 18	+0·65	+0·05	**+1·53**	**+2·27**	+2·08	+2·77	+2·12	+2·07	+1·90	**+1·07**	−0·13	−0·12	**+1·35**
9 18	**+1·22**	+0·37	+1·40	+1·47	+0·43	+1·20	+1·07	+0·27	+0·57	+0·47	+0·17	**+0·42**	+0·75
10 18	+0·72	**+0·38**	+0·72	+0·20	−1·17	−0·57	−0·17	−1·13	−0·68	−0·32	+0·12	+0·30	−0·13
11 18	−0·32	−0·38	−0·57	−1·37	−2·18	−1·83	−1·33	−2·20	−2·05	−1·25	−0·15	+0·08	−1·13
12 18	−0·63	−0·57	−1·62	**−2·23**	**−2·75**	**−2·82**	−1·93	**−2·48**	**−2·73**	**−1·38**	+0·12	+0·17	**−1·57**
13 18	−0·42	−0·13	**−1·73**	−2·20	−2·23	−2·67	**−2·02**	−2·23	−2·12	−0·80	+0·40	+0·25	−1·32
14 18	−0·15	+0·15	−0·97	−1·55	−1·25	−2·12	−1·65	−1·38	−1·02	−0·02	**+0·42**	+0·15	−0·78
15 18	+0·27	+0·37	0·00	−0·83	−0·32	−1·22	−0·98	−0·35	+0·12	+0·52	+0·15	+0·07	−0·18
16 18	+0·45	+0·35	+0·28	−0·27	+0·30	−0·33	−0·37	+0·42	+0·73	+0·53	+0·03	+0·07	+0·18
17 18	+0·10	−0·12	−0·05	−0·10	+0·38	+0·05	−0·10	+0·57	+0·45	−0·13	−0·05	+0·02	+0·08
18 18	−0·02	−0·32	−0·33	−0·18	+0·03	−0·05	−0·03	+0·13	+0·03	−0·17	+0·07	+0·13	−0·05
19 18	+0·12	+0·18	−0·17	−0·27	−0·38	−0·40	−0·47	−0·30	−0·03	0·00	+0·02	+0·23	−0·12
20 18	+0·10	+0·12	−0·03	−0·08	−0·32	−0·38	−0·48	−0·35	−0·15	+0·05	−0·05	+0·15	−0·12
21 18	+0·05	+0·13	+0·02	−0·02	−0·20	−0·30	−0·42	−0·25	−0·17	−0·05	−0·03	+0·12	−0·10
22 18	+0·02	+0·25	+0·07	+0·07	−0·03	−0·08	−0·28	−0·17	−0·10	+0·02	+0·08	+0·20	0·00
23 18	+0·02	+0·35	+0·12	+0·25	+0·17	+0·10	−0·12	−0·07	+0·03	+0·22	+0·23	+0·15	+0·12
Range ...	1·92	1·00	3·26	4·50	5·33	5·85	4·55	5·26	5·08	2·45	1·09	1·24	2·92

TABLES 150 & 151.—*Declination Magnetograph—showing the Mean Diurnal Inequalities for each month of the years 1896 and 1897 and for the whole years.*

1896.

Unity = 1 minute of arc.

1896. Bombay Civil Time.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0·30	+0·13	+0·23	+0·37	+0·32	+0·15	0·00	+0·10	+0·22	+0·17	+0·20	+0·18	+0·20
1 18	+0·18	+0·15	+0·22	+0·40	+0·42	+0·33	+0·17	+0·23	+0·28	+0·15	+0·17	+0·10	+0·23
2 18	+0·12	+0·12	+0·18	+0·38	+0·43	+0·35	+0·27	+0·32	+0·30	+0·05	+0·10	+0·07	+0·22
3 18	+0·03	−0·08	+0·08	+0·27	+0·47	+0·42	+0·33	+0·37	+0·25	−0·08	−0·02	−0·05	+0·17
4 18	−0·22	−0·15	+0·03	+0·17	+0·47	+0·48	+0·42	+0·42	+0·27	−0·18	−0·17	−0·18	+0·12
5 18	−0·55	−0·32	−0·03	+0·18	+0·70	+0·95	+0·85	+0·67	+0·42	−0·28	−0·33	−0·33	+0·17
6 18	−0·65	−0·52	+0·23	+0·82	+1·72	+1·85	+1·85	+1·78	+1·33	−0·18	−0·43	−0·45	+0·62
7 18	**−0·72**	**−0·62**	+0·78	+1·75	**+2·35**	**+2·20**	**+2·08**	**+2·53**	**+2·17**	+0·47	−0·3	**−0·85**	+0·98
8 18	−0·10	0·00	**+1·02**	**+2·02**	+2·03	+1·85	+1·70	+2·02	+1·93	**+0·88**	+0·08	−0·42	**+1·08**
9 18	**+0·53**	+0·40	+0·68	+1·28	+0·77	+0·87	+0·83	+0·62	+0·75	+0·65	+0·17	+0·02	+0·63
10 18	+0·28	**+0·42**	0·00	+0·05	−0·62	−0·05	−0·15	−0·60	−0·40	+0·13	−0·15	−0·05	−0·10
11 18	−0·38	−0·03	−0·83	−1·27	−1·75	−1·13	−1·17	−1·75	−1·87	−0·75	**−0·68**	−0·48	−1·00
12 18	−0·57	−0·37	**−1·27**	**−2·00**	**−2·35**	**−1·78**	−1·85	**−2·28**	**−2·58**	**−1·00**	−0·62	−0·43	**−1·42**
13 18	−0·20	−0·27	−1·07	−1·88	−2·13	−1·78	**−2·07**	−2·02	−2·12	−0·72	−0·17	−0·13	−1·22
14 18	−0·07	+0·08	−0·35	−1·28	−1·37	−1·42	−1·53	−1·27	−1·05	−0·12	+0·25	+0·15	−0·67
15 18	+0·02	+0·30	+0·23	−0·60	−0·55	−0·80	−0·65	−0·42	−0·05	+0·30	**+0·45**	+0·38	−0·12
16 18	+0·22	+0·23	+0·25	−0·05	+0·05	−0·25	−0·03	+0·12	+0·28	+0·23	+0·40	**+0·48**	+0·17
17 18	+0·10	+0·02	−0·12	+0·05	+0·17	−0·13	+0·20	+0·27	+0·20	−0·05	+0·07	+0·40	+0·10
18 18	+0·23	−0·07	−0·25	−0·17	0·00	−0·20	+0·15	−0·02	−0·15	−0·03	+0·15	+0·38	0·00
19 18	+0·25	+0·03	−0·18	−0·33	−0·35	−0·52	−0·32	−0·27	−0·18	+0·07	+0·22	+0·33	−0·10
20 18	+0·23	+0·08	−0·07	−0·25	−0·43	−0·55	−0·38	−0·37	−0·12	+0·07	+0·18	+0·25	−0·12
21 18	+0·27	+0·13	0·00	−0·10	−0·32	−0·53	−0·33	−0·30	−0·03	−0·03	+0·12	+0·20	−0·08
22 18	+0·30	+0·12	+0·02	+0·03	−0·10	−0·25	−0·23	−0·17	+0·07	+0·07	+0·17	+0·25	+0·02
23 18	+0·33	+0·12	+0·17	+0·20	+0·12	−0·03	−0·12	−0·02	+0·10	+0·13	+0·18	+0·20	+0·12
Range ...	1·25	1·04	2·29	4·02	4·70	3·98	4·15	4·81	4·75	1·88	1·13	1·33	2·50

1897.

Unity = 1 minute of arc.

1897. Bombay Civil Time.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October	November.	December.	Y.ar.
H. m.													
0 18	+0·17	+0·15	+0·17	+0·23	+0·22	+0·23	+0·12	+0·22	+0·17	+0·28	+0·22	+0·17	+0·20
1 18	+0·13	+0·15	+0·12	+0·30	+0·32	+0·37	+0·27	+0·32	+0·22	+0·23	+0·22	+0·08	+0·23
2 18	+0·03	+0·07	+0·10	+0·32	+0·30	+0·40	+0·33	+0·38	+0·25	+0·20	+0·10	0·00	+0·20
3 18	−0·17	−0·05	0·00	+0·20	+0·30	+0·40	+0·37	+0·40	+0·28	+0·03	−0·08	−0·17	+0·13
4 18	−0·25	−0·17	−0·03	+0·10	+0·30	+0·47	+0·45	+0·43	+0·25	−0·07	−0·17	−0·38	+0·08
5 18	−0·47	−0·33	0·00	+0·10	+0·62	+0·83	+0·70	+0·65	+0·45	−0·08	−0·32	−0·55	+0·13
6 18	−0·57	−0·43	−0·02	+0·73	+1·70	+1·72	+1·58	+1·58	+1·25	+0·05	−0·55	−0·70	+0·53
7 18	−0·32	−0·25	+0·60	+1·57	**+2·32**	**+2·08**	**+2·05**	**+2·28**	**+2·10**	+0·58	**−0·58**	**−0·98**	+0·95
8 18	+0·62	+0·40	+1·13	**+1·80**	+2·12	+1·83	+1·93	+1·95	+1·83	**+0·75**	−0·28	−0·55	**+1·13**
9 18	**+0·93**	**+0·70**	**+1·17**	+1·35	+0·92	+1·03	+1·17	+0·68	+0·60	+0·25	−0·17	−0·17	+0·70
10 18	+0·17	+0·38	+0·78	+0·43	−0·40	+0·05	+0·12	−0·47	−0·52	−0·30	−0·08	+0·07	+0·02
11 18	−0·73	−0·30	−0·28	−0·78	−1·52	−1·05	−1·10	−1·58	−1·82	−1·02	−0.32	+0·05	−0·87
12 18	**−0·78**	**−0·77**	−1·15	**−1·65**	**−2·13**	**−1·72**	**−1·80**	**−2·13**	**−2·33**	**−1·18**	+0·03	+0·22	**−1·28**
13 18	−0·25	−0·68	**−1·40**	−1·63	−2·02	−1·70	−1·75	−2·07	−1·92	−0·72	+0·53	+0·35	−1·10
14 18	+0·02	−0·22	−0·88	−1·28	−1·32	−1·45	−1·27	−1·40	−1·00	−0·10	**+0·58**	**+0·37**	−0·67
15 18	+0·37	+0·22	−0·13	−0·67	−0·63	−1·03	−0·73	−0·57	+0·02	+0·45	+0·38	+0·28	−0·17
16 18	+0·43	+0·35	+0·20	−0·20	−0·13	−0·48	−0·35	+0·10	+0·57	+0·53	+0·22	+0·30	+0·13
17 18	+0·05	+0·18	0·00	−0·12	+0·02	−0·23	−0·22	+0·28	+0·35	+0·10	−0·05	+0·22	+0·05
18 18	−0·03	+0·05	−0·25	−0·23	−0·10	−0·33	−0·27	−0·05	−0·07	0·00	+0·02	+0·28	−0·08
19 18	+0·13	+0·15	−0·15	−0·38	−0·38	−0·52	−0·47	−0·35	−0·23	−0·07	0·00	+0·27	−0·17
20 18	+0·13	+0.10	−0·08	−0·22	−0·32	−0·52	−0·48	−0·35	−0·28	−0·12	+0·02	+0·30	−0·15
21 18	+0·10	+0·08	0·00	−0·12	−0·23	−0·37	−0·38	−0·27	−0·18	−0·03	0·00	+0·22	−0·10
22 18	+0·13	+0·08	+0·07	+0·03	−0·03	−0·13	−0·20	−0·08	−0·08	+0·07	+0·08	+0·17	0·00
23 18	+0·17	+0·12	+0·13	+0·10	+0·12	+0·08	−0·03	+0·07	+0·05	+0·20	+0·17	+0·15	+0·12
Range ...	1·71	1·47	2·57	3·45	4·45	3·80	3·85	4·41	4·43	1·93	1·16	1·35	2·41

TABLES 152 & 153.—*Declination Magnetograph—showing the mean Diurnal Inequalities for each month of the years 1898 and 1899 and for the whole years.*

1898.

Unity = 1 minute of arc.

1898. Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0·17	+0·08	+0·12	+0·15	+0·25	+0·20	+0·03	+0·08	+0·23	+0·27	+0·22	+0·07	+0·15
1 18	+0·05	+0·03	+0·02	+0·27	+0·30	+0·32	+0·15	+0·22	+0·57	+0·28	+0·12	+0·05	+0·20
2 18	−0·08	+0·02	−0·03	+0·25	+0·32	+0·32	+0·27	+0·28	+0·28	+0·23	+0·05	−0·07	+0·15
3 18	−0·17	−0·05	−0·20	+0·18	+0·32	+0·35	+0·35	+0·30	+0·32	+0·10	−0·10	−0·20	+0·10
4 18	−0·38	−0·17	−0·27	+0·22	+0·30	+0·38	+0·43	+0·40	+0·28	−0·12	−0·18	−0·37	+0·05
5 18	−0·55	−0·25	−0·35	+0·33	+0·57	+0·67	+0·70	+0·58	+0·37	−0·07	−0·25	−0·48	+0·10
6 18	−0·68	−0·32	−0·32	+1·00	+1·57	+1·58	+1·58	+1·68	+1·37	+0·15	−0·48	−0·70	+0·53
7 18	−0·68	−0·25	+0·25	+1·60	+2·27	+2·18	+2·08	+2·42	+2·18	+0·67	−0·55	−0·82	+0·95
8 18	+0·02	+0·03	+0·77	+1·42	+2·15	+2·02	+1·85	+2·07	+1·82	+0·73	−0·30	−0·07	+1·03
9 18	+0·48	+0·07	+0·98	+0·62	+0·92	+1·15	+0·97	+0·93	+0·57	+0·12	−0·25	+0·33	+0·57
10 18	0·00	−0·03	+0·82	−0·32	−0·45	+0·10	+0·18	−0·15	−0·62	−0·43	−0·30	0·00	−0·10
11 18	−0·60	−0·47	+0·22	−1·40	−1·58	−1·27	−1·00	−1·32	−2·02	−1·17	−0·62	−0·37	−0·97
12 18	−0·42	−0·73	−0·58	−1·92	−2·27	−2·20	−1·60	−1·98	−2·75	−1·15	−0·42	0·00	−1·33
13 18	+0·10	−0·23	−0·80	−1·53	+1·98	−2·12	−1·65	−2·00	−2·30	−0·62	+0·20	+0·43	−1·03
14 18	+0·37	+0·20	−0·48	−0·68	−1·32	−1·57	−1·38	−1·45	−1·18	+0·03	+0·63	+0·38	−0·53
15 18	+0·50	+0·55	+0·08	+0·08	−0·53	−0·85	−0·85	−0·72	−0·17	+0·38	+0·70	+0·40	−0·03
16 18	+0·55	+0·60	+0·33	+0·40	−0·07	−0·20	−0·30	−0·15	+0·42	+0·40	+0·50	+0·42	+0·23
17 18	+0·25	+0·25	+0·18	+0·27	+0·10	+0·03	+0·03	+0·08	+0·38	−0·03	+0·23	+0·20	+0·17
18 18	+0·22	+0·08	−0·07	−0·12	−0·10	−0·05	+0·02	−0·05	+0·02	0·00	+0·22	+0·22	+0·03
19 18	+0·22	+0·12	−0·22	−0·28	−0·35	−0·32	−0·45	−0·32	−0·05	−0·07	+0·13	+0·18	−0·12
20 18	+0·17	+0·07	−0·25	−0·33	−0·32	−0·33	−0·53	−0·40	+0·02	−0·07	+0·07	+0·12	−0·15
21 18	+0·20	+0·08	−0·18	−0·25	−0·20	−0·32	−0·45	−0·32	+0·02	−0·02	+0·08	+0·07	−0·10
22 18	+0·15	+0·17	−0·10	−0·07	0·00	−0·13	−0·30	−0·18	+0·08	+0·12	+0·13	+0·08	0·00
23 18	+0·13	+0·13	+0·05	+0·07	+0·13	+0·03	−0·10	−0·02	+0·20	+0·22	+0·20	+0·07	+0·10
Range ...	1·23	1·33	1·78	3·52	4·54	4·38	3·73	4·42	4·93	1·90	1·32	1·25	2·36

1899.

Unity = 1 minute of arc.

1899. Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0·15	+0·13	+0·17	+0·23	+0·32	+0·28	+0·05	+0·02	+0·22	+0·17	+0·20	+0·03	+0·17
1 18	+0·15	+0·12	+0·10	+0·27	+0·37	+0·38	+0·17	+0·12	+0·27	+0·15	+0·13	+0·02	+0·18
2 18	+0·17	+0·03	+0·07	+0·25	+0·40	+0·43	+0·25	+0·20	+0·25	+0·12	+0·03	−0·12	+0·17
3 18	−0·05	−0·03	−0·10	+0·10	+0·35	+0·42	+0·28	+0·27	+0·22	+0·03	−0·13	−0·28	+0·08
4 18	−0·23	−0·17	−0·18	+0·07	+0·40	+0·40	+0·40	+0·38	+0·13	−0·07	−0·28	−0·38	+0·03
5 18	−0·33	−0·28	−0·22	+0·10	+0·63	+0·67	+0·77	+0·70	+0·25	−0·15	−0·38	−0·55	+0·10
6 18	−0·32	−0·20	−0·17	+0·63	+1·57	+1·43	+1·72	+1·65	+0·97	−0·02	−0·57	−0·58	+0·52
7 18	−0·22	−0·02	+0·48	+1·37	+2·13	+1·90	+2·13	+2·28	+1·85	+0·62	−0·47	−0·62	+0·95
8 18	+0·28	+0·13	+1·05	+1·60	+1·82	+1·77	+1·82	+2·02	+1·78	+0·97	−0·07	−0·20	+1·08
9 18	+0·23	0·00	+1·15	+1·17	+0·52	+0·90	+0·72	+0·65	+0·68	+0·58	−0·02	+0·13	+0·57
10 18	−0·62	−0·33	+0·77	+0·32	−0·78	−0·10	−0·28	−0·55	−0·22	+0·10	−0·05	+0·13	−0·13
11 18	−1·33	−0·83	−0·28	−0·88	−1·82	−1·18	−1·45	−1·63	−1·37	−0·77	−0·30	−0·15	−1·00
12 18	−1·02	−0·98	−1·12	−1·62	−2·28	−1·87	−1·98	−2·07	−2·25	−1·13	+0·02	−0·05	−1·37
13 18	−0·22	−0·58	−1·23	−1·68	−1·98	−1·75	−1·78	−1·88	−2·03	−0·77	+0·47	+0·13	−1·12
14 18	+0·35	+0·18	−0·65	−1·18	−1·28	−1·37	−1·12	−1·22	−1·10	−0·17	+0·50	+0·20	−0·57
15 18	+0·85	+0·60	+0·03	−0·53	−0·43	−0·78	−0·42	−0·37	−0·20	+0·30	+0·20	+0·37	−0·03
16 18	+0·92	+0·73	+0·23	+0·07	+0·10	−0·33	+0·03	+0·25	+0·27	+0·40	+0·05	+0·48	+0·27
17 18	+0·38	+0·38	+0·08	+0·23	+0·25	−0·17	+0·10	+0·42	+0·20	−0·02	+0·10	+0·33	+0·18
18 18	+0·15	+0·23	−0·02	−0·05	−0·02	−0·25	−0·08	0·00	+0·03	−0·15	+0·12	+0·33	+0·02
19 18	+0·22	+0·27	−0·12	−0·22	−0·18	−0·43	−0·35	−0·23	−0·07	−0·20	+0·05	+0·28	−0·08
20 18	+0·15	+0·15	−0·13	−0·25	−0·22	−0·37	−0·37	−0·35	−0·07	−0·12	+0·03	+0·17	−0·12
21 18	+0·13	+0·17	−0·03	−0·15	−0·12	−0·22	−0·33	−0·32	−0·02	−0·07	+0·07	+0·13	−0·07
22 18	+0·10	+0·15	+0·02	+0·03	+0·05	+0·03	−0·18	−0·20	+0·10	+0·03	+0·13	+0·15	+0·03
23 18	+0·08	+0·15	+0·12	+0·17	+0·22	+0·18	−0·05	−0·10	+0·12	+0·13	+0·20	+0·07	+0·10
Range ...	2·25	1·71	2·38	3·28	4·41	3·77	4·11	4·35	4·10	2·10	1·07	1·10	2·45

TABLES 154 & 155.—*Declination Magnetograph—showing the Mean Diurnal Inequalities for each month of the years 1900 and 1901 and for the whole years.*

1900.

Unity = 1 minute of arc.

1900. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·03	−0·02	+0·12	+0·18	+0·23	+0·28	+0·10	+0·13	+0·13	+0·17	+0·20	+0·15	+0·15
1 18	−0·02	+0·02	+0·10	+0·20	+0·25	+0·35	+0·20	+0·20	+0·20	+0·20	+0·15	+0·10	+0·17
2 18	−0·10	−0·07	0·00	+0·17	+0·25	+0·42	+0·25	+0·23	+0·23	+0·18	+0·10	+0·03	+0·15
3 18	−0·25	−0·17	−0·10	+0·08	+0·22	+0·40	+0·27	+0·28	+0·23	+0·12	−0·05	−0·08	+0·08
4 18	−0·38	−0·23	−0·18	0·00	+0·20	+0·33	+0·30	+0·40	+0·32	+0·05	−0·15	−0·18	+0·03
5 18	−0·52	−0·38	−0·17	−0·07	+0·38	+0·57	+0·58	+0·72	+0·52	+0·02	−0·22	−0·27	+0·10
6 18	**−0·67**	**−0·42**	−0·08	+0·48	+1·25	+1·37	+1·48	+1·73	+1·27	+0·08	−0·40	−0·33	+0·48
7 18	−0·55	−0·30	+0·57	+1·28	**+1·87**	**+1·70**	**+2·02**	**+2·38**	**+2·23**	+0·82	−0·35	**−0·67**	+0·92
8 18	+0·43	+0·35	+1·02	**+1·50**	+1·70	+1·57	+1·97	+1·92	+2·02	**+1·13**	−0·15	−0·43	**+1·08**
9 18	**+1·05**	**+0·63**	**+1·03**	+1·15	+0·73	+0·82	+1·13	+0·57	+0·72	+0·55	−0·22	−0·23	+0·67
10 18	+0·45	+0·50	+0·63	+0·50	−0·30	−0·10	+0·02	−0·72	−0·72	−0·33	−0·50	−0·18	−0·07
11 18	−0·38	−0·08	−0·42	−0·77	−1·40	−1·10	−1·18	−1·82	−2·13	−1·23	**−0·67**	−0·37	−0·97
12 18	−0·32	−0·35	**−1·13**	**−1·60**	**−1·97**	**−1·60**	−1·72	**−2·20**	**−2·75**	**−1·43**	−0·30	−0·30	**−1·30**
13 18	−0·13	−0·23	−1·13	−1·58	−1·75	−1·45	**−1·73**	+2·00	−2·17	−0·88	+0·38	+0·02	−1·05
14 18	−0·03	+0·05	−0·62	−1·07	−1·20	−1·18	−1·37	−1·42	−1·02	−0·22	**+0·75**	+0·30	−0·58
15 18	+0·17	+0·27	0·00	−0·33	−0·53	−0·75	−0·77	−0·48	+0·08	+0·37	+0·58	**+0·42**	−0·08
16 18	+0·40	+0·35	+0·20	+0·18	0·00	−0·32	−0·17	+0·32	+0·73	+0·45	+0·32	+0·40	+0·25
17 18	+0·17	+0·13	+0·15	+0·25	+0·20	−0·20	+0·10	+0·52	+0·55	+0·07	+0·07	+0·33	+0·20
18 18	+0·17	−0·02	−0·05	−0·02	+0·02	−0·28	−0·03	+0·12	−0·03	−0·08	+0·08	+0·33	+0·02
19 18	+0·17	−0·02	−0·10	−0·25	−0·10	−0·42	−0·42	−0·23	−0·15	−0·13	+0·05	+0·25	−0·10
20 18	+0·12	−0·02	−0·05	−0·27	−0·18	−0·37	−0·47	−0·32	−0·20	−0·08	+0·05	+0·22	−0·13
21 18	+0·07	0·00	−0·02	−0·15	−0·08	−0·23	−0·38	−0·23	−0·12	0·00	+0·03	+0·18	−0·07
22 18	+0·05	−0·02	+0·10	+0·02	+0·05	−0·02	−0·18	−0·13	−0·02	+0·07	+0·10	+0·18	+0·02
23 18	+0·07	−0·02	+0·12	+0·12	+0·15	+0·18	−0·03	+0·02	+0·07	+0·15	+0·13	+0·17	+0·10
Range ...	1·72	1·05	2·16	3·10	3·84	3·30	3·75	4·58	4·98	2·56	1·42	1·09	2·38

1901.

Unity = 1 minute of arc.

1901. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	0·00	+0·02	+0·05	+0·13	+0·10	+0·30	+0·20	+0·10	+0·20	+0·15	+0·07	+0·08	+0·12
1 18	−0·05	+0·02	+0·07	+0·13	+0·15	+0·40	+0·28	+0·18	+0·22	+0·17	+0·07	+0·02	+0·13
2 18	−0·17	−0·05	0·00	+0·15	+0·20	+0·40	+0·32	+0·25	+0·20	+0·13	0·00	−0·08	+0·12
3 18	−0·27	−0·20	−0·05	+0·07	+0·18	+0·40	+0·38	+0·30	+0·20	+0·05	−0·07	−0·22	+0·07
4 18	−0·40	−0·30	−0·17	0·00	+0·17	+0·40	+0·42	+0·40	+0·27	−0·03	−0·17	−0·33	+0·02
5 18	−0·52	−0·43	−0·22	−0·05	+0·23	+0·65	+0·65	+0·72	+0·42	−0·05	−0·23	−0·45	+0·05
6 18	−0·62	**−0·52**	−0·13	+0·37	+1·08	+1·45	+1·40	+1·62	+1·13	+0·10	−0·33	−0·57	+0·42
7 18	**−0·93**	−0·45	+0·38	+1·18	+1·95	**+1·85**	**+1·90**	**+2·10**	**+2·13**	+0·73	−0·07	**−0·75**	+0·83
8 18	−0·42	+0·18	+0·87	**+1·57**	**+2·03**	+1·65	+1·73	+1·72	+1·97	**+0·93**	+0·27	−0·32	**+1·02**
9 18	+0·45	+0·67	**+0·90**	+1·30	+1·13	+0·82	+0·80	+0·52	+0·80	+0·40	+0·20	+0·12	+0·67
10 18	**+0·77**	**+0·72**	+0·63	+0·48	−0·17	−0·28	−0·25	−0·78	−0·62	−0·17	−0·08	+0·25	+0·03
11 18	+0·37	+0·12	−0·28	−0·65	−1·22	−1·32	−1·27	−1·80	−1·98	−0·92	**−0·52**	−0·15	−0·80
12 18	+0·17	−0·25	**−0·95**	−1·45	**−1·75**	**−2·00**	**−1·95**	**−2·13**	**−2·58**	**−1·12**	−0·28	−0·02	**−1·20**
13 18	+0·37	−0·07	−0·93	**−1·53**	−1·70	−1·80	−1·90	−1·87	−2·10	−0·72	+0·20	+0·27	−0·98
14 18	+0·27	+0·22	−0·33	−1·10	−1·12	−1·32	−1·40	−1·13	−1·10	−0·27	**+0·37**	+0·32	−0·55
15 18	+0·08	+0·33	+0·33	−0·42	−0·48	−0·73	−0·73	−0·35	−0·02	+0·23	+0·22	+0·25	−0·10
16 18	+0·15	+0·25	+0·43	+0·07	−0·02	−0·20	−0·17	+0·28	+0·58	+0·33	+0·22	+0·35	+0·18
17 18	+0·20	+0·07	+0·08	+0·10	+0·05	−0·05	+0·05	+0·38	+0·50	+0·03	+0·02	**+0·37**	+0·15
18 18	+0·13	+0·02	−0·13	+0·02	−0·07	−0·12	−0·02	+0·05	+0·02	+0·02	+0·05	+0·23	+0·02
19 18	+0·12	−0·02	−0·22	−0·17	−0·30	−0·25	−0·22	−0·20	−0·10	−0·05	+0·02	+0·22	−0·10
20 18	+0·10	−0·05	−0·22	−0·22	−0·33	−0·25	−0·25	−0·25	−0·17	−0·05	−0·02	+0·15	−0·13
21 18	+0·08	−0·07	−0·12	−0·12	−0·23	−0·12	−0·15	−0·18	−0·02	−0·03	+0·02	+0·13	−0·07
22 18	+0·05	−0·07	−0·10	−0·02	−0·08	+0·02	−0·03	−0·08	+0·03	+0·05	+0·02	+0·10	−0·02
23 18	+0·05	−0·02	+0·02	+0·07	+0·02	+0·17	+0·08	+0·03	+0·13	+0·12	+0·08	+0·12	+0·07
Range ...	1·70	1·24	1·85	3·10	3·78	3·85	3·85	4·23	4·71	2·05	0·89	1·12	2·22

TABLES 156 & 157.—*Declination Magnetograph—showing the Mean Diurnal Inequalities for each month of the years 1902 and 1903 and for the whole years.*

1902.

Unity = 1 minute of arc.

1902. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·03	+0·02	−0·05	+0·02	+0·15	+0·20	+0·15	+0·15	+0·08	+0·20	+0·17	+0·10	+0·10
1 18	+0·02	−0·02	−0·05	+0·03	+0·17	+0·27	+0·22	+0·20	+0·13	+0·18	+0·20	+0·05	+0·12
2 18	−0·07	−0·07	−0·05	+0·02	+0·15	+0·25	+0·27	+0·27	+0·13	+0·15	+0·13	−0·05	+0·10
3 18	−0·18	−0·13	−0·13	−0·05	+0·12	+0·25	+0·33	+0·27	+0·10	+0·05	+0·05	−0·18	+0·03
4 18	−0·37	−0·25	−0·25	−0·12	+0·08	+0·20	+0·35	+0·40	+0·17	−0·03	−0·08	−0·32	−0·02
5 18	−0·52	−0·35	−0·27	−0·07	+0·27	+0·50	+0·55	+0·65	+0·30	−0·03	−0·17	−0·40	+0·03
6 18	−0·63	**−0·40**	−0·03	+0·45	+1·00	+1·47	+1·38	+1·55	+1·22	+0·12	−0·38	−0·55	+0·43
7 18	**−0·70**	−0·38	+0·68	+1·28	**+1·65**	**+2·00**	**+2·08**	**+2·35**	**+2·17**	+0·83	−0·38	**−0·72**	+0·90
8 18	+0·27	+0·10	+1·18	**+1·55**	+1·62	+1·92	+2·03	+2·27	+2·10	**+1·13**	−0·08	−0·42	**+1·13**
9 18	**+1·31**	+0·38	**+1·22**	+1·32	+0·77	+1·02	+1·12	+0·97	+1·02	+0·70	−0·12	−0·05	+0·80
10 18	+1·22	**+0·42**	+0·48	+0·50	−0·30	−0·08	−0·05	−0·85	−0·27	−0·17	−0·35	+0·08	+0·05
11 18	+0·33	−0·02	−0·42	−0·68	−1·25	−1·25	−1·25	−2·02	−1·72	−1·07	**−0·70**	−0·13	−0·85
12 18	−0·08	−0·17	**−1·30**	**−1·40**	**−1·73**	**−1·90**	−1·87	**−2·37**	**−2·47**	**−1·35**	−0·25	−0·12	**−1·22**
13 18	−0·27	+0·02	−0·87	−1·28	−1·45	−1·80	**−1·90**	−2·23	−2·18	−1·03	+0·23	+0·22	−1·05
14 18	−0·47	+0·20	−0·30	−0·68	−0·77	−1·30	−1·55	−1·47	−1·13	−0·43	**+0·40**	**+0·45**	−0·58
15 18	−0·43	+0·32	+0·23	−0·05	−0·23	−0·68	−0·90	−0·45	−0·17	+0·10	+0·32	+0·35	−0·13
16 18	·0·02	+0·23	+0·33	+0·27	+0·18	−0·15	−0·30	+0·23	+0·43	+0·28	+0·28	+0·35	+0·18
17 18	+0·12	+0·12	+0·03	+0·10	+0·20	+0·02	−0·03	+0·42	+0·37	+0·08	+0·17	+0·32	+0·15
18 18	+0·08	+0·05	−0·17	−0·15	−0·08	−0·22	−0·03	+0·03	+0·05	+0·02	+0·12	+0·30	0·00
19 18	+0·13	+0·07	−0·18	−0·33	−0·23	−0·37	−0·23	−0·15	−0·17	−0·07	+0·10	+0·23	−0·10
20 18	+0·12	+0·02	−0·15	−0·35	−0·27	−0·30	−0·25	−0·12	−0·17	+0·02	+0·08	+0·18	−0·10
21 18	+0·07	−0·02	−0·12	−0·22	−0·17	−0·20	−0·17	−0·10	−0·12	+0·08	+0·08	+0·17	−0·05
22 18	+0·05	+0·02	−0·08	−0·12	−0·02	−0·02	−0·05	−0·02	−0·02	+0·10	+0·12	+0·15	+0·02
23 18	+0·07	−0·02	−0·05	−0·03	+0·08	+0·10	+0·07	+0·08	+0·05	+0·20	+0·20	+0·12	+0·07
Range ...	2·00	0·82	2·22	2·95	3·38	3·90	3·98	4·72	4·64	2·48	1·10	1·17	2·35

1903.

Unity = 1 minute of arc.

1903. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 18	+0·07	+0·07	−0·02	+0·20	+0·10	+0·20	+0·12	−0·08	+0·18	+0·18	+0·13	+0·17	+0·12
1 18	+0·02	+0·05	−0·02	+0·27	+0·17	+0·27	+0·20	0·00	+0·22	+0·18	+0·05	+0·25	+0·13
2 18	−0·08	0·00	−0·07	+0·23	+0·18	+0·32	+0·27	+0·05	+0·25	+0·13	+0·02	+0·13	+0·12
3 18	−0·23	−0·10	−0·13	+0·20	+0·17	+0·28	+0·33	+0·10	+0·30	−0·18	−0·08	−0·05	+0·05
4 18	−0·37	−0·25	−0·18	+0·07	+0·17	+0·27	+0·38	+0·23	+0·40	−0·20	−0·28	−0·28	0·00
5 18	−0·52	−0·38	−0·23	+0·05	+0·38	+0·68	+0·68	+0·60	+0·63	−0·20	−0·35	−0·38	+0·08
6 18	−0·58	**−0·52**	−0·30	+0·50	+1·37	+1·85	+1·77	+1·82	+1·50	−0·05	−0·53	−0·52	+0·52
7 18	**−0·58**	−0·40	+0·20	+1·33	**+2·03**	**+2·38**	**+2·27**	**+2·50**	**+2·23**	+0·58	−0·25	**−0·80**	+0·95
8 18	+0·08	+0·18	+0·88	**+1·60**	+1·98	+2·20	+2·00	+2·17	+1·72	**+0·97**	+0·30	−0·60	**+1·12**
9 18	**+0·80**	**+0·68**	**+1·18**	+1·22	+0·97	+1·15	+0·93	+0·83	+0·33	+0·52	+0·30	−0·27	+0·72
10 18	+0·75	+0·68	+1·00	+0·27	−0·27	+0·15	−0·32	−0·53	−1·08	−0·18	−0·03	−0·02	+0·03
11 18	−0·02	+0·15	+0·20	−1·02	−1·28	−1·27	−1·63	−1·70	−2·38	−1·25	**−0·62**	−0·10	−0·92
12 18	−0·40	−0·20	−0·68	−1·83	**−1·87**	−2·20	**−2·37**	**−2·23**	**−2·83**	**−1·58**	−0·52	−0·17	**−1·40**
13 18	−0·13	−0·30	**−0·93**	**−1·85**	−1·67	**−2·27**	−2·23	−2·03	−2·23	−1·00	−0·12	+0·22	−1·22
14 18	−0·12	−0·23	−0·58	−1·28	−1·15	−1·72	−1·63	−1·35	−1·10	−0·15	+0·17	+0·38	−0·73
15 18	−0·17	−0·05	+0·02	−0·45	−0·48	−1·00	−0·77	−0·48	+0·13	+0·32	+0·42	+0·38	−0·18
16 18	+0·05	+0·05	+0·23	+0·15	+0·02	−0·27	+0·02	+0·30	+0·72	+0·52	**+0·42**	**+0·47**	+0·22
17 18	+0·22	+0·03	+0·12	+0·32	+0·23	+0·02	+0·35	+0·58	+0·65	+0·35	+0·23	+0·30	+0·28
18 18	+0·25	0·00	−0·02	+0·07	−0·05	−0·08	+0·23	+0·27	+0·12	+0·22	+0·17	+0·27	+0·12
19 18	+0·25	+0·10	−0·17	−0·12	−0·33	−0·38	−0·17	−0·17	+0·03	+0·08	+0·15	+0·20	−0·05
20 18	+0·25	+0·12	−0·18	−0·15	−0·33	−0·38	−0·23	−0·28	−0·03	+0·12	+0·13	+0·15	−0·07
21 18	+0·20	+0·08	−0·10	−0·05	−0·22	−0·27	−0·17	−0·27	+0·13	+0·23	+0·08	+0·08	−0·02
22 18	+0·17	+0·08	−0·08	+0·03	−0·08	−0·02	−0·05	−0·20	+0·08	+0·22	+0·12	+0·08	+0·03
23 18	+0·13	+0·10	−0·03	+0·12	+0·05	+0·03	+0·03	−0·13	+0·13	+0·27	+0·17	+0·17	+0·08
Range ...	1·38	1·20	2·11	3·45	3·90	4·65	4·64	4·73	5·06	2·55	1·04	1·27	2·52

TABLES 158 & 159.—*Declination Magnetograph—showing the Mean Diurnal Inequalities for each month of the years 1904 and 1905 and for the whole years.*

1904.

Unity = 1 minute of arc.

1904. Bombay Civil Time.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0·02	+0·07	−0·17	+0·10	+0·03	+0·13	0·00	+0·02	+0·13	+0·17	+0·12	+0·20	+0·07
1 18	0·00	+0·05	−0·18	+0·15	+0·18	+0·23	+0·12	+0·12	+0·20	+0·20	+0·08	+0·17	+0·12
2 18	−0·13	+0·02	−0·23	+0·23	+0·20	+0·23	+0·23	+0·17	+0·20	+0·13	+0·03	+0·05	+0·10
3 18	−0·27	−0·12	−0·30	+0·15	+0·17	+0·23	+0·32	+0·20	+0·22	+0·05	−0·08	−0·08	+0·03
4 18	−0·40	−0·27	−0·32	+0·05	+0·13	+0·27	+0·40	+0·30	+0·27	−0·02	−0·20	−0·22	0·00
5 18	−0·50	−0·37	−0·30	+0·07	+0·43	+0·65	+0·78	+0·70	+0·52	−0·10	−0·30	−0·38	+0·10
6 18	−0·53	−0·40	−0·18	+0·93	+1·47	+1·78	+1·88	+1·93	+1·53	+0·18	−0·43	−0·48	+0·63
7 18	−0·40	−025	+0·55	+1·93	+2·18	+2·42	+2·53	+2·65	+2·48	+0·68	−0·35	−0·75	+1·13
8 18	+0·32	+0·30	+1·32	+2·07	+2·03	+2·13	+2·27	+2·32	+2·13	+0·77	−0·03	−0·53	+1·25
9 18	+0·63	+0·62	+1·42	+1·25	+0·92	+1·02	+1·10	+0·87	+0·65	+0·33	−0·02	−0·28	+0·70
10 18	−0·02	+0·48	+1·05	+0·12	−0·37	−0·43	−0·18	−0·83	−0·75	−0·17	−0·13	−0·12	−0·12
11 18	−0·75	−0·30	+0·15	−1·22	−1·47	−1·67	−1·40	−1·95	−2·13	−0·98	−0·48	−0·37	−1·05
12 18	−0·65	−0·53	−0·58	−1·92	−2·07	−2·20	−2·23	−2·47	−2·67	−1·33	−0·23	−0·27	−1·43
13 18	−0·05	−0·33	−0·83	−1·77	−1·82	−2·20	−2·27	−2·23	−2·20	−0·88	+0·40	+0·20	−1·17
14 18	+0·28	−0·02	−0·40	−1·27	−1·15	−1·63	−1·82	−1·43	−1·12	−0·20	+0·58	0·58	−0·63
15 18	+0·68	+0·27	+0·17	−0·57	−0·45	−0·83	−0·90	−0·40	−0·02	+0·40	+0·45	+0·57	−0·05
16 18	+0·60	+0·33	+0·30	+0·12	+0·12	−0·08	−0·05	+0·25	+0·52	+0·52	+0·23	+0·43	+0·27
17 18	+0·20	+0·17	+0·05	+0·25	+0·30	+0·27	+0·32	+0·45	+0·27	+0·08	+0·02	+0·17	+0·22
18 18	+0·17	−0·02	−0·25	+0·02	+0·05	+0·20	+0·17	+0·17	+0·02	−0·05	+0·02	+0·20	+0·05
19 18	+0·20	+0·10	−0·27	−0·27	−0·25	−0·12	−0·30	−0·22	−0·08	−0·02	+0·07	+0·28	−0·07
20 18	+0·20	+0·02	−0·23	−0·27	−0·33	−0·25	−0·40	−0·28	−0·17	−0·02	+0·07	+0·23	−0·12
21 18	+0·20	−0·02	−0·23	−0·18	−0·25	−0·20	−0·30	−0·23	−0·12	0·00	0·00	+0·12	−0·10
22 18	+0·18	+0·02	−0·28	−0·08	−0·12	−0·05	−0·20	−0·17	−0·05	+0·08	+0·02	+0·15	−0·02
23 18	+0·17	+0·05	−0·20	+0·02	−0·02	+0·07	−0·08	−0·05	+0·03	+0·20	+0·07	+0·23	+0·0[illegible]
Range ...	1·43	1·15	2·25	3·99	4·25	4·62	4·80	5·12	5·15	2·10	1·07	1·33	2·6[illegible]

1905.

Unity = 1 minute of arc.

1905. Bombay Civil Time.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 18	+0·12	+0·02	−0·03	+0·08	+0·17	+0·20	+0·23	0·00	+0·10	+0·18	+0·45	+0·15	+0·13
1 18	+0·02	−0·08	+0·02	+0·17	+0·23	+0·32	+0·33	+0·05	+0·22	+0·15	+0·42	+0·13	+0·17
2 18	−0·17	−0·18	−0·07	+0·17	+0·23	+0·37	+0·32	+0·12	+0·27	+0·12	+0·32	+0·08	+0·13
3 18	−0·32	−0·33	−0·13	+0·02	+0·17	+0·33	+0·35	+0·17	+0·33	+0·08	+0·03	−0·02	+0·05
4 18	−0·50	−0·55	−0·23	−0·02	+0·12	+0·38	+0·38	+0·27	+0·37	+0·07	−0·15	−0·20	0·00
5 18	−0·62	−0·62	−0·27	+0·02	+0·38	+0·67	+0·75	+0·75	+0·68	+0·10	−0·37	−0·33	+0·10
6 18	−0·70	−0·67	−0·20	+0·70	+1·52	+1·78	+1·93	+2·03	+1·95	+0·52	−0·57	−0·43	+0·70
7 18	−0·87	−0·33	+0·62	+1·70	+2·23	+2·45	+2·45	+2·88	+2·77	+1·47	−0·40	−0·65	+1·20
8 18	−0·08	+0·80	+1·35	+2·07	+2·23	+2·18	+2·10	+2·53	+2·05	+1·70	+0·05	−0·12	+1·40
9 18	+0·80	+1·63	+1·45	+1·67	+1·33	+1·08	+0·95	+0·93	+0·37	+0·92	+0·23	+0·40	+0·98
10 18	+1·17	+1·75	+1·02	+0·80	+0·15	−0·20	−0·37	−0·80	−1·08	−0·30	+0·12	+0·58	+0·23
11 18	+0·57	+0·75	−0·05	−0·63	−1·00	−1·60	−1·65	−2·23	−2·57	−1·60	−0·53	+0·12	−0·87
12 18	−0·05	−0·17	−0·90	−1·72	−2·00	−2·33	−2·17	−2·68	−3·08	−2·00	−0·37	−0·08	−1·47
13 18	−0·22	−0·62	−1·12	−1·78	−2·17	−2·28	−2·13	−2·38	−2·53	−1·48	+0·05	−0·02	−1·38
14 18	−0·20	−0·57	−0·65	−1·30	−1·75	−1·63	−1·72	−1·53	−1·35	−0·53	+0·22	+0·03	−0·92
15 18	−0·05	−0·43	0·00	−0·75	−0·97	−0·87	−1·13	−0·55	0·00	+0·38	+0·28	0·00	−0·33
16 18	+0·18	−0·20	+0·18	−0·17	−0·27	−0·23	−0·55	+0·28	+0·72	+0·58	+0·05	+0·05	+0·05
17 18	+0·10	−0·10	−0·05	+0·07	+0·17	+0·02	−0·08	+0·58	+0·63	−0·05	−0·35	−0·12	+0·07
18 18	+0·05	−0·20	−0·23	−0·17	+0·10	+0·07	+0·10	+0·30	+0·12	−0·27	−0·17	−0·05	−0·03
19 18	+0·12	0·00	−0·17	−0·23	−0·30	−0·20	−0·15	−0·12	−0·05	−0·10	+0·05	+0·08	−0·08
20 18	+0·12	+0·02	−0·17	0·30	−0·33	−0·30	+0·15	−0·12	−0·05	−0·05	+0·05	+0·15	−0·07
21 18	+0·13	−0·02	−0·20	−0·20	−0·20	−0·15	−0·08	−0·18	−0·02	−0·08	+0·07	+0·07	−0·07
22 18	+0·10	+0·02	−0·17	−0·12	−0·03	−0·05	+0·02	−0·10	−0·02	−0·02	+0·22	+0·05	0·00
23 18	+0·17	+0·02	−0·05	−0·05	+0·07	+0·12	+0·12	−0·03	+0·10	+0·12	+0·40	+0·10	+0·08
Range ...	2·04	2·42	2·57	3·85	4·40	4·78	4·62	5·56	5·85	3·70	1·02	1·23	2·87

TABLE 160.—*Declination Magnetograph—showing the Mean Diurnal Inequalities for each month of the year 1871 and for the whole year.*

Unity = 1 minute of arc.

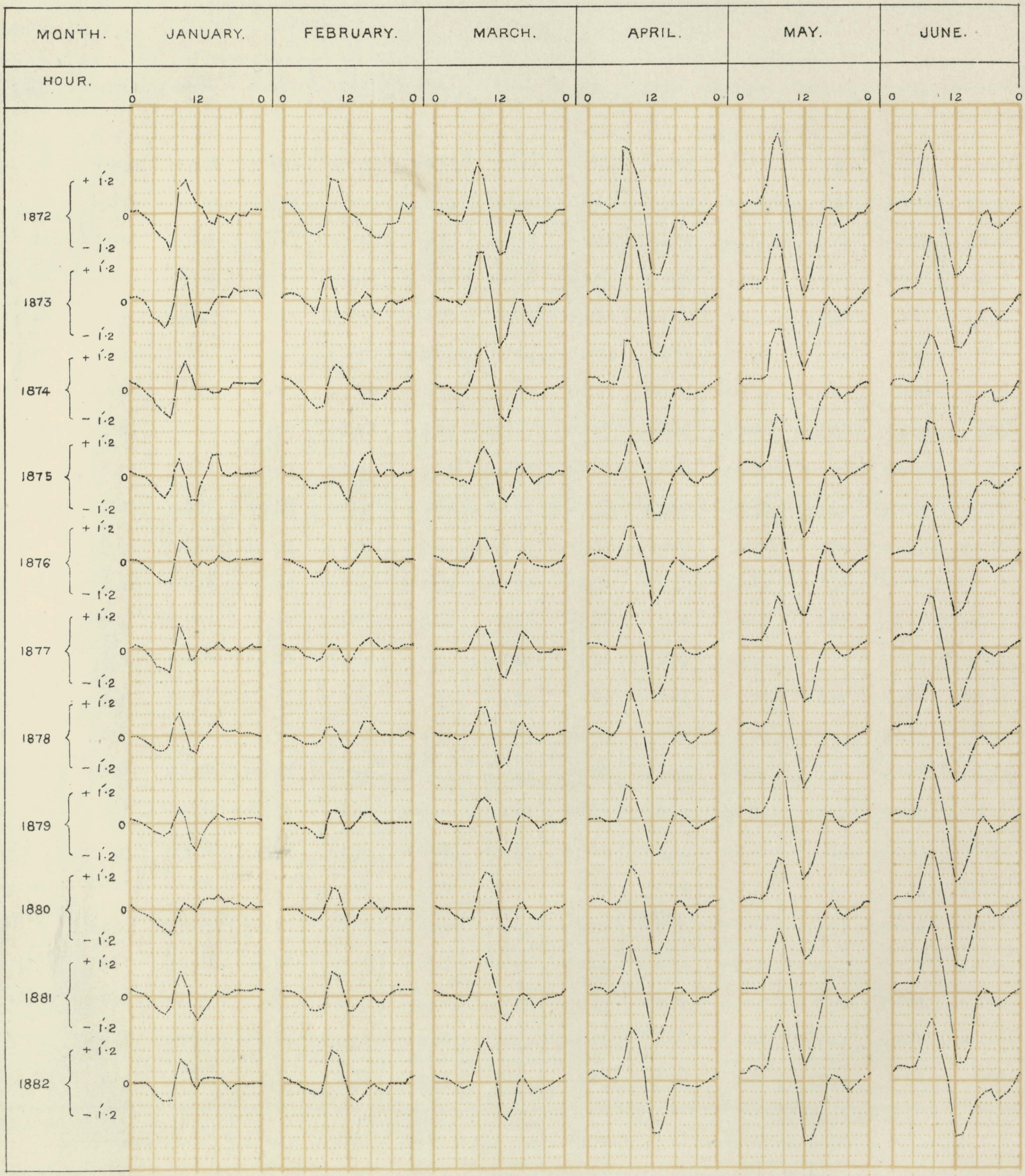
1871.	MONTH.												
Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October	November.	December.	Year.
H. m.													
0 18	+0·34	+0·40	+0·03	+0·52	+0·11	+0·20	0·00	+0·03	+0·31	+0·43	**+0·72**	+0·37	+0·29
1 18	+0·29	+0·34	+0·08	+0·60	+0·23	+0·31	+0·08	+0·18	+0·37	+0·46	+0·57	+0·31	+0·32
2 18	+0·15	+0·40	+0·03	+0·49	+0·20	+0·34	+0·11	+0·20	+0·34	+0·29	+0·43	+0·06	+0·25
3 18	−0·06	+0·03	−0·15	+0·46	+0·26	+0·29	+0·31	+0.29	+0·31	+0·18	+0·08	−0·15	+0·16
4 18	−0·34	−0·23	−0·18	+0·37	+0·37	+0·43	+0·52	+0·63	+0·29	+0·06	−0·11	−0·31	+0·12
5 18	−0·49	−0·52	−0·08	+0·55	+0·94	+1·04	+1·24	+1·15	+0·52	0·00	−0·52	−0·57	+0·27
6 18	−0·69	**−0·80**	+0·20	+1·69	+2·33	+2·76	+2·81	+2·81	+1·72	+0·63	**−0·89**	−0·78	+0·98
7 18	**−0·89**	−0·72	+1·27	**+2·62**	**+2·96**	**+3·27**	**+3·27**	**+3·56**	**+2·95**	**+1·43**	−0·66	**−1·20**	+1·49
8 18	+0·18	+0·11	+1·84	+2·41	+2·29	+2·88	+2·73	+2·85	+2·70	+1·38	+0·06	−0·78	**+1·55**
9 18	**+1·32**	+0·86	**+2·04**	+1·29	+0·69	+1·41	+1·35	+0·86	+1·35	+0·57	+0·49	−0·06	+1·02
10 18	+0·89	**+1·01**	+1·17	−0·08	−0·83	−0·20	−0·57	−0·95	−0·34	−0.60	+0·15	+0·08	−0·03
11 18	−0·29	+0·46	−0·37	−1·92	−1·95	−1·92	−1·92	−2·36	−2·24	−1·58	−0·52	−0·11	−1·23
12 18	−0·55	+0·03	−1·27	**−2·76**	**−2·59**	−2·81	**−2·56**	−3·16	**−3·16**	**−1·87**	−0·46	−0·11	**−1·78**
13 18	−0·29	+0·06	**−1·35**	−2·59	−2·24	**−2·99**	−2·56	**−3·22**	−2·90	−1·24	−0·11	+0·18	−1·60
14 18	−0·31	−0·20	−0·83	−2·10	−1·58	−2·27	−1·95	−2·24	−1·79	−0·49	+0·06	+0·43	−1·11
15 18	+0·23	−0·06	−0·06	−0·92	−0·55	−1·35	−0·95	−0·89	−0·49	+0·29	+0·08	**+0·46**	−0·35
16 18	+0·43	−0·08	−0·06	−0·23	+0·23	−0·43	−0·08	+0·23	+0·29	+0·37	−0·06	+0·37	+0·08
17 18	−0·08	−0·46	−0·57	−0·06	+0·40	+0·26	+0·31	+0·63	+0·23	−0·37	−0·49	−0·03	−0·02
18 18	−0·31	−0·72	−0·86	−0·20	+0·08	+0·40	+0·15	+0·34	−0·18	−0·49	−0·23	+0·06	−0·17
19 18	+0·08	−0·18	−0·49	−0·29	−0·46	−0·31	−0·49	−0·15	−0·20	−0·11	+0·15	+0·34	−0·18
20 18	+0·11	−0·08	−0·40	−0·18	−0·49	−0·49	−0·57	−0·31	−0·08	+0·03	+0.11	+0·26	−0·18
21 18	+0·06	−0·08	−0·18	−0·08	−0·34	−0·37	−0·49	−0·34	−0·20	+0·03	+0·20	+0·31	−0·12
22 18	+0·06	+0·06	−0·11	+0·11	−0·20	−0·23	−0·40	−0·26	−0·15	+0·18	+0·34	+0·31	−0·02
23 18	+0·18	+0·18	−0·03	+0·31	−0·06	+0·03	−0·29	−0·08	+0·08	+0·43	+0·60	+0·40	+0·16
Range ...	2·21	1·81	3·39	5·38	5·55	6·26	5·83	6·78	6·12	3·30	1·61	1·66	3·33

These inequalities for each month of each of the years 1872 to 1905 are charted in plates 44 to 49.

COLABA OBSERVATORY

Declination Diurnal Inequality
(Magnetograph)

Plate 44

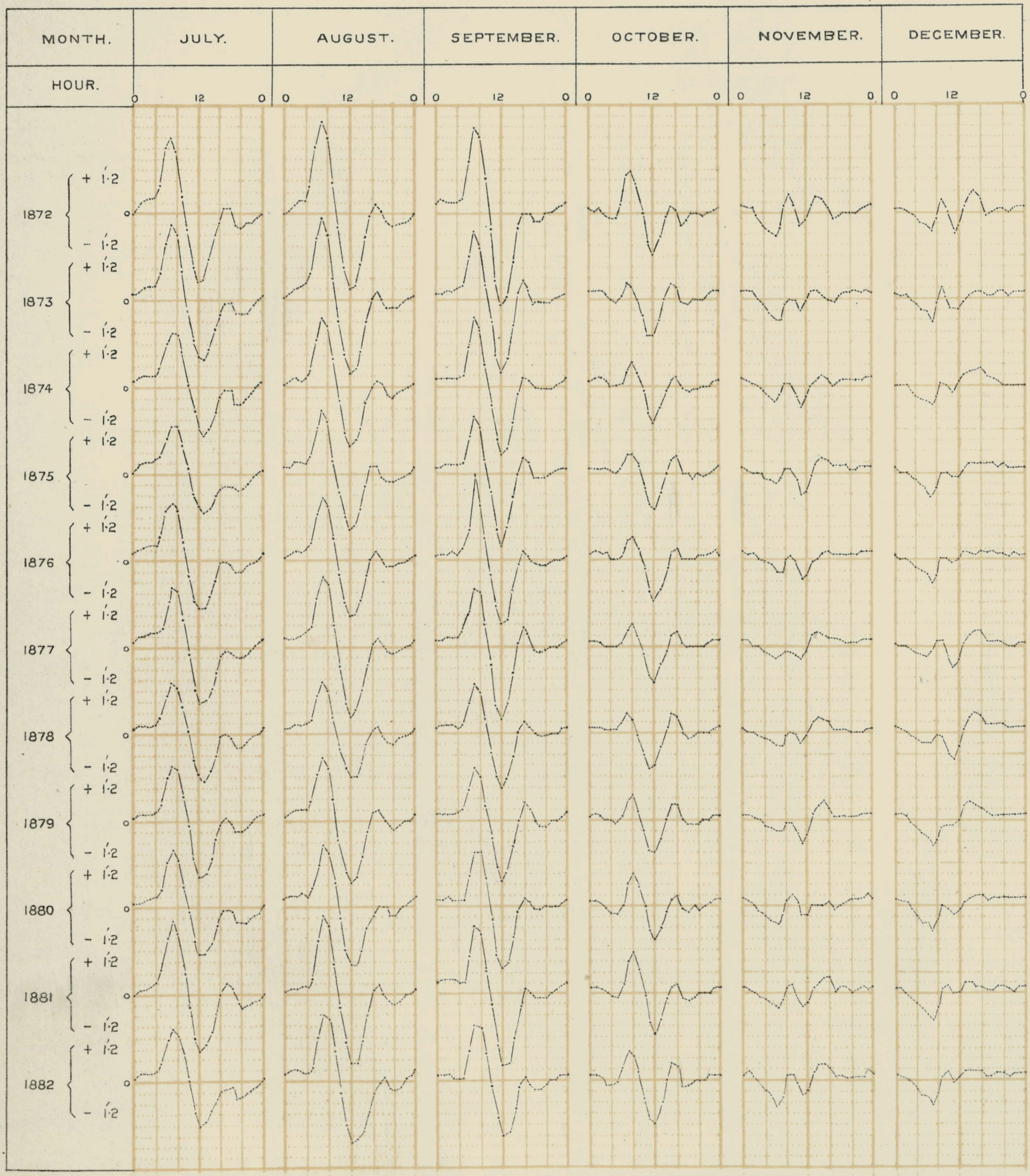


Govt. Photozinco: Office. Poona. 1909

Colaba Observatory.

Declination Diurnal Inequality.
(Magnetograph.)

Plate 45

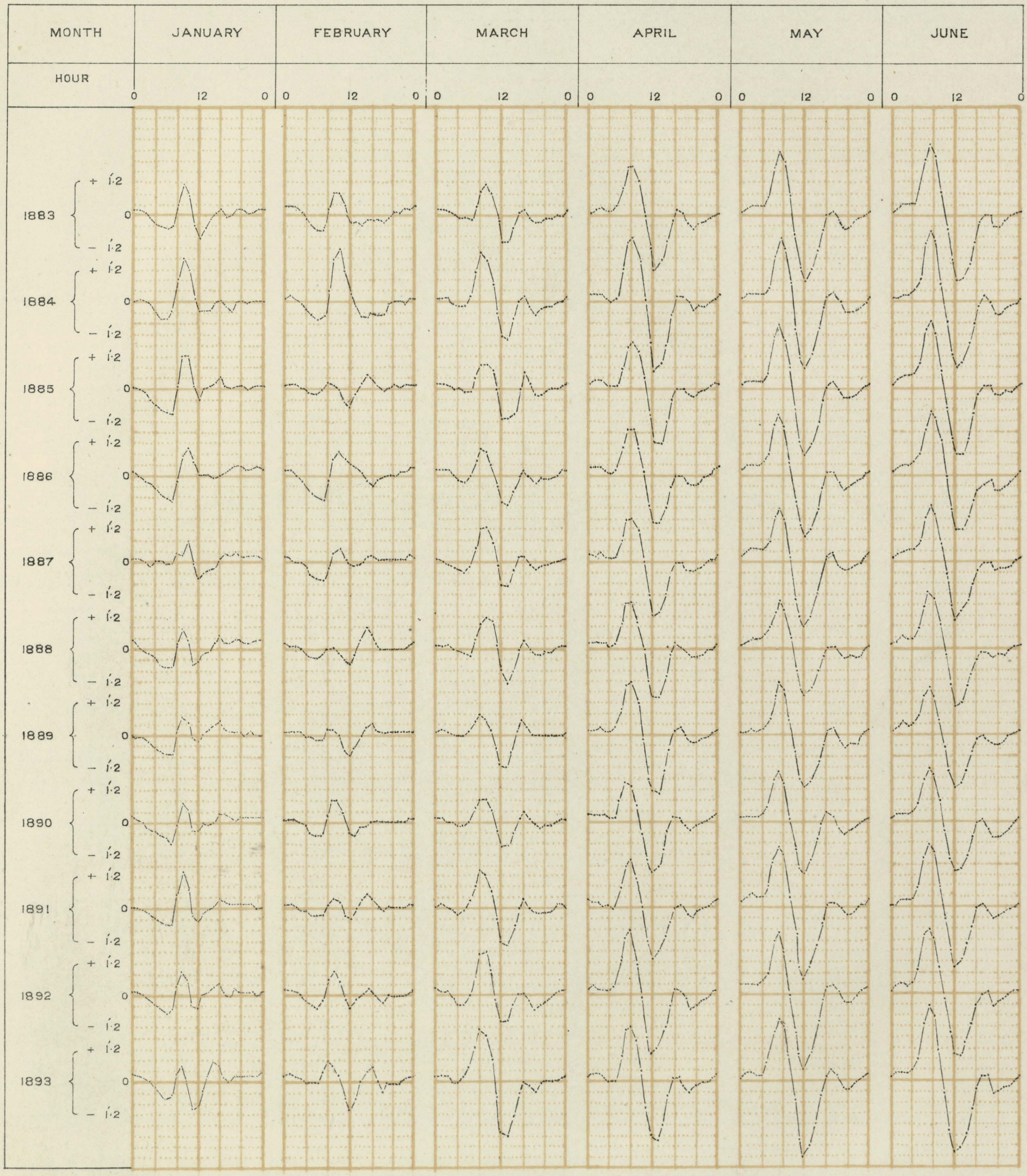


Govt. Photozinco Office, Poona 1909.

Colaba Observatory

Declination Diurnal Inequality.
(Magnetograph).

Plate 46.



Govt. Photozinco. Office, Poona 1909.

Colaba Observatory.

Declination Diurnal Inequality.
(Magnetograph)

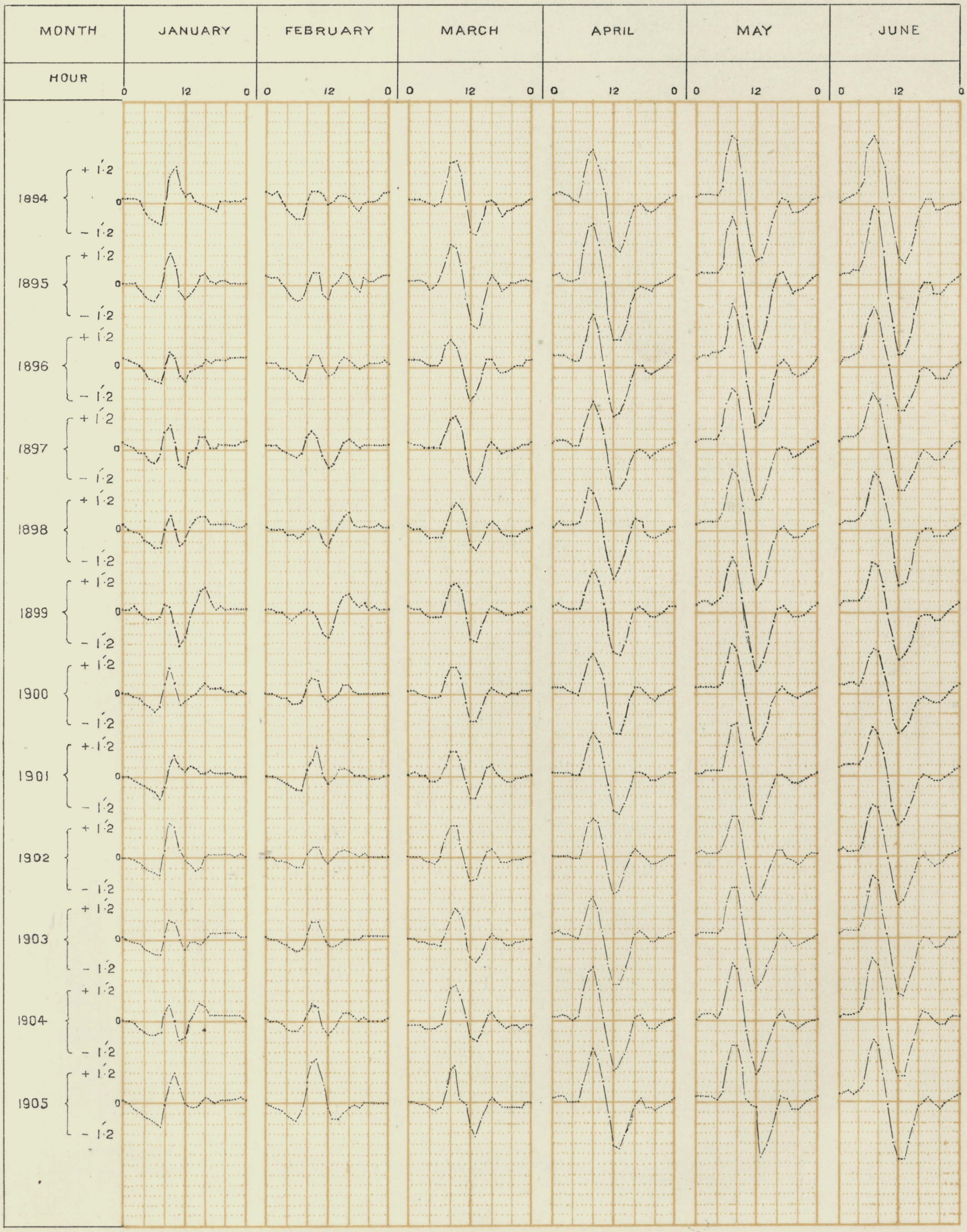
Plate 47

Govt. Photozinco. Office, Poona, 1909

Colaba Observatory

Declination Diurnal Inequality.
(Magnetograph).

Plate 48.

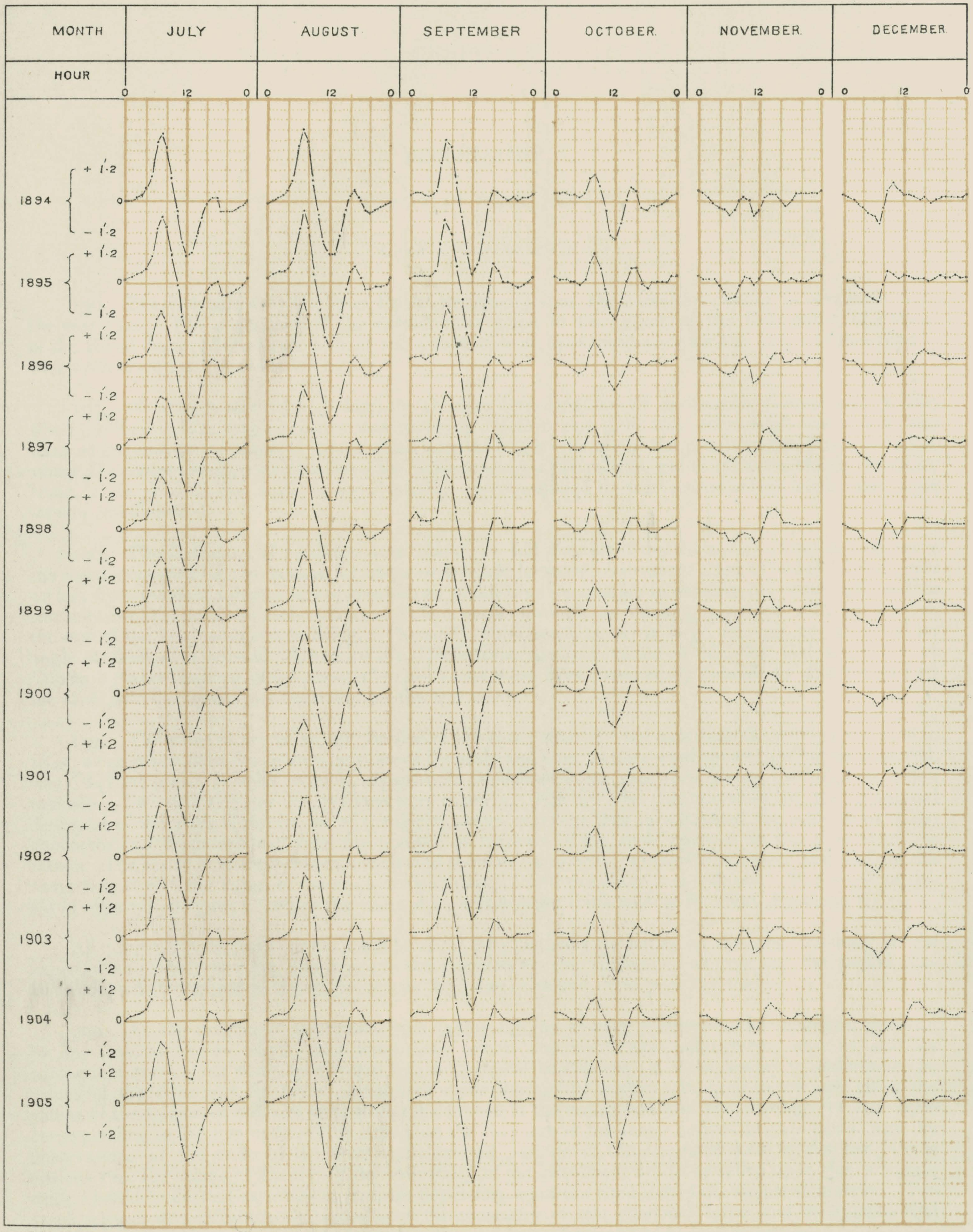


Govt Photozinco Office, Poona, 1909.

Colaba Observatory

Declination Diurnal Inequality, (Magnetograph).

Plate 49.



Govt. Photozinco Office, Poona 1909.

CHAPTER V.

DECLINATION.

VARIATION INSTRUMENT.

Grubb's Magnetometer.

196. The instrument by Grubb of Dublin was mounted in 1845 and the record is available from the year 1846. The description of the instrument is given in the report of the Committee of Physics of the Royal Society (1840), as also in the publication of the Observatory for the years 1879—1882 to which reference may be made for details.

197. As already mentioned before, the absolute determinations of declination commenced in 1867 when the Kew unifilar magnetometer was received. Before this date this differential instrument was used as an indicator of absolute values which were derived by the use of the usual formula $D = a\ (s-z)\ c$; where D denotes absolute declination, s the scale reading, a the value in arc of an unit of the declinometer scale, z the zero of the scale or zero reading corresponding to true astronomical north, and c the torsion co-efficient.

198. The instrumental readings were taken, as will be seen from the details of the description of the instrument given in the volume for 1879—1882, with a transit instrument fixed at a distance of about 27 feet from the declinometer, to the southward, which from its position is capable of being adjusted to true astronomical north by observations of Polaris made through an opening provided with shutters in the roof of the Magnetometer building. The scale of the declinometer is large enough to allow of an angle of about 4° to be read off, and as the Declination has not varied within the last 60 years at Colaba by more than 50′ (from about 1° to 10′ East) it has been found easily possible to *directly* read off the scale with the transit in adjustment for the true north.

199. The value in arc of an unit division of the scale, derived from experiments initially conducted in 1845, since which date the relative position of the scale and lens, as the record shows, has not been altered, was 6·841 minutes. A fresh series of experiments conducted in the year 1864 placed the value at 6·806 minutes. Two series of star observations were taken in 1896 for the determination of the equatorial distances of the wires of the transit of the declinometer, which in their turn enabled the scale value of the declinometer to be determined from the number of divisions of the scale covered by the 7 wires of the transit. The result of the experiments indicated the value at 6′·788. Observations were also made at the same time to find the value of the scale division directly with the aid of a theodolite. The result of this set of observations gave 6′·786 as the value of an unit division (*vide* volume for 1896, Appendix E).

All subsequent determinations, it will be seen, are practically the same as the one obtained in the experiments of the year 1864, and hence 6′·806 modified by the torsion co-efficient for the period, has been adopted throughout in the reductions as the value of an unit division of the scale.

200. As the magnet is restrained from taking up the correct position in the magnetic meridian by any residual torsion which may have been left in the skein after adjustment, and as also its subsequent movements would be affected by the torsional co-efficient, it is necessary to determine the values of the constants for every adjustment made during the period. In table below are given the values of the torsion co-efficient used from time to time in the reductions and the readings of the scale corresponding to the true north which constitute the true zero of the scale, derived in the usual way by observations of the scale in the erect and inverted position of the magnetic axis of the bar. It is obvious that the values of the zero, if the indications of the instrument are to be relied upon for accurate work, should be derived as often as possible depending upon the condition of the suspension skein. Too much reliance was unfortunately placed upon the constancy of this torsional force and it appears that observations for this purpose had been made only on a few occasions and at long intervals.

201. The values of such meridian readings and the torsion coefficient determined experimentally from time to time are given in the following table:—

TABLE 161.

Date.	True meridian reading.	Torsion coefficient.	Remarks.
1845 April 18th	25·172	1·0035	
1850 December 30th	25·221	1·003546	
1855 „ 26th	24·8777	1·003443	
1856 January 10th, 11th ...	22·3537	1·00358	Another magnet substituted from January 11th to 23rd, 1856.
1856 „ 25th	28·3064	1·003009	Magnet remagnetised between January 11th and 25th.
1861 July 8th	28·5334	1·00039	
1861 August 13th	28·2515	1·00088	
1861 November 2nd	28·2733	1·0028	
1861 „ 9th	......	1·002864	Torsion arm turned.

It will be seen from the table that the important breaks in the continuity of the record due to readjustment, etc., occurred in December 1850, December 1855, January 1856, and in November 1861. After this the instrument was allowed to lie undisturbed till 1896 when the breaking of the silk threads necessitated the dismounting of the instrument and the renewal of the silk suspension.

202. For the final reductions therefore as no known method for correcting the results of years *earlier than* 1861 is available, the zeros of the scale and the torsion co-efficient as shown in the table given above have been so far taken as correct and with the value—6′·806 for the scale division all readings for this period have been reduced. We shall presently see how far these results can be accepted as reliable for our purpose.

203. For the later period 1861 to 1895 during which the instrument was allowed to lie undisturbed in adjustment, advantage has been taken of the absolute determinations for the period 1868—1895 (as well as the concurrent magnetograph record) to standardise the readings of the instrument; and the treatment adopted for the evaluation of the zeros (*vide* paragraph 209) allows of the record to be extended backwards to the year 1861 with a fair degree of accuracy, by the adoption of the theoretical values of zeros derived from the process.

204. The record, by this instrument, runs for the period 1847—1872 exactly as in the force magnetometer, and consists of hourly observations taken daily except on Sundays and holidays. For the two years 1871 and 1872 observations by this instrument were allowed to run concurrently with the newly set up declination magnetograph. This has enabled a direct comparison of the records to be secured (*vide* table 179, for result of comparison for the year 1872) preserving a continuity between the earlier eye observation series for the period 1847—1872 and the later magnetograph series from 1872 to 1905.

205. The hourly eye observations were discontinued after 1872, and five observations only in the day, viz. at 6, 10, 14, 16 and 22 hours, were allowed to run. Simultaneous readings of this instrument at the time of the absolute determinations were however continued to 1905.

206. Table 162 gives the crude monthly mean scale readings of the instrument as derived from the 24 hourly readings for the period 1846 to 1872; and from the five hourly readings duly corrected for the mean of 24 hours for the period 1873 to 1895. In table 163 are given the reduced values of declination derived by the use of the formula given in paragraph 197. The scale readings used in the formula are given in table 162, and the zeros used for the purpose are the *fixed* zeros shown in table 161 for the different periods from 1846 to 1861, and the theoretically derived zeros shown in the next section for the period 1862 to 1895.

207. For the earlier period 1846 to 1861 it will be seen that the annual means of absolute declination have been given in their crude form in table 242, Part II, as it has not been found possible to apply any corrections to them for instrumental defects.

TABLE 162.—*Mean monthly and annual Scale readings of Grubb's D. Magnetometer.*

Years.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1846 ...	27·17	27·15	27·12	27·14	27·14	27·10	27·05	27·00	27·08	27·10	27·11	27·17	27·11
1847 ...	27·21	27·22	27·25	27·24	27·21	27·14	27·12	27·18	27·23	27·30	27·30	27·30	27·22
1848 ...	27·33	27·33	27·34	27·40	27·39	27·20	27·19	27·20	27·24	27·25	27·25	27·25	27·28
1849 ...	27·20	27·27	27·26	27·30	27·36	27·27	27·27	27·27	27·28	27·38	27·41	27·45	27·31
1850 ...	27·53	27·57	27·58	27·56	27·54	27·54	27·52	27·50	27·53	27·58	27·60	27·62	27·56
1851 ...	27·59	27·62	27·60	27·61	27·62	27·55	27·48	27·80	27·94	27·93	27·94	27·65	27·69
1852 ...	27·69	27·88	27·86	27·87	27·66	27·57	27·55	27·54	27·58	27·63	27·71	27·71	27·69
1853 ...	27·86	27·96	27·98	27·49	27·94	27·82	27·81	27·82	27·87	27·91	27·99	28·01	27·87
1854 ...	28·00	28·03	27·99	27·94	27·89	27·84	27·68	27·70	27·70	27·98	27·88	27·95	27·88
1855 ...	28·03	28·06	28·07	28·07	28·10	28·06	28·05	28·06	28·02	28·07	28·09	28·09	28·06
1856 ...	31·15	31·14	31·10	31·08	31·12	31·11	31·06	31·14	31·13	31·17	31·23	31·26	31·14
1857 ...	31·26	31·30	31·29	31·22	31·24	31·27	31·16	31·13	31·13	31·01	31·10	31·16	31·19
1858 ...	31·30	31·27	31·32	31·33	31·26	31·26	31·16	31·13	31·20	31·27	31·34	31·39	31·27
1859 ...	31·38	31·43	31·46	31·44	31·47	31·48	31·50	31·48	31·54	31·64	31·64	31·72	31·51
1860 ...	31·73	31·75	31·82	31·79	31·81	31·88	31·90	31·99	31·92	31·93	32·01	32·05	31·88
1861 ...	32·08	32·13	32·19	32·19	32·17	32·18	34·93	32·47	32·50	32·51	32·45	32·56	32·53
1862 ...	32.51	32·51	32·55	32·60	32·56	32·70	32·79	32·81	32·84	32·91	32·91	33·01	32·72
1863 ...	33·03	33·05	33·23	33·28	33·18	33·15	33·20	33·20	33·29	33·33	33·31	33·44	33·22
1864 ...	33·41	33·39	33·43	33·43	33·47	33·54	33·59	33·62	33·69	33·82	33·84	33·84	33·59
1865 ...	33·91	33·90	33·91	33·79	33·96	34·03	34·13	34·29	34·32	34·36	34·30	34·45	34·11
1866 ...	34·48	34·54	34·54	34·56	34·62	34·67	34·73	34·75	34·85	34·86	34·93	34·96	34·71
1867 ...	34·96	34·99	35·04	35·04	35·06	35·09	35·11	35·07	35·11	35·16	35·18	35·19	35·08
1868 ...	35·23	35·28	35·31	35·40	35·41	35·41	35·43	35·50	35·58	35·64	35·57	35·46	35·43
1869 ...	35·50	35·55	35·59	35·63	35·70	35·70	35·68	35·75	35·81	35·81	35·82	35·83	35·70
1870 ...	35·89	35·90	35·95	35·98	35·94	35·93	35·95	36·05	36·17	36·22	36·22	36·21	36·03
1871 ...	36·24	36·28	36·31	36·31	36·26	36·23	36·28	36·33	36·34	36·38	36·45	36·44	36·32
1872 ...	36·48	36·53	36·51	36·51	36·49	36·49	36·46	36·52	36·51	36·61	36·61	36·60	36·53
1873 ...	36·61	36·60	36·65	36·63	36·57	36·61	36·61	36·65	36·65	36·65	36·65	36·67	36·63
1874 ...	36·69	36·72	36·72	36·72	36·69	36·70	36·70	36·71	36·69	36·75	36·75	36·78	36·72
1875 ...	36·76	36·79	36·83	36·84	36·85	36·80	36·83	36·85	36·83	36·84	36·86	36·88	36·83
1876 ...	36.90	36·92	36·91	36·90	36·90	36·89	36·89	36·91	36·92	36·90	36·91	36·95	36·91
1877 ...	36·95	36·94	36·98	36·98	36·98	36·95	36·94	36·94	36·94	36·95	36·97	36·96	36·96
1878 ...	36·96	36·98	36·98	37·00	36·95	36·94	37·02	37·00	37·00	37·04	37·07	37·05	37·00
1879 ...	37·00	37·01	37·01	37·01	37·00	37·02	37·06	37·07	37·10	37·01	37·00	37·01	37·02
1880 ...	37·01	37·02	37·02	37·00	36·97	36·96	36·99	37·02	37·00	37·00	37·03	37·07	37·01
1881 ...	37·06	37·11	37·09	37·09	37·13	37·04	37·01	37·01	37·01	37·02	37·06	36·86	37·04
1882 ...	36·85	36·85	36·85	36·88	36·82	36·81	36·79	36·76	36·79	36·93	37·01	36·97	36·86
1883 ...	36·93	36·96	36·98	36·99	36·90	36·96	36·96	37·04	37·06	37·02	37·05	37·02	36·99
1884 ...	36·90	36·89	36·89	36·87	36·84	36·82	36·83	36·79	36·76	36·79	36·78	36·75	36·83
1885 ...	36·76	36·76	36·72	36·70	36·68	36·63	36·62	36·63	36·59	36·57	36·58	36·59	36·65
1886 ...	36·62	36·60	36·57	36·57	36·52	36·47	36·48	36·46	36·39	36·41	36·42	36·42	36·49
1887 ...	36·39	36·40	36·38	36·33	36·30	36·26	36·24	36·24	36·23	36·19	36·20	36·19	36·28
1888 ...	36·17	36·19	36·16	36·23	36·25	36·20	36·18	36·18	36·17	36·15	36·17	36·05	36·17
1889 ...	36·02	35·99	35·99	35·94	35·90	35·86	35·86	35·84	35·80	35·79	35·81	35·78	35·88
1890 ...	35·77	35·74	35·70	35·66	31·65	35·61	35·58	35·57	35·55	35·54	35·53	35·51	35·62
1891 ...	35·49	35·52	35·49	35·45	35·40	35·37	35·32	35·30	35·31	35·27	35·26	35·24	35·37
1892 ...	35·25	35·29	35·26	35·16	35·17	35·08	35·10	35·08	35·02	35·00	34·97	34·94	53·11
1893 ...	34·90	34·93	34·85	34·80	34·73	34·70	34·69	34·67	34·64	34·63	34·62	34·59	34·73
1894 ...	34·59	34·60	34·56	34·39	34·32	34·29	34·30	34·27	34·23	34·18	34·19	34·15	34·34
1895 ...	34·13	34·13	34·07	34·03	33·99	33·92	33·90	33·87	33·83	33·82	33·81	33·78	33·94

TABLE 163.—*Mean monthly and annual Declination derived from scale readings of Grubb's D. Magnetometer.*

Years.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.		Year.	
	′		′		′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″
1846 …	9	52	9	42	9	30	9	41	9	40	9	24	9	2	8	42	9	16	9	24	9	26	9	50	9	27
1847 …	10	7	10	14	10	26	10	20	10	6	9	40	9	31	9	57	10	14	10	44	10	43	10	44	10	14
1848 …	10	56	10	56	11	1	11	26	11	22	10	3	10	0	10	3	10	19	10	24	10	23	10	22	10	36
1849 …	10	2	10	31	10	30	10	45	11	8	10	33	10	34	10	32	10	38	11	17	11	29	11	48	10	49
1850 …	11	50	12	6	12	10	12	1	11	54	11	52	11	44	11	39	11	48	12	8	12	16	12	25	12	0
1851 …	12	13	12	26	12	17	12	22	12	23	11	58	11	27	[13	37]	14	36	14	30	14	37‖	12	36	12	55
1852 …	12	52	14	11	14	4	14	8	12	42	12	8	11	58	11	55	12	10	12	28	13	3	13	3	12	53
1853 …	14	5	14	46	14	54	[11	35]	14	35	13	46	13	44	13	48	14	6	14	25	14	56	15	4	14	9
1854 …	15	3	15	12	14	55	14	37	14	15	13	54	12	51	12	56	12	59	14	54	14	12	14	41	14	12
1855 …	15	14	15	27	15	29	15	30	15	43	15	27	15	21	15	27	15	9	15	29	15	39	15	38‖	15	28
1856 …	15	8	15	5	14	48	14	40	14	56	14	52	14	32	15	4	14	58	15	16	15	41	15	53	15	4
1857 …	15	55	16	8	16	7	15	38	15	46	15	55	15	11	14	58	15	2	14	10	14	49	15	12	15	24
1858 …	16	9	15	57	16	19	16	24	15	53	15	55	15	11	14	58	15	29	15	58	16	28	16	48	15	57
1859 …	16	43	17	1	17	16	17	5	17	20	17	23	17	31	17	25	17	50	18	27	18	25	19	0	17	38
1860 …	19	4	19	12	19	40	19	31	19	36	20	8	20	15	20	50	20	22	20	25	21	0	21	15	20	7
1861 …	21	28	21	51	22	15	22	12	22	6	22	11	[21	57]	24	55	25	8	25	14‖	24	43	25	3	23	15
1862 …	24	38	24	37	24	55	25	15	24	58	25	59	26	34	26	42	26	55	27	22	27	24	28	3	26	7
1863 …	28	25	28	33	29	46	30	7	29	30	29	13	29	35	29	35	30	11	30	29	30	17	31	12	29	45
1864 …	31	10	30	59	31	18	31	15	31	33	32	1	32	25	32	37	33	3	33	58	34	4	34	5	32	22
1865 …	34	40	34	39	34	42	33	54	35	1	35	33	36	10	37	16	37	28	37	43	37	18‖	38	20	36	4
1866 …	38	40	39	3	39	3	39	14‖	39	37	40	0	40	22	40	29	41	12	41	18	41	44	41	57	40	13
1867 …	42	1	42	13	42	34	42	32	42	44	42	54	43	0	42	46	43	1	43	21	43	29	43	35	42	51
1868 …	43	58	44	18	44	30	45	7	45	11	45	11	45	20	45	48	46	21	46	46	[46	17]	[45	32]	45	22
1869 …	45	53	46	14	46	30	46	46	47	15	47	15	47	7	47	36	48	0	48	0	48	4	48	8	47	14
1870 …	48	38	48	42	49	3	49	15	48	58	48	54	49	3	49	43	50	33	50	53	50	53	50	49	49	37
1871 …	51	5	51	22	51	34	51	34	51	13	51	1	51	22	51	42	51	46	52	3	52	31	52	27	51	38
1872 …	52	48	53	8	53	0	53	0	52	52	52	52	52	39	53	4	53	0	53	41	53	41	53	37	53	7
1873 …	53	44	53	40	54	0	53	52	53	27	53	44	53	44	54	0	54	0	54	0	54	0	54	8	53	52
1874 …	54	21	54	33	54	33	54	33	54	21	54	25	54	25	54	29	54	21	54	45	54	45	54	57	54	32
1875 …	54	53	55	6	55	22	55	26	55	30	55	10	55	22	55	30	55	22	55	26	55	34	55	42	55	22
1876 …	55	54	56	2	55	58	55	54	55	54	55	49	55	49	55	58	56	2	55	54	55	58	56	14	55	57
1877 …	56	17	56	13	56	29	56	29	56	29	56	17	56	13	56	13	56	13	56	17	56	25	56	21	56	20
1878 …	56	24	56	32	56	32	56	40	56	20	56	16	56	49	56	40	56	40	56	57	57	9	57	1	56	40
1879 …	56	43	56	48	56	48	56	48	56	43	56	52	57	8	57	12	57	24	56	48	56	43	56	48	56	54
1880 …	56	51	56	55	56	55	56	46	56	34	56	30	56	42	56	55	56	46	56	46	56	59	57	15	56	49
1881 …	57	14	57	35	57	26	57	26	57	43	57	6	56	54	56	54	56	54	56	58	57	14	55	52	57	6
1882 …	55	51	55	51	55	51	56	3	55	39	55	35	55	27	55	14	55	27	56	24	56	57	56	40	55	55
1883 …	56	26	56	38	56	46	56	50	56	14	56	38	56	38	57	11	57	19	57	3	57	15	57	3	56	50
1884 …	56	17	56	12	56	12	56	4	55	52	55	44	55	48	55	32	55	19	55	32	55	27	55	15	55	46
1885 …	55	22	55	22	55	6	54	58	54	49	54	29	54	25	54	29	54	13	54	4	54	9	54	13	54	38
1886 …	54	27	54	19	54	6	54	6	53	46	53	25	53	30	53	21	52	53	53	1	53	5	53	5	53	35
1887 …	52	56	53	0	52	52	52	31	52	19	52	2	51	54	51	54	51	50	51	34	51	38	51	34	52	10
1888 …	51	28	51	36	51	24	51	52	52	0	51	40	51	32	51	32	51	28	51	19	51	28	50	38	51	30
1889 …	50	28	50	16	50	16	49	55	49	39	49	23	49	23	49	14	48	58	48	54	49	2	48	50	49	31
1890 …	48	49	48	37	48	20	48	4	48	0	47	43	47	31	47	27	47	19	47	15	47	11	47	2	47	46
1891 …	46	56	47	8	46	56	46	40	46	19	46	7	45	47	45	38	45	42	45	26	45	22	45	14	46	6
1892 …	45	20	45	36	45	24	44	43	44	47	44	10	44	18	44	10	43	46	43	37	43	25	43	13	44	22
1893 …	43	0	43	12	42	39	42	19	41	50	41	38	41	34	41	25	41	13	41	9	41	5	40	53	41	50
1894 …	40	55	40	59	40	42	39	33	39	4	38	52	38	56	38	44	38	27	38	7	38	11	37	54	39	12
1895 …	37	48	37	48	36	44	37	7	36	51	36	22	36	14	36	2	35	45	35	41	35	37	35	25	36	30
Annual Inequality, 1846-1872.	−0	5	0	0	+0	4	+0	4	0	0	−0	8	−0	15	−0	8	+0	2	+0	12	+0	10	−0	3	…	

The annual inequalities are corrected for annual variation of zero.

Doubtful monthly means are enclosed in brackets and the interruptions are marked by strong vertical lines in the table.

208. The undisturbed condition of the instrument after 1861 and the derivation of the theoretical zero curve by the comparison of the absolute determinations with those indicated by the instrument for the period 1868 to 1895, have made an accurate determination of the theoretical zero curve as also its application backwards to 1861, as shown in the next section, fairly possible. The annual means of the absolute values so derived are given in Part II of this volume in Chapter II, table 242. It will be readily seen that from 1896 backwards to the year 1858, the coincidence of the observed curve (figure 1, plate 10) with the theoretical curve of absolute declinaton, is fairly close. But about this

TABLE 164.—*Mean monthly and annual values of D. Magnetometer Zero, and its Annual Inequalities.*

Years.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Annual means calculated by formula $\zeta = a + \beta\sqrt{t}$.	Observed *minus* calculated.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	′ ″	′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
1868 ...	196 19	196 53	196 8	196 23	197 15	196 57	197 11	196 39	197 19	197 14	196 50	196 19	196 47	196 29	+0 18
1869 ...	196 23	195 38	195 39	195 40	196 2	195 50	196 8	196 12	196 46	196 37	196 38	196 13	196 9	196 24	−0 15
1870 ...	196 30	196 47	196 49	196 39	196 27	196 16	196 6	196 23	196 16	196 35	197 5	197 5	196 35	196 19	+0 16
1871 ...	197 28	197 10	197 3	196 46	196 35	196 32	196 34	196 20	196 40	196 17	196 18	196 22	196 40	196 15	+0 25
1872 ...	196 33	196 36	196 19	196 19	196 23	196 14	196 13	196 2	195 59	196 8	196 7	196 1	196 14	196 11	+0 3
1873 ...	196 1	196 5	196 19	196 5	195 45	195 49	195 38	195 33	195 56	196 8	196 12	196 28	196 0	196 8	−0 8
1874 ...	196 47	196 38	196 29	196 18	196 5	195 49	195 57	196 0	196 1	195 55	195 57	195 57	196 9	196 4	+0 5
1875 ...	195 53	195 59	196 1	196 4	195 52	195 56	195 58	196 3	196 8	196 17	196 6	195 53	196 1	196 0	+0 1
1876 ...	196 3	196 3	196 4	196 14	196 18	196 15	196 1	195 46	195 37	195 28	195 36	195 46	195 56	195 57	−0 1
1877 ...	195 34	195 49	195 41	195 47	195 42	195 41	195 46	195 33	195 21	195 19	195 28	195 14	195 35	195 54	−0 19
1878 ...	195 15	195 2	195 13	195 19	195 14	195 0	195 38	195 51	195 40	195 41	195 40	195 24	195 25	195 51	−0 26
1879 ...	194 57	195 3	195 2	195 10	195 1	195 5	195 5	195 21	195 21	195 30	195 24	195 20	195 12	195 48	−0 36
1880 ...	195 27	195 37	195 46	195 37	195 20	195 11	195 15	195 11	195 20	195 23	195 21	195 40	195 26	195 45	−0 19
1881 ...	195 57	195 52	195 51	195 45	195 42	195 38	195 16	195 24	195 39	195 31	195 28	195 2	195 35	195 42	−0 7
1882 ...	195 1	195 9	194 59	194 51	194 38	194 29	194 16	194 21	194 21	194 42	194 59	195 1	194 44	195 39	+0 5
1883 ...	194 57	194 47	194 54	194 44	194 48	194 37	194 41	195 48	195 56	196 10	196 41	196 56	195 25	195 37	−0 12
1884 ...	196 18	195 59	195 40	195 32	195 42	195 33	195 36	195 32	195 31	195 36	195 38	195 38	195 41	195 34	+0 7
1885 ...	195 35	195 36	195 29	195 9	194 51	194 38	194 46	194 45	194 43	195 9	195 8	195 19	195 6	195 31	−0 25
1886 ...	195 40	195 59	195 59	196 1	195 54	195 29	195 20	195 14	195 18	195 25	195 25	195 30	195 36	195 29	+0 7
1887 ...	195 23	195 17	195 19	195 15	195 23	195 4	195 7	195 9	195 5	195 18	195 10	195 27	195 15	195 26	−0 11
1888 ...	195 38	195 15	195 0	195 1	195 26	195 42	195 26	195 31	195 43	195 39	195 53	196 0	195 31	195 24	+0 7
1889 ...	195 51	195 51	195 44	195 26	195 23	195 21	195 17	195 14	195 7	194 57	195 12	195 33	195 25	195 22	+0 3
1890 ...	195 39	195 37	195 29	195 30	195 27	195 34	195 26	195 19	195 28	195 35	195 35	195 38	195 31	195 19	+0 12
1891 ...	195 51	195 41	195 41	195 41	195 37	195 28	195 30	195 15	195 10	195 17	195 12	195 34	195 30	195 17	+0 13
1892 ...	195 41	195 47	195 47	195 48	195 52	195 47	195 55	195 34	195 17	195 6	195 0	195 27	195 35	195 15	+0 20
1893 ...	195 29	195 33	195 28	195 13	194 55	195 13	195 19	195 34	195 26	194 59	195 2	195 8	195 17	195 12	+0 5
1894 ...	195 13	195 31	195 31	195 16	195 5	194 47	194 50	194 33	194 3	193 59	194 10	194 14	194 46	195 10	−0 24
1895 ...	194 19	194 20	194 15	194 11	194 13	193 57	193 51	194 8	193 48	194 2	193 58	194 21	194 7	195 8	−1 1
Inequality, 1868-1895.	+0 9	+0 9	+0 5	+0 1	−0 1	−0 7	−0 7	−0 6	−0 5	−0 3	0 0	+0 3	195 37	...	...
Inequality* 1870-1895.	+0 12	+0 14	+0 12	+0 6	+0 1	−0 5	−0 7	−0 10	−0 11	−0 8	−0 3	+0 5	195 33	...	...
Inequality, Relative Humidity in percentage...	−8·3	−7·9	−3·9	−1·7	−2·0	+6·3	+11·0	+10·1	+9·0	+2·6	−6·5	−8·9	...	...	...

* Omitting years 1876, 1878, 1879, 1883 and 1888.

time a marked deviation is observed, and the values of the period 1846 to 1858 derived from the fixed zeros appear to be seriously divergent. The fault may lie of course with either series; but as there is little room for doubt that the later series is accurate, as will presently be seen, the values of these first 12 years should be considered as unreliable, and they have been for that reason given in thin type in table 242.

2. Determination of the Zeros of the Instrument.

209. In table 164 are given the mean monthly values of the zeros of the instrument from 1868 to 1895 as derived from the absolute observations of Declination and simultaneous readings of the Grubb's Declinometer. In column 14 of the same table are collected the annual means of such zeros.

Creep of the zero 1869—1895.

210. This series from 1868 to 1895 has been discussed fully in the volume for the year 1896, Appendix E, and it was seen that the law of the creep of the zero conformed very approximately to that given by the formula $\zeta = \alpha + \beta\sqrt{t}$, where α and β are constants and t the time in year reckoned from some convenient selected year. The test of the fit of the theoretical curve to the observed curve is that the residual errors for the annual values appear very small and remain so throughout the period considered; and what is of greater significance, the theoretical curve passes through the zero of November 1861, when the instrument was first adjusted, without any appreciably large error, though it was not included in the data used for the theoretical curve. The annual values of this curve are given in column 15 of table 164, and the departures of the theoretical from the observed appear in the next column 16. While discussing the secular variation of zero of the magnetograph instrument, we have already seen that the zero of that instrument showed a peculiar variation from year to year which was at first suspected to be due to some instrumental defect. The deviations of the annual means of the magnetograph zero have been charted in figure IV, plate 4, as are also the departures of the observed zero of Grubb's from the theoretically derived curve in figure III in the same plate.

211. The two-year fluctuations and the general parallel run of the two curves, we have already noted, are so strikingly close that any explanation ascribing the fluctuations to instrumental defects in each case can hardly be entertained. With reference to the details of the run of the two curves a few remarks seem to be necessarily called forth here. The indications of the Grubb's instrument were unfortunately for a few years in its early history, affected by the intrusion of a tiny species of spiders which somehow had gained access to the interior of the box. In the 50 years' history of this instrument which is given in the volume for 1896, Appendix E, the indications of the years 1881, 1882, 1883 have been identified as badly affected by this cause.

212. It will be seen (*vide* figures III and IV, plate 4) that between 1871 and 1875 the run of the two instruments is parallel as indicated by the two curves. Several attempts were made in 1876 extending over a period of two months, before the receiver of the Declination Magnetograph was properly exhausted, and the parallelism of the curves is, on account of this disturbance, lost for that year. Then from 1877 to 1880 they run more or less parallel again. The interruption from 1881 to 1883 is due as shown in the investigation above referred to, to the industry of the spiders. Then from 1884 to 1894 they once more run parallel, except for the small opposite run in 1888. The breaking of some of the silk strands of the Grubb's instrument explains the divergence of the Grubb's zero in 1894 and 1895, the skein finally giving way in 1896.

213. Taking up now the examination of the zeros shown in table 164, in their march from month to month, it is obvious that their indications would amongst other factors involve the effects of moisture, as the instrument, though well closed, was open to the influence of outside atmosphere. That a relation may exist between them is shown by figures X and XI in plate 4 where the fairly parallel sweeps of the curves leave little room for doubt in regard to this.

214. In the last two rows of table 164 are given the annual variations of the zero—the first representing the average phenomenon for the whole period and the second when certain years have been excluded from consideration. It will be seen that the latter variation of zero is almost exactly the same variation though derived by a slightly different process, shown in the volume for 1896, Appendix E, on page [49], where it is given without being corrected for progressive change. Both these variations are very small, but their character is practically the same. If the latter variation of zero derived from the period 1870 to 1895 be roughly taken as a measure of the variation of the zero of the instrument for the earlier period 1846 to 1872 and be also used as a correction applicable to the inequality in table 163 registered for the period 1846 to 1872, the inequality so modified for the period may be taken as approximately measuring the annual march of absolute declination. This is charted in figure X, plate 10. As the annual variation of the absolute declination is, we know, a very small inequality, the one derived from Grubb's must be regarded as a satisfactory result considering that it is registered by a differential

TABLE 165.—*Absolute Declination (observed) corrected for the mean of the day by Grubb's D. Magnetometer.*

Years.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
1867 ...	...	...	...	...	...	...	43 16	43 6	43 35	43 56	44 19	43 58	...
1868 ...	44 8	43 54	44 52	45 14	44 26	44 43	44 38	45 38	45 31	46 1	45 56	45 42	45 4
1869 ...	45 55	47 0	47 15	47 30	47 37	47 49	47 23	47 47	47 38	47 47	47 50	48 20	47 29
1870 ...	48 27	48 14	48 33	48 55	48 51	48 57	49 16	49 39	50 35	50 37	50 7	50 8	49 21
1871 ...	49 52	50 26	50 46	51 3	50 53	50 44	51 3	51 37	51 22	52 1	52 28	52 21	51 13
1872 ...	52 26	52 43	52 52	52 52	52 40	52 48	52 38	53 13	53 12	53 43	53 45	53 47	53 3
1873 ...	53 51	53 43	53 49	53 55	53 51	54 2	54 14	54 36	54 12	54 0	53 56	53 48	54 0
1874 ...	53 37	53 59	54 8	54 19	54 19	54 40	54 31	54 32	54 23	54 55	54 52	55 4	54 27
1875 ...	55 0	55 6	55 21	55 22	55 38	55 14	55 24	55 27	55 14	55 9	55 28	55 49	55 21
1876 ...	55 48	55 56	55 50	55 37	55 33	55 32	55 46	56 9	56 22	56 22	56 19	56 25	55 58
1877 ...	56 37	56 17	56 42	56 37	56 41	56 30	56 21	56 34	56 46	56 52	56 51	57 1	56 39
1878 ...	57 0	57 21	57 10	57 13	56 57	57 7	57 1	56 40	56 51	57 7	57 20	57 28	57 6
1879 ...	57 35	57 32	57 33	57 26	57 30	57 35	57 51	57 40	57 51	57 6	57 8	57 15	57 30
1880 ...	57 9	57 3	56 53	56 55	56 59	57 4	57 14	57 28	57 12	57 8	57 23	57 20	57 9
1881 ...	56 59	57 24	57 1	57 24	57 43	57 10	57 21	57 12	56 56	57 9	57 28	56 32	57 12
1882 ...	56 29	56 21	56 31	56 51	56 40	56 44	56 49	56 33	56 45	57 21	57 37	57 19	56 50
1883 ...	57 6	57 28	57 30	57 43	57 3	57 38	57 34	57 0	57 1	56 30	56 11	55 44	57 2
1884 ...	55 33	55 47	56 6	56 7	55 44	55 45	55 46	55 34	55 22	55 30	55 24	55 11	55 39
1885 ...	55 18	55 17	55 8	55 20	55 29	55 22	55 10	55 15	55 1	54 26	54 31	54 25	55 3
1886 ...	54 16	53 49	53 37	53 35	53 21	53 26	53 38	53 36	53 4	53 5	53 9	53 4	53 28
1887 ...	52 59	53 9	52 59	52 42	52 21	52 24	52 13	52 11	52 11	51 42	51 54	51 33	52 21
1888 ...	51 13	51 45	51 47	52 15	51 59	51 22	51 30	51 25	51 8	51 5	50 58	50 2	51 22
1889 ...	50 0	49 46	49 54	49 52	49 38	49 24	49 28	49 22	49 13	49 19	49 12	48 39	49 29
1890 ...	48 29	48 19	48 10	47 53	47 51	47 29	47 24	47 27	47 10	46 59	46 55	46 44	47 34
1891 ...	46 22	46 45	46 33	46 16	46 0	45 56	45 34	45 40	45 50	45 26	45 27	44 57	45 54
1892 ...	44 54	45 4	44 52	44 10	44 10	43 38	43 38	43 52	43 44	43 46	43 41	43 1	44 2
1893 ...	42 43	42 51	42 23	42 18	42 7	41 37	41 26	41 3	40 59	41 22	41 15	40 56	41 45
1894 ...	40 51	40 37	40 22	39 27	39 10	39 14	39 16	39 20	39 35	39 17	39 10	38 50	39 36
1895 ...	38 37	38 37	38 17	38 4	37 45	37 33	37 31	37 2	37 5	36 47	36 47	36 12	37 31
Annual Inequality, 1868—1895...	−0 8	−0 1	+0 3	+0 4	−0 3	−0 5	−0 2	+0 3	+0 2	+0 4	+0 7	−0 4	51 24

intsrument, that it is fairly identical in character to the one derived from absolute determinations and is only roughly corrected by the annual march of a zero series of another period on the supposition that the average instrumental and any other errors such as those due to moisture, etc., which are derived from a certain number of years may be made adaptable to any period. This annual inequality as registered by the instrument, we know, does include instrumental errors due to moisture and other meteorological causes and possibly also that minute magnetic factor, if any, referred to in the declination magnetograph zero curve, *vide* paragraph 188. When, however, the inequalities by this instrument are charted along with those registered by the magnetograph, the parallelism exhibited is fairly close notwithstanding the fact that the inequality by Grubb's is affected by a disturbing factor, *viz.* moisture.

3. Use of the Grubb's Instrument.

Derivation of the monthly means from Absolute Observations.

215. Having examined the behaviour of the instrument and noted its defects, we shall now see how far its use has been helpful in the determination of the monthly mean values of Absolute Declination derived from the simultaneous readings of the instrument taken at times of absolute observations, correcting the latter values for reducing them to the mean of the month. It is obvious that if the zero of the instrument is affected by the effects of moisture or some other meteorological factor, a portion of the error would contaminate the absolute monthly means so determined.

216. In table 165 hence are collected the observed absolute values corrected for the mean of 24 hours. These corrected monthly means are compared with another series corrected by the help of the magnetograph and the differences are collected in table 166.

It at once becomes apparent that here too as in the H. F. Magnetograph, but due to another cause, namely moisture, the indications of Grubb's Declinometer are affected differently at different hours of the day. The absolute observations are regularly taken 'every Thursday' about 12 noon, throughout the year and hence the last row of figures in table 166 should on an average show the condition of relation prevailing between the mean hour of the day and the hour of observation, namely 12 noon. This

TABLE 166.—*Differences between Absolute Declination corrected by D. Magnetometer and D. Magnetograph and their annual Inequalities.*

Years.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
	"	"	"	"	"	"	"	"	"	"	"	"	"
1871	− 3	+10	+12	+ 2	− 8	+ 6	+ 7	+ 6	+ 7	0	− 5	− 5	+ 2
1872	− 9	+ 3	0	−19	+ 9	+ 6	+ 2	+ 8	− 6	+ 2	+ 1	+11	0
1873	− 3	+ 1	0	+ 8	−11	+ 2	− 9	− 1	+ 5	+ 3	− 2	− 2	0
1874	− 4	− 6	−10	+ 2	+ 4	+ 5	+ 4	+ 9	− 4	+ 6	+ 2	− 1	+ 1
1875	+ 5	− 5	− 5	− 7	− 4	−12	+ 2	+ 7	+13	− 7	+ 1	− 2	− 1
1876	− 6	+ 8	+ 3	+ 6	+ 4	+ 5	+ 7	+ 4	− 9	− 8	+ 1	− 7	0
1877	− 3	− 2	+ 6	+12	+14	+19	+ 8	+ 9	+ 5	+ 2	− 5	− 1	+ 5
1878	−10	− 3	+ 9	+ 2	+ 2	+14	+23	+30	+25	+21	+11	−15	+ 9
1879	− 3	− 5	− 2	+ 9	+19	+19	+22	+32	0	− 4	+ 4	+ 8	+ 8
1880	+12	+ 6	− 7	−11	− 2	− 6	− 2	− 2	− 8	0	−10	− 7	− 3
1881	−16	− 6	−16	+ 1	+ 4	− 7	+13	+ 8	− 4	− 5	+ 2	+ 2	− 2
1882	0	0	+ 2	−15	− 9	− 2	0	− 4	− 1	− 5	−10	− 1	− 4
1883	−14	−14	− 2	+16	+ 8	− 5	+ 7	+ 3	+ 6	−16	+ 3	− 4	− 1
1884	+ 2	− 4	+ 5	+10	+10	+ 5	+12	+20	+ 7	+ 9	+ 5	+ 3	+11
1885	− 3	+ 5	+ 5	+ 9	+ 7	0	0	+ 9	0	− 8	− 3	− 2	+ 1
1886	−15	− 4	−15	+ 5	+ 6	+ 6	− 1	+ 9	+ 1	+ 4	+ 3	0	0
1887	− 5	− 7	− 4	− 5	+ 4	− 1	+ 3	+ 9	+ 9	− 1	+ 2	− 7	− 1
1888	0	+ 8	+ 1	+ 5	+ 8	+ 6	+ 9	+14	+ 7	+ 2	+ 1	− 9	+ 4
1889	− 3	− 5	+ 4	+ 8	+ 2	+ 2	+20	+ 4	+ 6	+ 2	− 1	− 8	+ 3
1890	− 6	− 7	+ 1	+16	+12	+22	+20	+10	+16	+ 6	+ 3	+ 6	+ 8
1891	− 2	+ 1	− 1	+ 1	+ 4	+ 5	+20	+23	+21	+ 4	− 9	−13	+ 5
1892	0	− 5	+ 7	+ 1	+ 8	+15	+22	+41	+20	+10	+ 3	−12	+ 9
1893	−16	+ 3	− 8	+ 6	+ 9	+23	+32	+22	+ 7	− 6	+ 5	− 2	+ 6
1894	+ 7	+ 4	+10	− 2	− 6	+ 7	+14	− 2	+ 5	− 2	− 7	− 1	+ 3
1895	+ 7	+11	+13	+30	+29	+31	+45	+37	+38	+27	+12	+ 6	+23
Annual Inequality, 1871—1875 ..	− 3	+ 1	− 1	− 3	− 2	+ 1	+ 1	+ 6	+ 3	+ 1	− 1	0	0
Annual Inequality, 1877—1895 ...	− 4	− 1	0	+ 5	+ 7	+ 8	+14	+14	+ 8	+ 2	0	− 3	...

conclusion is of course based on the assumption that the monthly means of absolute declination derived from the magnetograph corrections do not involve any such errors. The errors in table 166 hence may be taken to indicate the effect of moisture and other factors with which the absolute monthly means derived from Grubb's corrections are vitiated.

As in force observations, the absolute observation of declination were also, as part of routine, corrected for the mean of 24 hours from the simultaneous readings of the Grubb's instrument which was then considered sufficiently accurate for the requirements of supplying the necessary corrections. The monthly mean so derived when compared with similarly derived values corrected by the declination magnetograph, showed small irregularities and as this introduced some uncertainty in the results it was found advisable to redetermine the whole absolute series by corrections from the corresponding magnetograph tabulations.

We have seen that the Grubb's declinometer was exposed to the influence of the outer air, specially to moisture changes affecting the silk suspension, and hence the dislocations of the monthly datum as derived from the four or five observational points (at the times of absolute observations in the month), from the mean monthly zero derived from all hours to which the differences are presumably due, are clearly apparent in the difference tables. It will be noticed, however, that the differences indicated from 1871 to 1875 are much smaller. The coincidence of the results of the two instruments then appears to be due, as we know, to the fact that the magnetograph enclosure also was for this initial period, 1871 to 1875, not effectually closed against extraneous atmospheric influence. The two instruments thus appear to be almost equally affected by the moisture effects, and the differences become hence very small. From July 1876 however, the magnetograph enclosure was fully protected from these effects and the differences in the table 166, which hence thereafter become suddenly larger, tend to show how far the corrections derived from the Grubb's instrument deviate from those given by the magnetograph, the latter being subsequently free from errors due to atmospheric influence.

217. If this be recognized, as we must, it follows that the monthly means of absolute declination from 1871 to 1876 also, which have been corrected by the magnetograph, cannot be regarded as being altogether free from small errors of the type noticed here. This should be borne in mind when considering the values of declination given in table 111.

218. The point which is at any rate emphasised by the discussion above, is that the monthly mean values of the absolute determinations which apparently seem to be rightly corrected for the mean of 24 hours by a variation instrument which as usually is the case, is exposed to meteorological influence or is subject to some instrumental defects, should not be depended upon as a matter of course as being correct and above suspicion even though the corrections be small. We have seen how small unrecognised errors are bound to creep in if precautions in that direction are neglected. Here again, as already noted elsewhere, the necessity of the duplication of the work by two independent sets of instruments in all large Observatories has been clearly indicated.

Diurnal Variation of Declination.

219. As already remarked the instrument was in continuous action from 1848 to 1905, but the eye observations of 24 hourly readings have been secured by its help only for the earlier period, and tables 167 to 178 give the inequalities of all days (except Sundays and holidays) for this period 1848 to 1872. No corrections have been applied for the aperiodic change as this has invariably been very small.

220. The inequalities for the later period 1871 to 1905 derived from the magnetograph have been referred to and given in the previous chapter; and how far the two series run parallel and are comparable will be seen from the comparison of the inequalities given in table 179 by the two instruments, recorded simultaneously for the 12 months during the year 1872. The same quiet days which have been used in the comparison of force inequalities already referred to, have been employed in this discussion. The differences which appear in the same table in the last row show that the eye series by Grubb's is fairly closely comparable to that registered by the magnetograph and may be accepted to continue reliably the record of the diurnal inequalities back to the year 1848.

TABLE 167.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declination for each of the years 1848 to 1860 and for the whole period 1850 to 1860.*

Bombay Civil Time.	Year.													1850—1860
	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·27	+0·20	+0·21	+0·17	+0·26	+0·28	+0·37	+0·26	+0·23	+0·25	+0·27	+0·23	+0·16	+0·24
1 18	+ ·29	+ ·23	+ ·25	+ ·27	+ ·28	+ ·31	+ ·38	+ ·29	+ ·27	+ ·26	+ ·28	+ ·27	+ ·21	+ ·28
2 18	+ ·20	+ ·19	+ ·20	+ ·26	+ ·25	+ ·29	+ ·34	+ ·26	+ ·25	+ ·21	+ ·24	+ ·20	+ ·15	+ ·24
3 18	+ ·12	+ ·10	+ ·11	+ ·16	+ ·13	+ ·21	+ ·21	+ ·18	+ ·19	+ ·14	+ ·18	+ ·13	+ ·09	+ ·16
4 18	0	+ ·03	− ·02	+ ·09	+ ·05	+ ·15	+ ·12	+ ·1[illegible]	+ ·12	+ ·05	+ ·07	+ ·03	+ ·06	+ ·08
5 18	+ ·11	+ ·18	+ ·05	+ ·15	+ ·11	+ ·30	+ ·16	+ ·1[illegible]	+ ·16	+ ·12	+ ·16	+ ·18	+ ·27	+ ·16
6 18	+ ·78	+ ·83	+ ·61	+ ·63	+ ·59	+ ·79	+ ·57	+ ·56	+ ·52	+ ·56	+ ·69	+ ·84	+ ·97	+ ·67
7 18	+1·40	+1·36	+1·23	+1·24	+1·06	**+1·12**	+ ·90	+1·00	+ ·90	+1·01	+1·20	+1·46	+1·56	+1·15
8 18	**+1·64**	**+1·59**	**+1·49**	**+1·37**	**+1·18**	+1·07	**+1·02**	**+1·1[illegible]**	**+1·04**	**+1·16**	**+1·45**	**+1·81**	**+1·72**	**+1·31**
9 18	+1·12	+1·13	+1·12	+ ·92	+ ·76	+ ·55	+ ·56	+ ·72	+ ·64	+ ·72	+1·04	+1·22	+1·14	+ ·85
10 18	+ ·02	+ ·12	+ ·15	+ ·01	− ·02	− ·21	− ·27	− ·15	− ·17	− ·16	+ ·06	+ ·22	+ ·06	− ·04
11 18	−1·14	− ·98	− ·95	− ·99	− ·91	−1·22	−1·08	−1·00	−1·02	− ·90	−1·03	− ·75	−1·17	−1·00
12 18	**−1·68**	**−1·60**	**−1·52**	**−1·52**	**−1·38**	**−1·59**	**−1·42**	**−1·39**	**−1·33**	**−1·26**	**−1·55**	**−1·73**	**−1·71**	**−1·49**
13 18	−1·43	−1·40	−1·37	−1·33	−1·20	−1·31	−1·19	−1·21	−1·04	−1·09	−1·37	−1·63	−1·54	−1·30
14 18	− ·90	− ·89	− ·84	− ·78	− ·75	− ·80	− ·68	− ·75	− ·57	− ·69	− ·92	−1·15	−1·07	− ·82
15 18	− ·34	− ·34	− ·31	− ·20	− ·31	− ·20	− ·21	− ·28	− ·11	− ·24	− ·46	− ·52	− ·46	− ·30
16 18	+ ·04	− ·02	+ ·05	+ ·11	+ ·01	+ ·13	+ ·11	+ ·07	+ ·11	+ ·04	− ·13	− ·11	− ·04	+ ·03
17 18	− ·05	− ·06	+ ·02	+ ·03	+ ·04	+ ·17	+ ·06	+ ·07	+ ·04	− ·02	− ·09	− ·17	− ·06	+ ·01
18 18	− ·16	− ·23	− ·13	− ·13	− ·09	+ ·01	− ·09	− ·03	− ·09	− ·13	− ·13	− ·24	− ·14	− ·11
19 18	− ·18	− ·25	− ·19	− ·19	− ·14	− ·09	− ·14	− ·12	− ·16	− ·19	− ·12	− ·15	− ·10	− ·14
20 18	− ·14	− ·16	− ·14	− ·19	− ·10	− ·06	− ·09	− ·08	− ·14	− ·15	− ·09	− ·06	− ·10	− ·11
21 18	− ·12	− ·10	− ·07	− ·16	− ·04	0	+ ·01	− ·01	− ·04	− ·05	− ·01	− ·03	− ·08	− ·04
22 18	0	− ·03	+ ·02	− ·01	+ ·04	+ ·08	+ ·14	+ ·07	+ ·05	+ ·08	+ ·06	+ ·03	− ·03	+ ·05
23 18	+ ·15	+ ·12	+ ·15	+ ·09	+ ·16	+ ·21	+ ·24	+ ·18	+ ·16	+ ·20	+ ·20	+ ·18	+ ·09	+ ·17
Range...	3·32	3·19	3·01	2·89	2·56	2·71	2·44	2·52	2·37	2·42	3·00	3·54	3·43	2·80

TABLE 168.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declination for each of the years 1861 to 1872 and for the whole period 1861 to 1871.*

Bombay Civil Time.	Year.												1861—1871.
	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·17	+0·17	+0·22	+0·24	+0·25	+0·29	+0·24	+0·24	+0·22	+0·24	+0·30	+0·27	+0·23
1 18	+ ·22	+ ·21	+ ·27	+ ·29	+ ·28	+ ·31	+ ·26	+ ·25	+ ·28	+ ·29	+ ·35	+ ·32	+ ·27
2 18	+ ·23	+ ·21	+ ·25	+ ·27	+ ·26	+ ·23	+ ·26	+ ·24	+ ·30	+ ·32	+ ·30	+ ·34	+ ·27
3 18	+ ·14	+ ·16	+ ·18	+ ·22	+ ·18	+ ·15	+ ·18	+ ·20	+ ·25	+ ·27	+ ·23	+ ·24	+ ·20
4 18	+ ·08	+ ·07	+ ·09	+ ·14	+ ·12	+ ·05	+ ·08	+ ·14	+ ·17	+ ·23	+ ·22	+ ·14	+ ·13
5 18	+ ·24	+ ·21	+ ·21	+ ·20	+ ·13	+ ·03	+ ·10	+ ·18	+ ·28	+ ·42	+ ·40	+ ·29	+ ·22
6 18	+ ·90	+ ·76	+ ·64	+ ·65	+ ·58	+ ·33	+ ·48	+ ·63	+ ·78	+1·14	+1·04	+ ·99	+ ·72
7 18	+1·36	+1·18	+1·04	+1·02	+ ·98	+ ·74	+ ·80	+1·02	+1·18	+1·75	+1·56	+1·54	+1·14
8 18	**+1·45**	**+1·26**	**+1·10**	**+1·09**	**+ ·98**	**+ ·90**	**+ ·94**	**+1·09**	**+1·26**	**+1·77**	**+1·61**	**+1·61**	**+1·22**
9 18	+ ·93	+ ·85	+ ·67	+ ·73	+ ·46	+ ·58	+ ·60	+ ·69	+ ·89	+1·09	+1·03	+1·00	+ ·77
10 18	− ·14	− ·11	− ·11	− ·13	− ·38	− ·13	− ·20	− ·09	− ·24	− ·23	− ·10	− ·07	− ·17
11 18	−1·15	−1·09	−1·04	−1·03	−1·16	− ·83	− ·92	− ·92	−1·17	−1·44	−1·25	−1·18	−1·09
12 18	**−1·73**	**−1·50**	**−1·39**	**−1·44**	**−1·49**	**−1·2[illegible]**	**−1·26**	**−1·33**	**−1·62**	**−1·99**	**−1·79**	**−1·65**	**−1·52**
13 18	−1·52	−1·27	−1·25	−1·24	−1·19	− ·98	−1·11	−1·12	−1·30	−1·74	−1·62	−1·43	−1·30
14 18	− ·95	− ·73	− ·78	− ·77	− ·68	− ·57	− ·61	− ·72	− ·77	−1·13	−1·12	− ·90	− ·80
15 18	− ·31	− ·16	− ·28	− ·31	− ·12	− ·20	− ·17	− ·24	− ·21	− ·48	− ·50	− ·37	− ·27
16 18	+ ·10	+ ·19	+ ·11	+ ·02	+ ·16	+ ·08	+ ·11	+ ·02	+ ·07	− ·05	− ·06	− ·10	+ ·07
17 18	+ ·04	+ ·03	+ ·07	+ ·05	+ ·11	+ ·05	+ ·12	− ·01	+ ·01	− ·12	− ·07	− ·16	+ ·03
18 18	− ·08	− ·13	− ·01	− ·06	+ ·04	− ·02	+ ·02	− ·07	− ·07	− ·22	− ·21	− ·25	− ·07
19 18	− ·13	− ·16	− ·08	− ·12	− ·01	− ·04	− ·09	− ·15	− ·11	− ·16	− ·21	− ·25	− ·11
20 18	− ·08	− ·14	− ·09	− ·12	+ ·02	− ·06	− ·08	− ·15	− ·11	− ·13	− ·17	− ·25	− ·10
21 18	− ·06	− ·08	− ·02	− ·02	+ ·08	+ ·02	− ·01	− ·08	− ·07	− ·08	− ·11	− ·18	− ·04
22 18	− ·02	− ·02	+ ·02	+ ·06	+ ·12	+ ·10	+ ·08	+ ·02	+ ·03	+ ·03	+ ·02	− ·04	+ ·04
23 18	+ ·12	+ ·08	+ ·15	+ ·15	+ ·11	+ ·21	+ ·18	+ ·14	+ ·13	+ ·18	+ ·16	+ ·09	+ ·15
Range...	3·18	2·76	2·49	2·53	2·47	2·10	2·20	2·42	2·88	3·76	3·40	3·26	2·74

TABLE 169.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declination for the half-year (January to March and October to December) of each of the years 1848 to 1860 and for the whole period 1850 to 1860.*

Bombay Civil Time.	Year.													1850—1860.
	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·28	+0·16	+0·14	+0·08	+0·23	+0·27	+0·37	+0·24	+0·18	+0·20	+0·26	+0·27	+0·18	+0·22
1 18	+ ·22	+ ·13	+ ·14	+ ·19	+ ·16	+ ·21	+ ·30	+ ·18	+ ·12	+ ·12	+ ·16	+ ·21	+ ·14	+ ·18
2 18	+ ·11	+ ·06	− ·01	+ ·13	+ ·02	+ ·09	+ ·17	+ ·06	+ ·05	− ·03	+ ·05	+ ·10	+ ·05	+ ·06
3 18	− ·03	− ·10	− ·15	− ·01	− ·16	− ·08	− ·07	− ·09	− ·10	− ·17	− ·11	− ·06	− ·08	− ·10
4 18	− ·28	− ·34	− ·33	− ·18	− ·38	− ·29	− ·23	− ·25	− ·26	− ·32	− ·35	− ·29	− ·27	− ·29
5 18	− ·44	− ·44	− ·45	− ·32	− ·53	− ·40	− ·38	− ·41	− ·40	− ·46	− ·51	− ·41	− ·40	− ·42
6 18	− ·34	− ·36	− ·36	− ·23	− ·63	− ·49	− ·50	− ·37	− ·45	− ·47	− ·46	− ·38	− ·31	− ·42
7 18	− ·05	0	+ ·07	+ ·15	− ·32	− ·37	− ·34	− ·13	− ·17	− ·20	− ·15	+ ·03	+ ·02	− ·13
8 18	+ ·70	+ ·73	+ ·79	+ ·66	+ ·25	+ ·08	+ ·17	+ ·35	+ ·36	+ ·37	+ ·64	+ ·86	+ ·72	+ ·48
9 18	+ ·97	+1·12	+1·15	+ ·74	+ ·66	+ ·33	+ ·31	+ ·53	+ ·52	+ ·59	+1·10	+1·05	+1·09	+ ·73
10 18	+ ·39	+ ·72	+ ·62	+ ·23	+ ·53	+ ·11	+ ·03	+ ·08	+ ·15	+ ·20	+ ·65	+ ·64	+ ·66	+ ·35
11 18	− ·47	− ·11	− ·29	− ·47	+ ·01	− ·34	− ·49	− ·51	− ·50	− ·19	− ·20	− ·28	− ·20	− ·31
12 18	− ·70	− ·55	− ·77	− ·77	− ·30	− ·51	− ·64	− ·69	− ·57	− ·36	− ·59	− ·70	− ·50	− ·58
13 18	− ·37	− ·38	− ·60	− ·49	− ·17	− ·31	− ·38	− ·43	− ·22	− ·22	− ·36	− ·49	− ·37	− ·37
14 18	− ·05	− ·12	− ·19	− ·04	− ·01	0	− ·04	− ·09	+ ·08	− ·10	− ·10	− ·21	− ·11	− ·07
15 18	+ ·18	+ ·02	+ ·11	+ ·31	+ ·08	+ ·28	+ ·19	+ ·14	+ ·29	+ ·04	− ·02	0	− ·01	+ ·13
16 18	+ ·18	− ·01	+ ·17	+ ·33	+ ·15	+ ·32	+ ·28	+ ·27	+ ·26	+ ·14	− ·04	− ·08	+ ·01	+ ·16
17 18	− ·20	− ·23	− ·09	− ·04	+ ·01	+ ·19	+ ·13	+ ·14	+ ·07	+ ·02	− ·26	− ·41	− ·30	− ·05
18 18	− ·30	− ·34	− ·20	− ·20	− ·07	+ ·03	+ ·05	+ ·12	+ ·03	+ ·01	− ·21	− ·47	− ·39	− ·12
19 18	− ·06	− ·10	− ·03	− ·03	+ ·04	+ ·11	+ ·13	+ ·13	+ ·06	+ ·05	+ ·01	0	− ·05	+ ·04
20 18	0	− ·01	+ ·03	− ·04	+ ·10	+ ·16	+ ·18	+ ·14	+ ·07	+ ·07	+ ·03	+ ·12	0	+ ·08
21 18	+ ·01	− ·02	+ ·01	− ·09	+ ·08	+ ·17	+ ·22	+ ·16	+ ·12	+ ·13	+ ·08	+ ·06	− ·03	+ ·08
22 18	+ ·07	0	+ ·06	+ ·02	+ ·12	+ ·19	+ ·25	+ ·19	+ ·14	+ ·18	+ ·14	+ ·13	+ ·03	+ ·13
23 18	+ ·18	+ ·14	+ ·15	+ ·07	+ ·21	+ ·26	+ ·28	+ ·23	+ ·18	+ ·23	+ ·24	+ ·30	+ ·17	+ ·21
Range...	1·67	1·67	1·92	1·51	1·29	·84	1·01	1·22	1·09	1·06	1·69	1·75	1·59	1·31

TABLE 170.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declination for the half-year (January to March and October to December) of each of the years 1861 to 1872 and for the whole period 1861 to 1871.*

Bombay Civil Time.	Year.												1861—1871.
	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·21	+0·16	+0·19	+0·27	+0·25	+0·28	+0·26	+0·23	+0·27	+0·28	+0·35	+0·30	+0·25
1 18	+ ·15	+ ·13	+ ·19	+ ·21	+ ·18	+ ·21	+ ·18	+ ·17	+ ·24	+ ·26	+ ·36	+ ·27	+ ·21
2 18	+ ·09	+ ·08	+ ·08	+ ·10	+ ·06	+ ·02	+ ·10	+ ·06	+ ·17	+ ·28	+ ·24	+ ·20	+ ·12
3 18	− ·03	− ·01	− ·07	− ·03	− ·05	− ·16	− ·07	− ·06	+ ·06	+ ·14	+ ·05	− ·01	− ·02
4 18	− ·18	− ·19	− ·25	− ·21	− ·19	− ·32	− ·25	− ·22	− ·12	− ·04	− ·10	− ·25	− 19
5 18	− ·32	− ·30	− ·33	− ·37	− ·40	− ·47	− ·38	− ·34	− ·30	− ·15	− ·22	− ·39	− ·33
6 18	− ·25	− ·27	− ·39	− ·38	− ·33	− ·50	− ·41	− ·35	− ·36	0	− ·24	− ·22	− ·32
7 18	− ·03	− ·08	− ·23	− ·22	− ·13	− ·28	− ·33	− ·18	− ·22	+ ·43	+ ·08	+ ·17	− ·11
8 18	+ ·58	+ ·45	+ ·19	+ ·23	+ ·09	+ ·15	+ ·06	+ ·26	+ ·21	+ ·96	+ ·62	+ ·78	+ ·35
9 18	+ ·82	+ ·70	+ ·47	+ ·48	+ ·11	+ ·30	+ ·28	+ ·51	+ ·63	+1·01	+ ·92	+ ·95	+ ·57
10 18	+ ·38	+ ·26	+ ·16	+ ·21	− ·34	− ·03	− ·08	+ ·31	+ ·04	+ ·22	+ ·42	+ ·45	+ ·14
11 18	− ·43	− ·45	− ·43	− ·39	− ·84	− ·49	− ·51	− ·21	− ·51	− ·66	− ·40	− ·37	− ·48
12 18	− ·77	− ·74	− ·51	− ·62	− ·91	− ·65	− ·58	− ·50	− ·66	− ·95	− ·74	− ·62	− ·69
13 18	− 58	− ·46	− ·31	− ·34	− ·43	− ·30	− ·32	− ·32	− ·23	− ·67	− ·52	− ·35	− ·41
14 18	− ·23	− ·05	+ ·02	− ·06	+ ·06	+ ·03	+ ·09	− ·08	+ ·17	− ·32	− ·26	− ·04	− ·06
15 18	+ ·12	+ ·24	+ ·17	+ ·04	+ ·37	+ ·21	+ ·29	+ ·15	+ ·40	− ·04	− ·08	+ ·10	+ ·17
16 18	+ ·22	+ ·28	+ ·25	+ ·17	+ ·45	+ ·33	+ ·33	+ ·20	+ ·25	− ·01	− ·01	− ·02	+ ·22
17 18	− 09	− ·08	+ ·03	+ ·07	+ ·24	+ ·22	+ ·22	− ·02	− ·13	− ·50	− ·34	− ·36	− ·03
18 18	− ·19	− ·15	0	+ ·01	+ ·24	+ ·18	+ ·17	− ·04	− ·16	− ·54	− ·49	− ·43	− ·09
19 18	+ ·05	+ ·08	+ ·11	+ ·09	+ ·29	+ ·26	+ ·13	+ ·06	+ ·06	− ·13	− ·11	− ·14	+ ·08
20 18	+ ·14	+ ·06	+ ·14	+ ·11	+ ·29	+ ·21	+ ·15	+ ·03	+ ·07	− ·03	− ·02	− ·09	+ ·10
21 18	+ ·10	+ ·05	+ ·14	+ ·13	+ ·32	+ ·23	+ ·18	+ ·06	+ ·06	+ ·03	+ ·04	− ·10	+ ·12
22 18	+ ·07	+ ·07	+ ·12	+ ·17	+ ·31	+ ·27	+ ·23	+ ·13	+ ·12	+ 16	+ ·16	+ ·01	+ ·16
23 18	+ ·18	+ ·15	+ ·20	+ ·21	+ ·31	+ ·29	+ ·25	+ ·19	+ ·22	+ ·27	+ ·28	+ ·16	+ ·23
Range...	1·59	1·44	0·98	1·10	1·36	0·98	0·91	1·01	1·29	1·96	1·66	1·57	1·26

TABLE 171.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declination for the half-year (April to September) of each of the years 1848 to 1860 and for the whole period 1850 to 1860.*

Bombay Civil Time.	Year.													1850—1860.
	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·27	+0·24	+0·28	+0·27	+0·29	+0·31	+0·36	+0·29	+0·30	+0·30	+0·27	+0·20	+0·12	+0·27
1 18	+ ·36	+ ·33	+ ·35	+ ·35	+ ·40	+ ·42	+ ·47	+ ·41	+ ·40	+ ·38	+ ·39	+ ·33	+ ·26	+ ·38
2 18	+ ·30	+ ·32	+ ·42	+ ·39	+ ·47	+ ·49	+ ·52	+ ·47	+ ·45	+ ·47	+ ·44	+ ·31	+ ·27	+ ·43
3 18	+ ·27	+ ·31	+ ·37	+ ·33	+ ·42	+ ·51	+ ·48	+ ·45	+ ·47	+ ·45	+ ·46	+ ·31	+ ·24	+ ·41
4 18	+ ·30	+ ·39	+ ·29	+ ·35	+ ·48	+ ·60	+ ·46	+ ·52	+ ·50	+ ·44	+ ·50	+ ·36	+ ·40	+ ·45
5 18	+ ·67	+ ·80	+ ·55	+ ·61	+ ·77	+1·00	+ ·71	+ ·70	+ ·72	+ ·71	+ ·83	+ ·75	+ ·94	+ ·75
6 18	+1·92	+2·01	+1·59	+1·49	+1·82	+2·06	+1·64	+1·47	+1·49	+1·57	+1·85	+2·06	+2·26	+1·75
7 18	**+2·85**	**+2·72**	**+2·39**	**+2·33**	**+2·45**	**+2·61**	**+2·13**	**+2·13**	**+1·97**	**+2·22**	**+2·55**	**+2·90**	**+3·10**	**+2·43**
8 18	+2·57	+2·45	+2·19	+2·09	+2·13	+2·07	+1·87	+1·90	+1·72	+1·95	+2·25	+2·74	+2·72	+2·15
9 18	+1·28	+1·15	+1·11	+1·10	+ ·87	+ ·76	+ ·79	+ ·91	+ ·76	+ ·85	+1·00	+1·39	+1·21	+ ·98
10 18	− ·35	− ·50	− ·32	− ·21	− ·57	− ·53	− ·56	− ·39	− ·48	− ·52	− ·44	− ·19	− ·54	− ·43
11 18	−1·82	−1·86	−1·61	−1·51	−1·83	−2·11	−1·66	−1·50	−1·53	−1·62	−1·84	−1·21	−2·13	−1·69
12 18	**−2·66**	**−2·65**	**−2·23**	**−2·26**	**−2·45**	**−2·68**	**−2·20**	**−2·09**	**−2·09**	**−2·15**	**−2·51**	**−2·77**	**−2·93**	**−2·40**
13 18	−2·48	−2·42	−2·14	−2·17	−2·21	−2·37	−2·00	−1·99	−1·88	−1·96	−2·38	−2·77	−2·72	−2·24
14 18	−1·77	−1·67	−1·49	−1·53	−1·51	−1·60	−1·33	−1·42	−1·23	−1·29	−1·75	−2·08	−2·02	−1·57
15 18	− ·87	− ·72	− ·74	− ·72	− ·68	− ·67	− ·60	− ·72	− ·52	− ·53	− ·91	−1·05	− ·91	− ·73
16 18	− ·10	− ·03	− ·07	− ·10	− ·11	− ·06	− ·06	− ·12	− ·03	− ·05	− ·20	− ·13	− ·09	− ·09
17 18	+ ·11	+ ·12	+ ·15	+ ·12	+ ·06	+ ·16	− ·03	0	+ ·01	− ·06	+ ·08	+ ·06	+ ·20	+ ·07
18 18	− ·03	− ·12	− ·04	− ·05	− ·10	− ·01	− ·23	− ·18	− ·22	− ·28	− ·04	− ·02	+ ·13	− ·09
19 18	− ·30	− ·41	− ·34	− ·34	− ·32	− ·30	− ·39	− ·37	− ·39	− ·42	− ·26	− ·30	− ·14	− ·32
20 18	− ·29	− ·32	− ·31	− ·33	− ·30	− ·27	− ·36	− ·32	− ·35	− ·38	− ·23	− ·24	− ·20	− ·30
21 18	− ·24	− ·19	− ·16	− ·25	− ·17	− ·18	− ·20	− ·19	− ·21	− ·22	− ·11	− ·13	− ·14	− ·18
22 18	− ·07	− ·05	− ·01	− ·05	− ·03	− ·02	+ ·03	− ·05	− ·05	− ·03	− ·02	− ·05	− ·09	− ·03
23 18	+ ·12	+ ·09	+ ·15	+ ·12	+ ·11	+ ·16	+ ·21	+ ·12	+ ·14	+ ·15	+ ·15	+ ·05	+ ·01	+ ·12
Range...	5·51	5·37	4·67	4·59	4·90	5·29	4·33	4·22	4·06	4·37	5·06	5·67	6·03	4·83

TABLE 172.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declination for the half-year (April to September) of each of the years 1861 to 1872 and for the whole period 1861 to 1871.*

Bombay Civil Time.	Year.												1861—1871.
	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·14	+0·18	+0·24	+0·21	+0·26	+0·29	+0·22	+0·24	+0·17	+0·20	+0·25	+0·25	+0·22
1 18	+ ·30	+ ·29	+ ·36	+ ·37	+ ·39	+ ·40	+ ·35	+ ·34	+ ·32	+ ·32	+ ·33	+ ·38	+ ·34
2 18	+ ·37	+ ·34	+ ·42	+ ·43	+ ·46	+ ·45	+ ·41	+ ·41	+ ·42	+ ·35	+ ·35	+ ·48	+ ·40
3 18	+ ·33	+ ·33	+ ·44	+ ·46	+ ·41	+ ·46	+ ·43	+ ·46	+ ·43	+ ·40	+ ·39	+ ·49	+ ·41
4 18	+ ·35	+ ·34	+ ·43	+ ·48	+ ·43	+ ·41	+ ·41	+ ·51	+ ·45	+ ·51	+ ·55	+ ·53	+ ·44
5 18	+ ·80	+ ·71	+ ·75	+ ·76	+ ·66	+ ·51	+ ·59	+ ·72	+ ·85	+1·00	+1·03	+ ·98	+ ·76
6 18	+2·06	+1·80	+1·67	+1·67	+1·51	+1·17	+1·36	+1·61	+1·93	+2·27	+2·32	+2·19	+1·76
7 18	**+2·75**	**+2·45**	**+2·31**	**+2·26**	**+2·10**	**+1·76**	**+1·93**	**+2·22**	**+2·57**	**+3·08**	**+3·05**	**+2·92**	**+2·41**
8 18	+2·31	+2·06	+2·00	+1·94	+1·87	+1·65	+1·82	+1·94	+2·31	+2·58	+2·59	+2·44	+2·10
9 18	+1·06	+ ·98	+ ·87	+ ·99	+ ·82	+ ·87	+ ·92	+ ·86	+1·13	+1·18	+1·14	+1·04	+ ·98
10 18	− ·52	− ·48	− ·36	− ·47	− ·42	− ·25	− ·32	− ·49	− ·52	− ·65	− ·62	− ·59	− ·46
11 18	−1·86	−1·71	−1·65	−1·67	−1·47	−1·17	−1·34	−1·62	−1·83	−2·22	−2·09	−1·99	−1·69
12 18	**−2·70**	**−2·26**	**−2·27**	**−2·27**	**−2·08**	**−1·75**	**−1·93**	**−2·17**	**−2·58**	**−3·03**	**−2·84**	**−2·68**	**−2·35**
13 18	−2·46	−2·08	−2·19	−2·16	−1·94	−1·66	−1·90	−1·93	−2·38	−2·82	−2·73	−2·50	+2·20
14 18	−1·67	−1·42	−1·58	−1·49	−1·43	−1·18	−1·32	−1·36	−1·71	−1·95	−1·97	−1·74	−1·55
15 18	− ·75	− ·56	− ·73	− ·67	− ·61	− ·61	− ·64	− ·63	− ·81	− ·91	− ·93	− ·85	− ·71
16 18	− ·02	+ ·09	− ·03	− ·12	− ·14	− ·17	− ·11	− ·15	− ·12	− ·09	− ·11	− ·18	− ·09
17 18	+ ·16	+ ·15	+ ·12	+ ·02	− ·01	− ·11	+ ·02	+ ·01	+ ·15	+ ·26	+ ·20	+ ·05	+ ·09
18 18	+ ·02	− ·11	− ·02	− ·12	− ·17	− ·22	− ·14	− ·10	+ ·01	+ ·09	+ ·08	− ·07	− ·06
19 18	− ·32	− ·39	− ·28	− ·33	− ·32	− ·36	− ·32	− ·36	− ·28	− ·18	− ·30	− ·37	− ·31
20 18	− ·29	− ·36	− ·33	− ·34	− ·26	− ·34	− ·31	− ·33	− ·28	− ·22	− ·32	− ·41	− ·31
21 18	− ·21	− ·22	− ·18	− ·19	− ·16	− ·20	− ·19	− ·22	− ·21	− ·19	− ·26	− ·25	− ·20
22 18	− ·10	− ·11	− ·07	− ·05	− ·05	− ·06	− ·06	− ·08	− ·07	− ·08	− ·11	− ·10	− ·08
23 18	+ ·06	+ ·02	+ ·09	+ ·09	+ ·13	+ ·13	+ ·09	+ ·09	+ ·05	+ ·07	+ ·06	+ ·01	+ ·08
Range...	5·45	4·71	4·58	4·53	4·18	3·51	3·86	4·39	5·15	6·11	5·89	5·60	4·76

COLABA OBSERVATORY.
Declination Diurnal Inequality.
(Magnetometer.)

Plate 35

Govt. Photozinco: Office, Poona, 1909.

Colaba Observatory

Declination Diurnal Inequality

(Magnetometer.)

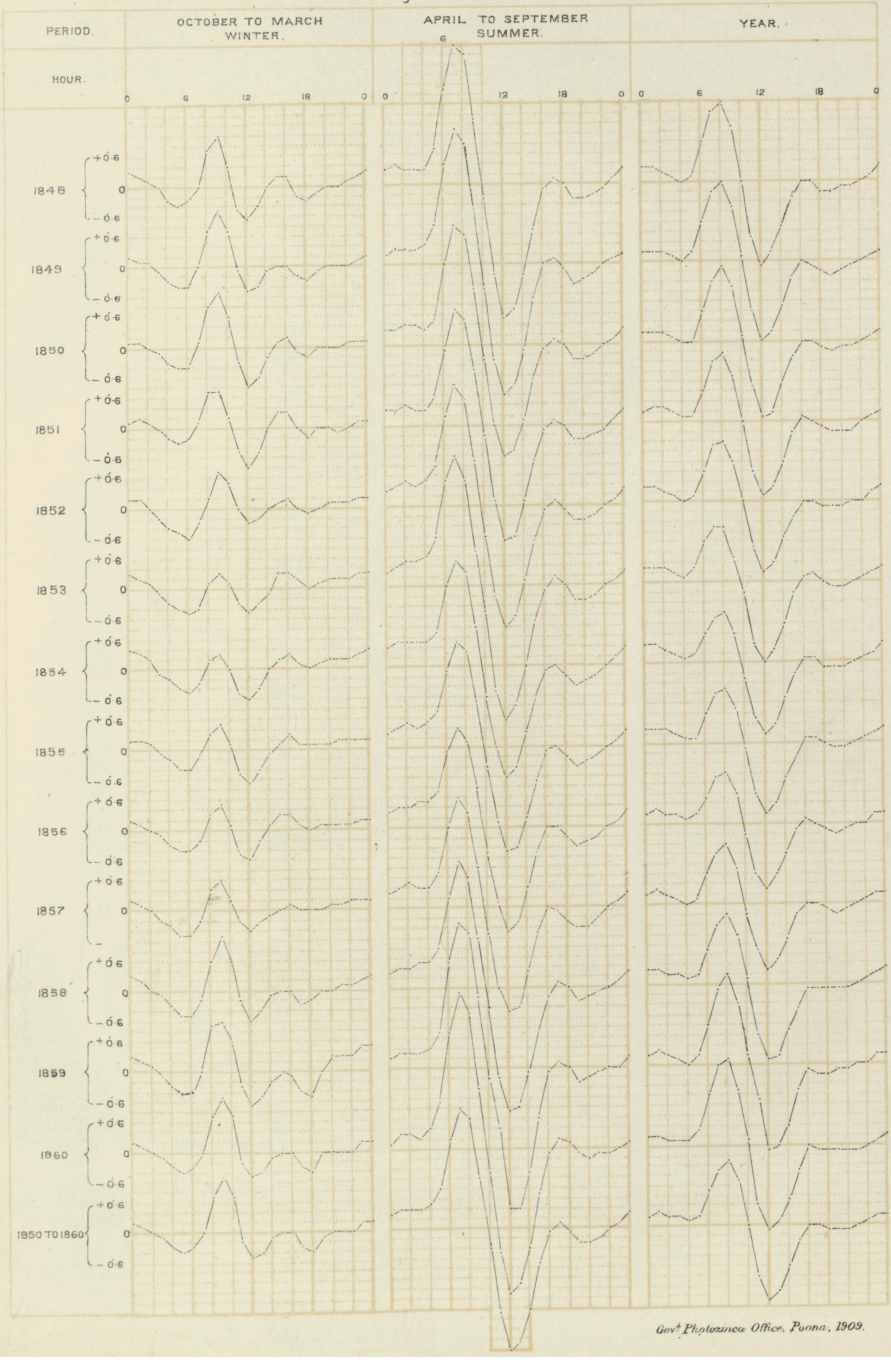
Plate 36.

Govt. Photozinco: Office, Poona, 1909.

Colaba Observatory

Declination Diurnal Inequality (Magnetometer)

Plate 37.

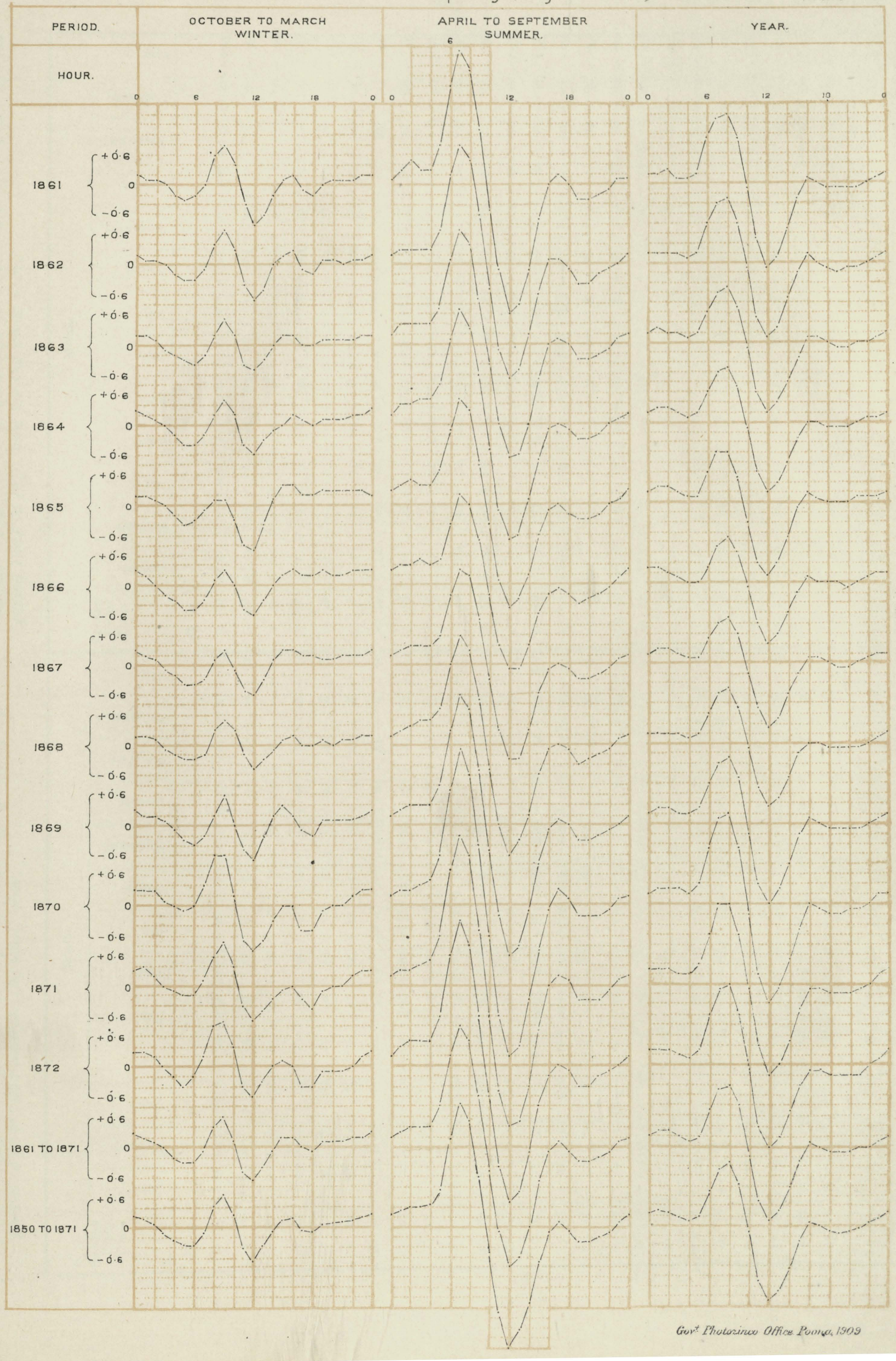


Govt. Photozinco Office, Poona, 1909.

Colaba Observatory

Declination Diurnal Inequality (Magnetometer)

Plate 38.



Govt. Photozinco Office Poona, 1909

TABLE 173.—*Grubb's Declination Magnetometer—showing mean diurnal inequality of Declination for each average month of the period 1850 to 1860 and for the whole year.*

Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·16	+0·20	+0·16	+0·34	+0·31	+0·27	+0·24	+0·20	+0·28	+0·33	+·028	+0·18	+0·25
1 18	+ ·09	+ ·15	+ ·14	+ ·45	+ ·39	+ ·41	+ ·40	+ ·32	+ ·33	+ ·30	+ ·27	+ ·10	+ ·28
2 18	– ·04	+ ·04	+ ·05	+ ·44	+ ·43	+ ·48	+ ·46	+ ·41	+ ·33	+ ·20	+ ·15	– ·01	+ ·24
3 18	– ·20	– ·10	– ·09	+ ·27	+ ·38	+ ·49	+ ·52	+ ·47	+ ·35	+ ·08	– ·07	– ·20	+ ·16
4 18	– ·43	– ·31	– ·23	+ ·22	+ ·42	+ ·54	+ ·62	+ ·57	+ ·37	– ·07	– ·29	– ·38	+ ·09
5 18	– ·66	– ·46	– ·31	+ ·26	+ ·76	+ ·90	+1·01	+1·00	+ ·69	– ·13	– ·45	– ·56	+ ·17
6 18	– ·77	– ·59	– ·11	+1·00	+1·86	+2·01	+2·04	+2·13	+1·64	+ ·20	– ·61	– ·65	+ ·68
7 18	– ·70	– ·46	+ ·64	+1·91	+2·47	+2·55	+2·51	+2·77	+2·54	+ ·95	– ·49	– ·73	+1·16
8 18	+ ·17	+ ·28	+1·33	+2·05	+2·19	+2·26	+2·13	+2·21	+2·13	+1·21	+ ·03	– ·15	+1·32
9 18	+1·06	+ ·84	+1·36	+1·34	+ ·95	+1·19	+ ·98	+ ·65	+ ·62	+ ·71	+ ·21	+ ·23	+ ·84
10 18	+ ·81	+ ·71	+ ·88	+ ·05	– ·61	– ·16	– ·35	– ·97	– ·88	– ·20	– ·07	– ·01	– ·07
11 18	+ ·02	+ ·16	– ·12	–1·31	–1·80	–1·51	–1·54	–2·12	–2·22	–1·10	– ·48	– ·36	–1·03
12 18	– ·28	– ·30	– ·95	–2·17	–2·41	–2·27	–2·14	–2·66	–2·91	–1·44	– ·25	– ·27	–1·50
13 18	– ·12	– ·29	–1·10	–2·08	–2·20	–2·23	–2·18	–2·41	–2·48	–1·07	+ ·22	+ ·16	–1·31
14 18	– ·06	– ·13	– ·69	–1·42	–1·51	–1·80	–1·72	–1·68	–1·41	– ·40	+ ·36	+ ·38	– ·83
15 18	+ ·01	– ·01	– ·05	– ·67	– ·74	–1·10	–1·00	– ·69	– ·22	– ·08	+ ·29	+ ·41	– ·32
16 18	+ ·14	+ ·03	+ ·09	– ·08	– ·17	– ·44	– ·42	– ·11	+ ·42	+ ·25	+ ·12	+ ·34	+ ·03
17 18	+ ·07	·05	– ·19	– ·02	+ ·04	– ·13	– ·11	+ ·33	+ ·30	– ·14	– ·10	+ ·13	+ ·01
18 18	– ·02	– ·20	– ·41	– ·20	– ·08	– ·16	– ·08	+ ·07	– ·11	– ·24	– ·02	+ ·19	– ·10
19 18	+ ·17	+ ·03	– ·31	– ·35	– ·38	– ·45	– ·43	– ·24	– ·09	– ·09	+ ·12	+ ·30	– ·14
20 18	+ ·16	+ ·09	– ·17	– ·23	– ·31	– ·44	– ·51	– ·27	– ·04	0	+ ·12	+ ·28	– ·11
21 18	+ ·15	+ ·09	– ·09	– ·08	– ·15	– ·30	– ·36	– ·17	0	+ ·03	+ ·13	+ ·19	– ·05
22 18	+ ·15	+ ·08	00	+ ·07	– ·01	– ·13	– ·15	– ·08	+ ·09	+ ·18	+ ·18	+ ·20	+ ·05
23 18	+ ·19	+ ·14	+ ·11	+ ·22	+ ·16	+ ·08	+ ·05	+ ·06	+ ·17	+ ·32	+ ·30	+ ·23	+ ·17
Range ...	1·83	1·43	2·46	4·22	4·88	4·82	4·69	5·43	5·45	2·65	·97	1·14	2·82

TABLE 174.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declinatian for each average month of the period 1861 to 1871 and for the whole year.*

Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·21	+0·25	+0·14	+0·34	+0·21	+0·25	+0·16	+0·16	+0·21	+0·28	+0·34	+0·27	+0·23
1 18	+ ·15	+ ·24	+ ·16	+ ·42	+ ·35	+ ·40	+ ·33	+ ·25	+ ·29	+ ·23	+ ·28	+ ·21	+ ·28
2 18	+ ·04	+ ·20	+ ·12	+ ·46	+ ·41	+ ·50	+ ·44	+ ·31	+ ·31	+ ·14	+ ·14	+ ·06	+ ·26
3 18	– ·11	+ ·05	+ ·03	+ ·34	+ ·39	+ ·52	+ ·49	+ ·40	+ ·33	+ ·05	– ·04	– ·10	+ ·20
4 18	– ·31	– ·14	– ·05	+ ·20	+ ·46	+ ·59	+ ·57	+ ·51	+ ·32	– ·05	– ·26	– ·32	+ ·13
5 18	– ·48	– ·32	– ·05	+ ·32	+ ·78	+1·02	+1·00	+ ·93	+ ·56	– ·13	– ·48	– ·49	+ ·22
6 18	– ·66	– ·39	+ ·19	+1·06	+1·77	+2·09	+2·06	+2·06	+1·53	+ ·22	– ·62	– ·63	+ ·72
7 18	– ·64	– ·29	+ ·85	+1·90	+2·31	+2·58	+2·52	+2·74	+2·37	+ ·85	– ·61	– ·80	+1·15
8 18	00	+ ·26	+1·34	+2·04	+2·04	+2·31	+2·08	+2·19	+2·00	+1·03	– ·18	– ·40	+1·23
9 18	+ ·63	+ ·65	+1·30	+1·45	+ ·85	+1·22	+ ·95	+ ·71	+ ·71	+ ·54	+ ·08	+ ·06	+ ·76
10 18	+ ·39	+ ·42	+ ·60	+ ·13	– ·59	– ·25	– ·36	– ·89	– ·83	– ·40	– ·11	– ·06	– ·16
11 18	– ·29	– ·15	– ·43	–1·28	–1·69	–1·53	–1·55	–1·98	–2·13	–1·27	– ·45	– ·34	–1·09
12 18	– ·44	– ·52	–1·17	–2·10	–2·26	–2·30	–2·13	–2·55	–2·77	–1·49	– ·27	– ·28	–1·52
13 18	– ·15	– ·37	–1·24	–2·04	–2·02	–2·33	–2·14	–2·35	–2·32	–1·03	+ ·22	+ ·16	–1·30
14 18	+ ·01	– ·14	– ·72	–1·45	–1·36	–1·87	–1·68	–1·68	–1·29	– ·24	+ ·38	+ ·39	– ·80
15 18	+ ·18	– ·01	– ·11	– ·68	– ·64	–1·14	– ·93	– ·77	– ·13	+ ·36	+ ·28	+ ·42	– ·26
16 18	+ ·30	+ ·06	+ ·07	– ·17	– ·08	– ·47	– ·27	+ ·02	+ ·45	+ ·44	+ ·12	+ ·35	+ ·07
17 18	+ ·07	– ·11	– ·21	– ·13	+ ·13	– ·13	– ·02	+ ·37	+ ·31	– ·05	– ·07	+ ·13	+ ·02
18 18	+ ·01	– ·21	– ·40	– ·30	– ·01	– ·14	– ·09	+ ·20	– ·03	– ·11	+ ·05	+ ·15	– ·07
19 18	+ ·22	+ ·02	– ·23	– ·38	– ·39	– ·46	– ·45	– ·15	– ·06	+ ·05	+ ·19	+ ·25	– ·12
20 18	+ ·24	+ ·07	– ·16	– ·24	– ·39	– ·46	– ·51	– ·22	– ·03	+ ·07	+ ·19	+ ·23	– ·10
21 18	+ ·22	+ ·09	– ·09	– ·08	– ·26	– ·32	– ·39	– ·18	+ ·02	+ ·08	+ 20	+ ·23	– ·04
22 18	+ ·21	+ ·14	– ·03	+ ·05	– ·09	– ·15	– ·22	– ·12	+ ·04	+ ·18	+ ·25	+ ·25	+ ·04
23 18	+ ·23	+ ·20	+ ·08	+ ·19	+ ·08	+ ·06	– ·02	+ ·03	+ ·15	+ ·27	+ ·35	+ ·26	+ ·16
Range ..	1·29	1·17	2·58	4·14	4·57	4·91	4·66	5·29	5·14	2·52	1·00	1·22	2·75

TABLE 175.—*Grubb's Declination Magnetometer—showing the mean diurnal inequaility of Declination for each average month of the maximum sun spot years 1848, 1849, 1859, 1860, 1861, 1870, 1871 and 1872 and for the whole year.*

Bombay Civil Time.	Month.												Year.
	January.	F bruary.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
H. m	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·16	+0·27	+0·14	+0·35	+0·25	+0·23	+0·08	+0·11	+0·24	+0·31	+0·36	+0·29	+0·23
1 18	+ ·12	+ ·27	+ ·12	+ ·44	+ ·34	+ ·33	+ ·25	+ ·25	+ ·35	+ ·30	+ ·28	+ ·24	+ ·27
2 18	+ ·03	+ ·22	+ ·06	+ ·39	+ ·32	+ ·39	+ ·32	+ ·31	+ ·34	+ ·24	+ ·22	+ ·08	+ ·24
3 18	− ·12	+ ·05	− ·07	+ ·22	+ ·28	+ ·42	+ ·40	+ ·38	+ ·37	+ ·10	+ ·04	− ·10	+ ·16
4 18	− ·31	− ·20	− ·21	+ ·11	+ ·38	+ ·51	+ ·58	+ ·57	+ ·39	− ·05	− ·23	− ·31	+ ·10
5 18	− ·49	− ·43	− ·19	+ ·28	+ ·87	+1·03	+1·15	+1·18	+ ·72	− ·05	− ·45	− ·48	+ ·26
6 18	− **·58**	− ·49	+ ·25	+1·20	+2·18	+2·32	+2·50	+2·65	+1·97	+ ·49	− **·62**	− ·63	+ ·94
7 18	− ·47	− ·27	+1·25	+2·29	+**2·84**	+**2·90**	+**3·02**	+**3·44**	+**3·01**	+1·33	− ·49	− **·86**	+1·50
8 18	+ ·46	+ ·63	+**1·98**	+**2·45**	+2·49	+2·59	+2·45	+2·70	+2·62	+**1·52**	+ ·16	− ·29	+**1·65**
9 18	+**1·31**	+**1·23**	+1·72	+1·72	+1·05	+1·39	+1·07	+ ·83	+1·02	+ ·90	+ **·46**	+ ·32	+1·08
10 18	+ ·91	+1·02	+ ·88	+ ·25	− ·68	− ·25	− ·44	−1·07	− ·82	− ·22	+ ·11	+ ·23	− ·01
11 18	− ·14	+ ·19	− ·44	−1·35	−2·02	−1·76	−1·89	−2·37	−2·35	−1·32	− ·39	− ·09	−1·16
12 18	− ·47	− ·38	−1·36	−**2·35**	−**2·72**	−**2·65**	−2·55	−**3·18**	−**3·26**	−**1·65**	− ·20	− ·08	−**1·74**
13 18	− ·31	− ·38	−**1·44**	−2·29	−2·41	−2·62	−**2·56**	−2·96	−2·84	−1·22	+ ·27	+ ·27	−1·54
14 18	− ·19	− ·28	− ·85	−1·73	−1·64	−2·08	−1·96	−2·07	−1·66	− ·47	+ ·37	+ **·41**	−1·01
15 18	+ ·06	− ·28	− ·20	− ·93	− ·75	−1·25	−1·09	− ·87	− ·36	+ ·13	+ ·21	+ ·36	− ·41
16 18	+ ·20	− ·24	0	− ·26	− ·08	− ·44	− ·31	+ ·16	+ ·37	+ ·14	− ·06	+ ·18	− ·03
17 18	− ·16	− ·40	− ·36	− ·14	+ ·18	+ ·02	+ ·09	+ ·50	+ ·19	− ·37	− ·38	− ·20	− 0·9
18 18	− ·35	− **·57**	− ·66	− ·31	+ ·10	+ ·11	+ ·12	+ ·25	− ·21	− ·43	− ·20	− ·16	− ·19
19 18	+ ·04	− ·14	− ·34	− ·37	− ·40	− ·36	− ·29	− ·18	− ·15	− ·10	0	+ ·13	− ·17
20 18	+ ·09	0	− ·16	− ·21	− ·37	− ·40	− ·47	− ·25	− ·03	+ ·01	+ ·01	+ ·13	− ·14
21 18	+ ·04	+ ·01	− ·13	− ·07	− ·21	− ·29	− ·35	− ·21	− ·07	0	+ ·04	+ ·12	− ·09
22 18	+ ·06	+ ·03	− ·06	+ ·08	− ·05	− ·15	− ·23	− ·16	0	+ ·15	+ ·13	+ ·18	0
23 18	+ ·12	+ ·13	+ ·09	+ ·23	+ ·10	+ ·05	− ·10	− ·04	+ ·12	+ ·28	+ ·35	+ ·29	+ ·13
Range ...	1·89	1·80	3·42	4·80	5·56	5·55	5·58	6·62	6·30	3·17	1·08	1·27	3·39

TABLE 176.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declintion for each average month of the minimum sun spot years 1854, 1855, 1856, 1866 and 1867 and for the whole year.*

Bombay Civil Time.	Month.												Year.
	January.	F.bruary.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·25	+0·32	+0·18	+0·31	+0·31	+0·30	+0·23	+0·28	+0·33	+0·28	+0·36	+0·20	+0·28
1 18	+ ·09	+ ·22	+ ·21	+ ·37	+ ·42	+ ·46	+ ·40	+ ·41	+ ·38	+ ·28	+ ·29	+ ·10	+ ·30
2 18	− ·03	+ ·11	+ ·15	+ ·37	+ ·49	+ ·54	+ ·50	+ ·48	+ ·37	+ ·15	+ ·11	− ·02	+ ·27
3 18	− ·19	− ·09	+ ·03	+ ·27	+ ·51	+ ·53	+ ·53	+ ·52	+ ·39	+ ·04	− ·15	− ·25	+ ·18
4 18	− ·41	− ·31	− ·05	+ ·22	+ ·49	+ ·55	+ ·59	+ ·57	+ ·37	− ·02	− ·32	− ·44	+ ·10
5 18	− ·64	− ·44	− ·13	+ ·21	+ ·73	+ ·78	+ ·82	+ ·81	+ ·54	− ·13	− ·56	− ·55	+ ·12
6 18	− **·71**	− ·59	− ·01	+ ·84	+1·55	+1·60	+1·64	+1·66	+1·27	+ ·07	− **·71**	− ·62	+ ·49
7 18	− ·63	− **·62**	+ ·54	+1·68	+**2·04**	+**2·08**	+**2·03**	+**2·14**	+**1·92**	+ ·63	− ·66	− **·76**	+ ·87
8 18	+ ·19	− ·02	+ ·99	+**1·87**	+1·81	+1·95	+1·79	+1·74	+1·57	+ **·79**	− ·28	− ·35	+**1·01**
9 18	+ **·77**	+ ·49	+**1·02**	+1·35	+ ·78	+1·17	+ ·94	+ ·51	+ ·35	+ ·29	− ·14	− ·10	+ ·62
10 18	+ ·38	+ **·58**	+ ·36	+ ·17	− ·54	+ ·02	− ·17	− ·83	−1·05	− ·53	− ·33	− ·27	− ·18
11 18	− ·34	+ ·08	− ·48	−1·06	−1·45	−1·08	−1·21	−1·71	−2·16	−1·26	− ·52	− ·49	− ·97
12 18	− ·65	− ·27	−**1·05**	−**1·88**	−**1·90**	−1·81	−1·74	−**2·14**	−**2·61**	−**1·40**	− ·18	− ·21	−**1·32**
13 18	− ·37	− ·27	−1·05	−1·86	−1·79	−**1·82**	−**1·77**	−1·96	−2·09	− ·92	+ ·30	+ ·33	−1·11
14 18	− ·15	− ·08	− ·55	−1·32	−1·23	−1·50	−1·39	−1·30	−1·04	− ·14	+ **·47**	+ **·6**	− ·64
15 18	+ ·10	0	+ ·01	− ·64	− ·67	−1·00	− ·85	− ·57	+ ·02	+ ·38	+ ·38	+ ·51	− ·19
16 18	+ ·38	+ ·04	+ ·14	− ·10	− ·19	− ·52	− ·37	− ·01	+ ·59	+ ·49	+ ·27	+ ·44	+ ·10
17 18	+ ·32	+ ·04	− ·03	− ·06	− ·10	− ·32	− ·20	+ ·15	+ ·39	+ ·15	+ ·15	+ ·30	+ ·07
18 18	+ ·24	+ ·04	− ·16	− ·22	− ·30	− ·40	− ·24	− ·05	+ ·02	+ ·03	+ ·20	+ ·31	− ·04
19 18	+ ·34	+ ·12	− ·17	− ·35	− ·46	− ·60	− ·51	− ·24	− ·01	+ ·06	+ ·22	+ ·28	− ·11
20 18	+ ·30	+ ·11	− ·11	− ·27	− ·37	− ·52	− ·53	− ·29	− ·02	+ ·11	+ ·22	+ ·29	− ·09
21 18	+ ·32	+ ·16	− ·02	− ·08	− ·20	− ·36	− ·40	− ·18	+ ·03	+ ·15	+ ·23	+ ·26	− ·01
22 18	+ ·29	+ ·21	+ ·07	+ ·05	− ·08	− ·13	− ·17	− ·06	+ ·16	+ ·21	+ ·29	+ ·26	+ ·09
23 18	+ ·26	+ ·22	+ ·13	+ ·20	+ ·15	+ ·09	+ ·02	+ ·13	+ ·23	+ ·30	+ ·34	+ ·26	+ ·19
Range ...	1·56	1·20	2·07	3·75	3·94	3·90	3·80	4·28	4·53	2·19	1·18	1·32	2·33

TABLE 177.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declination for each average month of the periods 1848 to 1872 and for the whole year.*

Bombay Civil Time.	Month. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·18	+0·24	+0·15	+0·34	+0·27	+0·25	+0·19	+0·17	+0·26	+0·31	+0·32	+0·22	+0·24
1 18	+ ·12	+ ·20	+ ·14	+ ·43	+ ·37	+ ·39	+ ·36	+ ·29	+ ·32	+ ·27	+ ·26	+ ·16	+ ·28
2 18	0	+ ·14	+ ·08	+ ·44	+ ·42	+ ·47	+ ·44	+ ·37	+ ·33	+ ·18	+ ·15	+ ·03	+ ·26
3 18	− ·16	− ·01	− ·04	+ ·29	+ ·38	+ ·48	+ ·50	+ ·44	+ ·34	+ ·06	− ·05	− ·14	+ ·17
4 18	− ·37	− ·23	− ·16	+ ·19	+ ·44	+ ·54	+ ·60	+ ·55	+ ·35	− ·07	− ·28	− ·35	+ ·10
5 18	− ·57	− ·40	− ·18	+ ·28	+ ·79	+ ·95	+1·01	+ ·98	+ ·63	− ·13	− ·48	− ·52	+ ·20
6 18	− **·71**	− **·49**	+ ·07	+1·04	+1·87	+2·05	+2·10	+2·15	+1·61	+ ·23	− **·63**	− ·64	+ ·72
7 18	− ·64	− ·37	+ ·83	+1·95	**+2·44**	**+2·58**	**+2·57**	**+2·81**	**+2·52**	+ ·94	− ·55	− **·77**	+1·19
8 18	+ ·13	+ ·32	**+1·43**	**+2·09**	+2·15	+2·30	+2·14	+2·25	+2·14	**+1·15**	− ·05	− ·27	**+1·31**
9 18	+ **·92**	+ **·82**	+1·38	+1·42	+ ·91	+1·23	+ ·97	+ ·70	+ ·77	+ ·65	+ ·16	+ ·17	+ ·84
10 18	+ ·69	+ ·64	+ ·74	+ ·11	− ·62	− ·20	− ·37	− ·94	− ·84	− ·29	− ·08	− ·01	− ·10
11 18	− ·09	+ ·04	− ·32	−1·29	−1·79	−1·52	−1·59	−2·07	−2·20	−1·18	− ·46	− ·34	−1·07
12 18	− ·36	− ·40	−1·12	**−2·14**	**−2·39**	**−2·29**	−2·19	**−2·64**	**−2·89**	**−1·46**	− ·25	− ·25	**−1·53**
13 18	− ·16	− ·33	**−1·21**	−2·06	−2·14	−2·29	**−2·21**	−2·41	−2·45	−1·05	+ ·25	+ ·18	−1·32
14 18	− ·07	− ·14	− ·67	−1·45	−1·44	−1·84	−1·72	−1·69	−1·38	− ·32	+ **·40**	+ ·41	− ·83
15 18	+ ·07	− ·04	− ·08	− ·70	− ·69	−1·12	− ·97	− ·74	− ·20	+ ·23	+ ·31	+ **·43**	− ·29
16 18	+ ·20	+ ·01	+ ·08	− ·14	− ·11	− ·44	− ·34	+ ·06	+ ·42	+ ·30	+ ·12	+ ·33	+ ·04
17 18	+ ·05	− ·13	− ·21	− ·08	+ ·09	− ·12	− ·05	+ ·35	+ ·28	− ·14	− ·10	+ ·09	0
18 18	− ·05	− ·25	− ·43	− ·26	− ·06	− ·12	− ·06	+ ·12	− ·09	− ·21	+ ·01	+ ·13	− ·11
19 18	+ ·17	·00	− ·28	− ·37	− ·40	− ·45	− ·42	− ·22	− ·09	− ·03	+ ·14	+ ·26	− ·14
20 18	+ ·19	+ ·05	− ·17	− ·24	− ·37	− ·45	− ·50	− ·26	− ·04	+ ·03	+ ·14	+ ·24	− ·11
21 18	+ ·17	+ ·06	− ·10	− ·09	− ·21	− ·31	− ·36	− ·19	0	+ ·05	+ ·15	+ ·19	− ·05
22 18	+ ·16	+ ·09	− ·02	+ ·06	− ·04	− ·14	− ·18	− ·11	+ ·06	+ ·17	+ ·21	+ ·21	+ ·04
23 18	+ ·20	+ ·16	+ ·10	+ ·21	+ ·12	+ ·06	− ·02	+ ·03	+ ·16	+ ·28	+ ·32	+ ·24	+ ·15
Range.	1·63	1·31	2·64	4·23	4·83	4·87	4·78	5·45	5·41	2·61	1·03	1·20	2·84

TABLE 178.—*Grubb's Declination Magnetometer—showing the mean diurnal inequality of Declination for each average month of the periods 1850 to 1871 and for the whole year.*

Bombay Civil Time.	Month. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Summer means.	Winter means.
H. m.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
0 18	+0·19	+0·22	+0·15	+0·34	+0·26	+0·26	+0·20	+0·18	+0·25	+0·31	+0·31	+0·22	+0·24	+ 25	+23
1 18	+ ·12	+ ·19	+ ·15	+ ·43	+ ·37	+ ·41	+ ·36	+ ·29	+ ·31	+ ·26	+ ·27	+ ·15	+ ·28	+ 36	+19
2 18	0	+ ·12	+ ·09	+ ·46	+ ·42	+ ·49	+ ·45	+ ·37	+ ·32	+ ·17	+ ·15	+ ·02	+ ·25	+ 42	+ 9
3 18	− ·15	− ·02	− ·03	+ ·31	+ ·39	+ ·50	+ ·51	+ ·44	+ ·34	+ ·06	− ·06	− ·15	+ ·18	+ 41	− 6
4 18	− 37	− ·23	− ·14	+ ·21	+ ·44	+ ·56	+ ·60	+ ·54	+ ·35	− ·06	− ·28	− ·35	+ ·11	+ 45	−24
5 18	− ·57	− ·39	− ·18	+ ·29	+ ·78	+ ·95	+1·00	+ ·96	+ ·62	− ·13	− ·47	− ·52	+ ·19	+ 77	38
6 18	− **·71**	− **·49**	+ ·04	+1·03	+1·82	+2·05	+2·05	+2·10	+1·58	+ ·20	− **·62**	− ·65	+ ·70	+177	−37
7 18	− ·68	− ·37	+ ·75	+1·91	**+2·39**	**+2·57**	**+2·52**	**+2·75**	**+2·46**	+ ·90	− ·55	− **·76**	+1·16	**+245**	−12
8 18	+ ·09	+ ·27	+1·33	**+2·04**	+2·11	+2·28	+2·11	+2·20	+2·07	**+1·12**	− ·07	− ·28	**+1·27**	+213	+41
9 18	+ **·84**	+ **·75**	**+1·33**	+1·39	+ ·91	+1·21	+ ·97	+ ·68	+ ·71	+ ·62	+ ·15	+ ·14	+ ·81	+ 98	+6[illegible]
10 18	+ ·59	+ ·56	+ ·75	+ ·10	− ·60	− ·21	− ·35	− ·94	− ·86	− ·30	− ·08	− ·04	− ·11	− 48	+2[illegible]
11 18	− ·14	0	− ·28	−1·29	−1·75	−1·52	−1·54	−2·05	−2·17	−1·18	− ·46	− ·36	−1·06	−172	−40
12 18	− ·36	− ·40	−1·07	**−2·14**	**−2·33**	**−2·28**	−2·13	**−2·61**	**−2·84**	**−1·46**	− ·26	− ·27	**−1·51**	**−239**	−6[illegible]
13 18	− ·14	− ·33	**−1·17**	−2·06	−2·10	−2·28	**−2·16**	−2·38	−2·41	−1·05	+ ·22	+ ·16	−1·31	−223	−38
14 18	− ·03	− ·14	− ·66	−1·43	−1·43	−1·83	−1·70	−1·67	−1·35	− ·31	+ **·37**	+ ·39	− ·82	−157	− 6
15 18	+ ·09	− ·01	− ·08	− ·68	− ·69	−1·12	− ·96	− ·73	− ·17	+ ·25	+ ·29	+ **·41**	− ·28	− 72	+16
16 18	+ ·22	+ ·05	+ ·08	− ·12	− ·13	− ·45	− ·34	+ ·06	+ ·44	+ ·34	+ ·13	+ ·34	+ ·05	− 9	+19
17 18	+ ·07	− ·09	− ·20	− ·07	+ ·08	− ·13	− ·07	+ ·35	+ ·30	− ·09	− ·09	+ ·12	+ ·01	+ 8	− 5
18 18	− ·01	− ·21	− ·41	− ·25	− ·05	− ·15	− ·08	+ ·13	− ·07	− ·18	+ ·02	+ ·17	− ·09	− 8	−10
19 18	+ ·19	+ ·03	− ·27	− ·36	− ·38	− ·46	− ·44	− ·20	− ·08	− ·02	+ ·16	+ ·28	− ·13	− 32	+ 6
20 18	+ ·20	+ ·08	− ·16	− ·24	− ·36	− ·45	− 51	− ·24	− ·04	+ ·03	+ ·16	+ ·26	− ·11	− 31	+ 9
21 18	+ ·19	+ ·09	− ·09	− ·08	− ·21	− ·31	− ·37	− ·17	+ ·01	+ ·06	+ ·17	+ ·21	− ·04	− 19	+10
22 18	+ ·18	+ ·11	− ·03	+ ·06	− ·05	− ·14	− ·18	− ·10	+ ·07	+ ·18	+ ·22	+ ·22	+ ·04	− 6	+15
23 18	+ ·21	+ ·17	− ·06	+ ·21	+ ·11	+ ·07	− ·02	+ ·05	+ ·16	+ ·29	+ ·32	+ ·25	+ ·15	+ 10	+20
Range.	1·55	1·24	2·50	4·18	4·72	4·85	4·68	5·36	5·30	2·58	·99	1·17	2·78	4·82	1·28

TABLE 179.—*Showing the comparison of the Diurnal Inequalities given by*
determined from the selected

			0	1	2	3	4	5	6	7	8	9
July.	1	Diurnal Inequality by Magnetograph	+0·2	+0·2	+0·5	+0·5	+0·5	+1·0	+2·2	+2·7	+2·3	+1·1
	2	Diurnal Inequality corrected for P. change	+0·1	+0·2	+0·4	+0·4	+0·5	+0·9	+2·2	+2·7	+2·3	+1·1
	3	Diurnal Inequality by Grubb's Magnetometer	+0·2	+0·3	+0·5	+0·5	+0·6	+0·9	+2·1	+2·7	+2·4	+1·2
	4	Diurnal Inequality corrected for P. change	+0·1	+0·2	+0·4	+0·4	+0·5	+0·9	+2·1	+2·7	+2·4	+1·2
	5	Diurnal Inequality corrected to 18 minutes past the hour ...	+0·1	+0·2	+0·4	+0·4	+0·6	+1·0	+2·2	+2·7	+2·3	+1·1
	6	Excess Diurnal Inequality ...	0·0	0·0	0·0	0·0	+0·1	+0·1	0·0	0·0	0·0	0·0
August.	1	Diurnal Inequality by Magnetograph	0·0	+0·1	+0·2	+0·3	+0·4	+0·9	+2·4	+3·3	+2·8	+1·2
	2	Diurnal Inequality corrected for P. change	−0·1	+0·1	+0·2	+0·2	+0·4	+0·9	+2·4	+3·2	+2·8	+1·2
	3	Diurnal Inequality by Grubb's Magnetometer	0·0	+0·2	+0·2	+0·4	+0·5	+0·9	+2·3	+3·3	+2·9	+1·2
	4	Diurnal Inequality corrected for P. change	0·0	+0·1	+0·2	+0·3	+0·4	+0·8	+2·3	+3·3	+2·9	+1·2
	5	Diurnal Inequality corrected to 18 minutes past the hour ...	0·0	+0·1	+0·2	+0·3	+0·5	+1·0	+2·4	+3·2	+2·7	+1·0
	6	Excess Diurnal Inequality ...	+0·1	0·0	0·0	+0·1	+0·1	+0·1	0·0	0·0	−0·1	−0·2
September.	1	Diurnal Inequality by Magnetograph	+0·5	+0·5	+0·5	+0·4	+0·4	+0·7	+2·0	+3·3	+3·1	+1·6
	2	Diurnal Inequality corrected for P. change	+0·5	+0·5	+0·5	+0·4	+0·4	+0·7	+2·0	+3·3	+3·1	+1·6
	3	Diurnal Inequality by Grubb's Magnetometer	+0·5	+0·4	+0·6	+0·5	+0·4	+0·7	+1·9	+3·2	+3·2	+1·8
	4	Diurnal Inequality corrected for P. change	+0·5	+0·4	+0·6	+0·5	+0·4	+0·6	+1·9	+3·2	+3·2	+1·8
	5	Diurnal Inequality corrected to 18 minutes past the hour ...	+0·5	+0·4	+0·6	+0·5	+0·4	+0·8	+2·0	+3·2	+3·1	+1·6
	6	Excess Diurnal Inequality ...	0·0	−0·1	+0·1	+0·1	0·0	+0·1	0·0	−0·1	0·0	0·0
October.	1	Diurnal Inequality by Magnetograph	+0·2	+0·3	+0·4	+0·2	0·0	0·0	+0·7	+1·7	+1·7	+1·0
	2	Diurnal Inequality corrected for P. change	+0·2	+0·3	+0·3	+0·2	0·0	−0·1	+0·6	+1·7	+1·7	+0·9
	3	Diurnal Inequality by Grubb's Magnetometer	+0·2	+0·3	+0·5	+0·3	+0·1	0·0	+0·8	+1·7	+1·8	+1·1
	4	Diurnal Inequality corrected for P. change	+0·2	+0·3	+0·5	+0·3	+0·1	0·0	+0·8	+1·7	+1·8	+1·1
	5	Diurnal Inequality corrected to 18 minutes past the hour ...	+0·2	+0·3	+0·4	+0·2	+0·1	+0·1	+0·9	+1·7	+1·8	+1·0
	6	Excess Diurnal Inequality ...	0·0	0·0	+0·1	0·0	+0·1	+0·2	+0·3	0·0	+0·1	+0·1
November.	1	Diurnal Inequality by Magnetograph	+0·2	+0·2	+0·3	0·0	−0·2	−0·5	−0·7	−0·5	+0·3	+0·7
	2	Diurnal Inequality corrected for P. change	+0·2	+0·2	+0·2	0·0	−0·3	−0·6	−0·7	−0·5	+0·3	+0·7
	3	Diurnal Inequality by Grubb's Magnetometer	+0·3	+0·3	+0·3	+0·1	−0·2	−0·5	−0·6	−0·4	+0·4	+0·7
	4	Diurnal Inequality corrected for P. change	+0·2	+0·2	+0·3	0·0	−0·2	−0·5	−0·6	−0·4	+0·4	+0·6
	5	Diurnal Inequality corrected to 18 minutes past the hour ...	+0·2	+0·2	+0·2	0·0	−0·3	−0·5	−0·6	−0·4	+0·4	+0·6
	6	Excess Diurnal Inequality ...	0·0	0·0	0·0	0·0	0·0	+0·1	+0·1	+0·1	+0·1	−0·1
December.	1	Diurnal Inequality by Magnetograph	0.0	+0·1	+0·1	0·0	−0·2	−0·4	−0·5	−0·7	−0·2	+0·4
	2	Diurnal Inequality corrected for P. change	+0·1	+0·1	+0·1	0·0	−0·1	−0·4	−0·5	−0·7	−0·2	+0·4
	3	Diurnal Inequality by Grubb's Magnetometer	+0·1	+0·2	+0·2	0·0	−0·1	−0·4	−0·4	−0·6	−0·2	+0·2
	4	Diurnal Inequality corrected for P. change	0·0	+0·2	+0·2	0·0	−0·1	−0·4	−0·4	−0·6	−0·2	+0·2
	5	Diurnal Inequality corrected to 18 minutes past the hour ...	+0·1	+0·2	+0·2	0·0	−0·2	−0·4	−0·5	−0·6	−0·2	+0·2
	6	Excess Diurnal Inequality ...	0·0	+0·1	+0·1	0·0	−0·1	0·0	0·0	+0·1	0·0	−0·2

Grubb's Declination Magnetometer, and the Declination Magnetograph as quiet days of the year 1872.

10	11	12	13	14	15	16	17	18	19	20	21	22	23
0·0	−1·3	−2·2	−2·3	−1·9	−1·1	−0·6	−0·1	0·0	−0·4	−0·4	−0·3	−0·2	−0·1
0·0	−1·3	−2·2	−2·3	−1·8	−1·1	−0·6	−0·1	+0·1	−0·4	−0·4	−0·3	−0·2	0·0
−0·1	−1·3	−2·2	−2·4	−1·9	−1·2	−0·7	−0·1	+0·1	−0·3	−0·4	−0·3	−0·2	−0·1
−0·1	−1·3	−2·2	−2·4	−1·9	−1·2	−0·7	−0·1	+0·1	−0·3	−0·4	−0·3	−0·1	−0·1
−0·2	−1·4	−2·2	−2·4	−1·8	−1·2	−0·6	−0·1	+0·1	−0·3	−0·3	−0·2	−0·1	0·0
−0·2	−0·1	0·0	−0·1	0·0	−0·1	0·0	0·0	0·0	+0·1	+0·1	+0·1	+0·1	0·0
−0·5	−1·9	−2·6	−2·6	−1·7	−0·7	+0·2	+0·5	0·0	−0·4	−0·5	−0·5	−0·5	−0·2
−0·5	−1·9	−2·6	−2·6	−1·7	−0·6	+0·2	+0·5	+0·1	−0·3	−0·5	−0·5	−0·4	−0·2
−0·6	−1·9	−2·7	−2·7	−1·6	−0·9	+0·1	+0·4	+0·1	−0·3	−0·5	−0·5	−0·4	−0·2
−0·6	−1·9	−2·7	−2·7	−1·6	−0.9	+0·1	+0·4	+0·2	−0·3	−0·4	−0·5	−0·4	−0·1
−0·6	−2·0	−2·7	−2·6	−1·6	−0·8	+0·1	+0·4	+0·1	−0·3	−0·4	−0·5	−0·4	−0·1
−0·1	−0·1	−0·1	0·0	+0·1	−0·2	−0·1	−0·1	0·0	0·0	+0·1	0·0	0·0	+0·1
−0·2	−2·1	−3·5	−3·2	−1·9	−0·7	0·0	−0·2	−0·5	−0·3	−0·3	−0·2	0·0	+0·2
−0·2	−2·1	−3·5	−3·2	−1·9	−0·7	0·0	−0·2	−0·5	−0·4	−0·3	−0·2	0·0	+0·2
−0·2	−2·1	−3·4	−3·3	−2·1	−0·9	−0·1	−0·1	−0·4	−0·4	−0·3	−0·1	−0·1	+0·1
−0·2	−2·1	−3·4	−3·3	−2·1	−0·9	−0.1	−0·1	−0·4	−0·4	−0·3	−0·1	0·0	+0·2
−0·4	−2·2	3·4	−3·2	−2·0	−0·8	−0·1	−0·2	−0·4	−0·4	−0·3	−0·1	0·0	+0·2
−0·2	−0·1	+0·1	0·0	·0·1	−0·1	−0·1	0·0	+0·1	0·0	0·0	+0·1	0·0	0·0
0·0	−1·2	−1·8	−1·3	−0·5	+0·2	+0·1	−0·6	−0·7	−0·2	−0·1	−0·2	0·0	+0·1
−0·1	−1·2	−1·8	−1·3	−0·5	+0·2	+0·2	−0·6	−0·6	−0·2	−0·1	−0·2	0·0	+0·1
0·0	−1·2	−1·8	−1·5	−0·7	0·0	+0·1	−0·6	−0·8	−0·3	−0·2	−0·2	0·0	+0·1
0·0	−1·2	−1·8	−1·5	−0·7	0·0	+0·1	−0·6	−0·8	−0·2	−0·2	−0·2	0·0	+0·1
−0·1	−1·3	−1·8	−1·4	−0·7	0·0	+0·1	−0·6	−0·7	−0·2	−0·2	−0·2	0·0	+0·1
0·0	−0·1	0·0	−0·1	−0·2	−0·2	−0·1	0·0	−0·1	0·0	−0·1	0·0	0·0	0·0
+0·2	−0·7	−0·3	+0·2	+0·5	+0·4	0·0	−0·3	−0·2	−0·1	−0·1	0·0	+0·1	+0·3
+0·2	−0·7	−0·3	+0·2	+0·5	+0·4	+0·1	−0·3	−0·2	−0·1	−0·1	0·0	+0·2	+0·3
+0·4	−0·6	−0·3	+0·2	+0·5	+0·4	0·0	−0·4	−0·3	−0·1	−0·2	−0·1	+0·1	+0·3
+0·4	−0·6	−0·3	+0·2	+0·5	+0·4	0·0	−0·4	−0·3	−0·1	−0·1	0·0	+0·2	+0·3
+0·3	−0·6	−0·3	+0·2	+0·5	+0·4	0·0	−0·4	−0·3	−0·1	−0·1	0·0	+0·2	+0·3
+0·1	+0·1	0·0	0·0	0·0	0·0	−0·1	−0·1	−0·1	0·0	0·0	0·0	0·0	0·0
+0·2	−0·4	−0·2	+0·5	+0·9	+0·9	+0·5	−0·4	−0·1	+0·1	0·0	−0·1	−0·1	0·0
+0·2	−0·4	−0·2	+0·5	+0·9	+0·9	+0·4	−0·4	−0·2	+0·1	−0·1	−0·1	−0·1	−0·1
+0·1	−0·4	−0·3	+0·5	+0·8	+0·8	+0·5	−0·4	−0·2	+0·1	0·0	−0·1	−0·2	0·0
+0·1	−0·4	−0·3	+0·5	+0·8	+0·8	+0·5	−0·4	−0·2	+0·1	0·0	−0·1	−0·2	0·0
+0·1	−0·4	−0·2	+0·5	+0·8	+0·8	+0·4	−0·4	−0·2	+0·1	0·0	−0·1	0·2	0·0
−0·1	0·0	0·0	0·0	−0·1	−0·1	0·0	0·0	0·0	0·0	+0·1	0·0	−0·1	+0·1

CHAPTER VI.

VERTICAL FORCE.

VARIATION INSTRUMENTS: MAGNETOGRAPHS.

221. The V. F. Magnetograph was received along with the other variation instruments, in the year 1870, and was mounted with them in the same underground chamber. The record by this instrument commenced regularly from 1873 and has run uninterruptedly to 1905. A full description of the installation and the peculiarities of the instrument will be found in the volume for 1879—1882 to which reference is specially invited.

222. Correctly indicated as the principle of the instrument is in theory, it is well recognised that even though close and careful attention is devoted to the adjustment of the instrument and to its subsequent treatment, in practice the accuracy of the results is by no means found to be commensurate with those of the other two magnetographs. And the reason is obvious. The effect of the force which acts on the magnet of the balance magnetometer adjusted in the magnetic meridian at places, for instance where the vertical force attains its greatest possible value, is not very large, and under the most advantageous circumstances it is equivalent to a displacement of the centre of gravity of the balance roughly to about 1/40 of an inch. Hence at an almost equatorial station like Bombay if the instrument is to record correctly a change of 1γ (a very small fraction of the whole force) it will be readily seen how the slightest disturbance in any part of the instrument or some inherent defects in it, which are specially emphasized in instruments of the Kew type which carry heavy magnets, would influence the microscopic shift of the centre of gravity indicated by such a small change of force.

223. In the Colaba instrument unfortunately as will be seen later on, defects of a peculiar type had required to be contended against. These have been fully investigated and will be referred to presently. In completing the inquiry, as also with a view to secure with certainty a reliable and unvitiated record for subsequent years, it was found essential to provide for a new vertical force magnetograph free from defects of the kind noted in the old instrument and another magnetograph was specially ordered out and installed in 1892 in the underground chamber. The duplicate record of the old and new instrument, which we shall call V. F. No. 1 and V. F. No. 2 magnetographs respectively, has run concurrently from 1893 to 1905.

As advantage is taken of the comparison of these two simultaneous records in order to secure the necessary corrections for the older series, for convenience of discussion the record of V. F. No. 2 magnetograph is taken in hand first for examination.

224. The principle of the balance magnetograph is briefly as follows :—

If a magnet is correctly balanced in the magnetic meridian, the north end of the magnet in a place like Bombay in the northern hemisphere would dip down. The effect of the magnetism in the bar is apparently to shift the centre of gravity a little to the northward, depending upon the angle of the inclination at the place. In this state it is delicately restored in its balance by weights just compensating this terrestrial vertical force, and the magnet then takes up the correct horizontal position. If now any change occurs in the vertical force, motion will ensue and the magnet will take up a fresh position of equilibrium, the north end either inclining downwards or upwards according as the force increases or decreases. If these movements are small, it is clear that the angular movement of the magnet will practically be a measure of the change of the vertical component. The weights one on each side which act as a counterpoise in bringing the magnet to the horizontal position are adjustable—one to move parallel and the other perpendicular to the axis of the magnet. Thus not only is it possible to shift the centre of gravity on either side of the centre of suspension, but also to lower or raise it so as to modify the period of the magnet and therefore its sensibility. The attachments are further supplemented by what are called the temperature compensation bars which if properly adjusted prevent the equilibrium of the system from being disturbed by any temperature changes leaving the magnet free to correctly respond to any natural change in the force which may occur.

The equilibrium maintained under these conditions shall be presently investigated in connection with the question of the scale coefficient of the instrument.

225. As in other magnetographs a mirror is attached to the magnet and in close proximity to it is placed the zero mirror fixed to the base plate of the instrument. A reading telescope and scale are also attached to the magnetograph for securing eye observations as in the other instruments.

226. To obtain the angular values of an inch of ordinate in the magnetograph curves, as also of an unit division of the scale attached to the reading telescope, the following measurements were made :—

The actual distance from the back of the mirror to the middle point of the surface of the cylinder is 58·998 inches, the thickness of the lens being ·48 inch, that of the mirror ·098 inch, and that of glass plate in the metal base of the instrument ·210 inch. Whence the virtual distance = 58·735 inches. In the extreme position of the image on the cylinder when the beam is placed on the edge of the paper say about 1·75 inches away from the middle point, the actual distance between this point and the back of the mirror will obviously be slightly longer and consequently also the virtual distance. The computed average virtual distance adopted was 58·743 inches.

Similarly the actual distance between the mirror and the scale = 51·351 inches. With the thickness of the mirror and of the glass plate as above and ·026 as correction due to the arc subtended at the mirror by the telescope and scale, the virtual distance would equal 51·222 inches.

From the virtual distances, supposing that the movements are very small, the angular movement of the magnet in minutes indicated by an inch of increase or decrease of the ordinate of the curve equals

$$1000 \sin^{-1} \frac{\cdot 001}{2 \times 58 \cdot 743} = 29' \cdot 26 \text{ or } \cdot 00851$$

or for 1 c.m. ordinate the angular value equals 11′·52 or ·00335.

For the ivory scale which is circular in form with a chord of an arc of 50 divisions measuring 9·993 inches the angular movement in minutes corresponding to a change of unity in the scale reading equals

$$\frac{1}{50} \sin^{-1} \frac{4 \cdot 9965}{51 \cdot 222} = 6' \cdot 72 \text{ or } \cdot 001955.$$

From these the factors for changing the scale readings into ordinates of 1 inch and 1 c.m. respectively equal ·230 and ·583 ; and for changing an ordinate of one inch and one centimeter into scale reading the factors are respectively 4·35 and 1·715.

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2. Scale Co-efficient of the V. F. Magnetograph (No. 2).

227. The theory of the balance magnetometer is as follows :—

If V is the vertical component of terrestical force, m the moment of a magnet of weight w, and μ the angle (which may be kept very small) which the magnetic axis makes with the horizon, and d the distance of the centre of gravity of the bar from the axis of support and α the angle which the plane through the axle and the centre of gravity makes with the magnetic axis, we have the moment of the terrestrial force equal to $m\mathrm{V}\cos\mu$. This is balanced by the force of gravity which attempts to turn the magnet in the opposite direction. The moment of this is $wd.\cos(\mu-\alpha)$ and the equilibrium is hence given by the equation

$$m\mathrm{V}\cos\mu = w.d.\cos(\mu-\alpha) \tag{78}$$

When the angle μ is zero, that is when the magnet is truly horizontal, we have

$$m\mathrm{V} = w.d.\cos\alpha \tag{79}$$

Assuming m as constant for the time, differentiating equation (78) with respect to μ and dividing by the equation itself we have

$$\frac{\delta \mathrm{V}}{\mathrm{V}} = \Big[\tan\mu - \tan(\mu-\alpha)\Big]\,\delta\mu \tag{80}$$

When $\mu = 0$ we have

$$\frac{\delta \mathrm{V}}{\mathrm{V}} = \tan\alpha\,.\,\delta\mu \tag{81}$$

Thus the changes in the vertical force vary as $\delta\mu$ and are obtained by multiplying the latter by $\mathrm{V}\tan\alpha$.

228. As in the horizontal force, the scale coefficient of the vertical force magnetograph also is derivable by two experimental methods, the determination of the angle α being made (1) by the method of vibrations and (2) by the method of deflection. The first experimental method involves the determination of the times of vibration of the magnet both in the vertical and the horizontal plane, the latter experiment requiring for obvious reasons the detachment of the magnet from the instrument. This involves considerable practical difficulties, and as the accuracy of the final result is also somewhat uncertain, the method of deflection which is less troublesome and ensures greater certainty of result, is adopted for the evaluation of the scale coefficient.

229. The theory of the deflection method is briefly as follows :—

Deflections are produced on the magnetograph magnet by a deflector whose moment is known or subsequently ascertained by experiment. If the deflection produced be n inches long, and if the same deflector produces on the declination magnet a deflection of angle μ, it is clear that the moment of the deflector magnet that is the disturbing force, equals $H \tan \mu$. If θ is the angle of inclination we have the disturbing force $= V \cot \theta \tan \mu$. Hence a change of n inches of ordinate in the magnetograph is produced by this disturbing force and we have for the value of force corresponding to one inch of ordinate, equal to $\delta V = \dfrac{V \tan \mu}{n \tan \theta}$. (82)

The operations for the deflection experiments performed on the vertical force magnetograph at Colaba, are almost similar to those described in Chapter II, paragraph 66, for the horizonal force magnetograph. The first operation consists in performing deflection experiments on the magnetograph in the underground room every month periodically at a single distance of 2·5 feet; and once every year at five distances, *viz.* 1·8, 2·0, 2·3, 2·5 and 3·0 feet. The deflector employed is magnet E_1 which is used both on the north and south side of the instrument and with its ends alternately upwards and downwards, at each position.

The second operation together with operation (3) made for the determination of the disturbing force, is performed every month at the electrometer tower where the absolute determinations are made, by using the above deflector E_1, at 1·0 foot distance from the magnet N_{23c} in the Kew unifilar magnetometer.

The third operation also utilised for the determination of the distribution constant, consists of deflections made once every year by the same deflector on the magnet N_3* (which is similar in shape and dimensions as that used in the magnetograph) suspended by a single thread in a suitable magnetometer at six distances, *viz.* 1·08, 1·8, 2·0, 2·3, 2·5 and 3·0 feet. This experiment is also made in the tower room.

The last operation should really consist of the deflections of the very magnet used in the magnetograph. If the same magnet suspended by a thread in the horizontal plane with its knife edge vertical, is used in a magnetometer and deflected by the deflector magnet used in experiment (1) turned east and west instead of up and down, the relation of the two magnets to each other as to position would be identically the same as in experiment (1). In this case the motion of the (vertical force) magnet in the horizontal plane would be produced by the horizontal component of the earth's force, while in the first experiment, the deflections would be the result of the unknown disturbing force in the vertical plane the value of which we have to determine. The detachment of the very magnet every now and again from the magnetograph would be obviously inconvenient and the usual method is to employ the declination magnetograph for this purpose. At Colaba, however, the procedure adopted has been (as in the case of the other magnetographs) to substitute a magnet similar in shape and dimension to the magnetograph magnet and use it in its stead for the necessary observations at the place where absolute determinations are made. The substitution of the magnet, it must be noted, is only justifiable if the distribution of magnetism in the two magnets is alike and previously ascertained to be similar in character.

As experiment 2 is conducted at the electrometer tower where the absolute force is known, the angular values of the deflections corrected for torsion have only to be multiplied by the known value of force to secure the disturbing force of the deflector magnet E_1.

For reasons already stated as considerable care is necessary in the derivation of the scale co-efficient of this instrument, the process and the several formulæ used for the derivation of the co-efficient (adapted to the readings of the scale attached to the telescope) are given below with full details.

230. Let H_0, H_2, H_3 be respectively the values of horizontal force on the occasion of the absolute determination of force, and at the times of the second and third experiment referred to in the last parapraph, m_0, m_2, m_3, the moment of the deflector E_1 on the above three occasions (all nearly the same

* *Vide* paragraph 66.

as the observations are all simultaneously made within 2 or 3 days) μ_0, μ_2, μ_3, angles of deflections in arc as above, μ_3 being derived from $\frac{d}{2}$—the deflection in scale divisions of the old magnetometer used in experiment (3), multiplied by a which is the value in arc of a single division of the scale; d being equal to the double deflection; $1 + \frac{H}{F}$ the torsion co-efficient of the thread supporting the magnet N_3 in experiment (3), and r_1, r_2, r_3, etc., distances apart of the deflected and deflecting magnets.

From experiment (3) we have the disturbing force given by the equation

$$Y = H_3 \left(1 + \frac{H}{F}\right) \frac{d}{2} \cdot a \tag{83}$$

where $\frac{d}{2} \cdot a \doteq \mu_3$; considering that the deflector is side on to the deflected magnet we have also

$$Y = \frac{m_3}{r^3}\left(1 + \frac{p}{r^2}\right) \tag{84}$$

where p equals the distribution constant.

From experiment (2), as also in the standard absolute determinations in which the Kew magnetometer and its magnet N_{23c} are used, we have

$$\sin \mu_2 = \frac{2m_2}{H_2} \frac{1}{r_0^3}\left(1 + \frac{p'}{r_0^2}\right) \tag{85}$$

$$\sin \mu_0 = \frac{2m_0}{H_0} \frac{1}{r_0^3}\left(1 + \frac{p'}{r_0^2}\right) \tag{86}$$

dividing (85) by (86)

$$\frac{\sin \mu_2}{\sin \mu_0} = \frac{H_0}{H_2} \cdot \frac{m_2}{m_0}, \text{ whence } m_2 = \frac{m_0}{H_0 \sin \mu_0} H_2 \sin \mu_2. \tag{87}$$

Putting $\frac{m_0}{H_0 \sin \mu_0}$ equal to some constant J we have $m_2 = JH_2 \sin \mu_2$ (88)

and inserting this value generally of m in equation (84) we have the disturbing force

$$Y = \frac{J \cdot H_2 \sin \mu_2}{r^3}\left(1 + \frac{p}{r^2}\right) \tag{89}$$

whence combining with equation (83)

$$J = \frac{H_3}{H_2} \frac{\left(1 + \frac{H}{F}\right) \frac{d}{2} a}{\frac{1}{r^3}\left(1 + \frac{p}{r^2}\right) \sin \mu_2}. \tag{90}$$

As in a set of observations of deflections all performed within a few days, it is always seen that the difference between H_3 and H_2 as shown by the scale readings of the H. F. magnetograph, is much less than $\frac{1}{200}$ of the whole force, $\frac{H_3}{H_2}$ may be replaced by unity and we have the last two equations modified thus—

$$Y = J \cdot H \cdot \sin \mu_2 \frac{1}{r^3}\left(1 + \frac{p}{r^2}\right) \tag{91}$$

$$\text{and } J = \frac{a\left(1 + \frac{H}{F}\right)}{2 \sin \mu_2} \cdot \frac{d}{\frac{1}{r^3}\left(1 + \frac{p}{r^2}\right)}. \tag{92}$$

Such values of J are derived from several distances and are summed together to reduce the errors of observations, and hence for the full experiment the most probable value of J for all distances is—

$$J = \frac{a\left(1 + \frac{H}{F}\right)}{2 \sin \mu_2} \cdot \frac{\Sigma d}{\Sigma\left\{\frac{1}{r^3}\left(1 + \frac{p}{r^2}\right)\right\}} \tag{93}$$

Σd being the sum of all double deflections except the largest and $\Sigma\left\{\frac{1}{r^3}\left(1 + \frac{p}{r^2}\right)\right\}$ the summed value of the expression at various distances.

Similarly the value of J is derivable from the nearest single distance deflection at 1·08 feet thus :—

$$J = \frac{a\left(1+\frac{H}{F}\right)}{2\sin\mu_2} \cdot \frac{d_{1\cdot08}}{\frac{1}{r^3_{1\cdot08}}\left(1+\frac{p}{r^2_{1\cdot08}}\right)} \qquad (94)$$

231. The two values of J are useful for the determination of the value of p the distribution constant, as considerable accuracy and consistency in the value of the latter is secured by giving to the deflection at the nearest distance 1·08 feet a full weight and combining it with the summed result of the deflections at all the other five remoter distances.

Thus combining equations (93) and (94) J is eliminated and we get

$$p = \frac{d_{1\cdot08}\,\Sigma\frac{1}{r^3} - \frac{1}{r^3_{1\cdot08}}\Sigma d}{\frac{\Sigma d}{r^5_{1\cdot08}} - d_{1\cdot08}\,\Sigma\frac{1}{r^5}}. \qquad (95)$$

The values of p and J derived from equations (95) and (93) are given in the table below :—

TABLE 180.—*Values of p and J.*

Date.	p	J	Date.	p	J	Date.	p	J
15th April 1893 ...	·18797	·49814	24th March 1898 ...	·18742	·49775	17th January 1902 ...	·18302	·49671
15th March 1894 ...	·18043	·49820	24th March 1899 ...	·17807	·49773	20th January 1903 ...	·18446	·49825
25th April 1895 ...	·18233	·49932	22nd March 1900 ...	·18316	·49926	25th January 1904 ...	·18011	·49864
16th April 1896 ...	·19870	·49304	14th March 1901 ...	·17559	·50347	12th January 1905 ...	·18531	·49763
25th March 1897 ...	·19407	·49976	27th May 1901 ...	·17542	·49962	18th January 1906 ...	·18252	·50084

232. The practice adopted at Colaba however is not to use the values of p and J derived from every fresh experiment, as they are subject to large probable errors of observations. Mean values of the constants derived from a large number of observations after careful examination, are adopted once for all and used throughout in the reductions. Subsequent determinations, if they continue to lie within certain limits of the adopted value, serve to indicate that the accepted values have been so far correctly derived. For this instrument the values of p and J derived from observations extending over six years from the year 1893 to 1899 have been averaged and their mean adopted. The observed values of the subsequent years which have since been recorded, give a revised mean to date which shows that each value lies within allowable limits and does not influence the coefficient sought, by more than 1/200 of the whole.

233. In connection with the question of similarity of distribution of magnetism in the magnet mounted in the V. F. Magnetograph No. 2 and in the magnet N_3* used in the deflection experiment (3), it has been noted by special deflection experiments conducted on the electrometer tower on both the above magnets (the former being dismounted from the magnetograph for the purpose) at 13 distances, *viz.* 1·1, 1·15, 1·20, 1·25, 1·3, 1·4, 1·5, 1·6, 1·8, 2·0, 2·3, 2·5 and 3·0 feet, the deflector used being E_1, that a sensible difference exists in the respective deflections. The result solved by the method of least squares, however showed that if each of the deflections of magnet N_3 be multiplied by the factor 1·014, the figures closely reproduce the deflection series noted by the magnet in the magnetograph, all the departures lying well within the probable error of observation. Hence in experiment (3) in taking the value of the disturbing force as measured by magnet N_3 they were increased by the factor 1·014 to make it strictly comparable to actual conditions of the magnetograph magnet.

234. The disturbing force in equation (91) hence becomes

$$Y = [1\cdot014 \,.\, J \,.\, H \,.\, \sin\mu_2]\,\frac{1}{r^3}\left(1+\frac{p}{r^2}\right) \qquad (96)$$

From this, the crude scale co-efficient or value in force for an unit of scale division—derived from the monthly deflections—is given by the equation

$$\frac{\delta Y}{\delta s} = \frac{2[1\cdot014 \,.\, J \,.\, H \,.\, \sin\mu_2]\,\frac{1}{r^3}\left(1+\frac{p}{r^2}\right)}{d} \qquad (97)$$

where d is the double deflection of the magnetograph magnet by deflector E_1 at 2·5 feet distance.

* This magnet has been similarly experimented upon along with the H. F. Magnetograph and V. F. No. 1 Magnetograph magnets and in either case the distribution appears to be sensibly the same.

TABLE 181.—*Monthly observed Scale Co-efficients of V. F. Magnetograph No. 2 derived from formula (97).*

Unity = ·1γ = ·000001 C. G. S.

Years.	Months.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1893					913	919	926	929	933	914	934	924
1894	941	939	939	935	929	932	929	944	936	935	935	944
1895	943	942▌	908	922	919	930	933	935	932	940	929	927
1896	935	932	933	929	930	941	941	945	941	937	945	939
1897	944	940	938	946	941	935	942	943	941	939	940	944
1898	952	947	952	948	954	945	955	944	952	946	949	955
1899	950	950	949	950	951	958	951	955	944	954	963	951
1900	956	966	954	947	955	956	961	949	950	949	937	928
1901	926	938	936	946	953	947	946	930	929	926	934	929
1902	937	934	942	933	931	932	921	929	933	927	924	936
1903	920▌	988	979	989▌	966	964	964	965	969	976	962	966
1904	973	971	971	975	971	971	977	980	981	977	978	988
1905	982	984	985	980▌	952	961	965	955	976	972	958	965

Thick lines separating the values show either adjustment or exhaustion of the receiver.

235. The values of the co-efficients derived from monthly deflection at a single distance, which are given above, it will be seen, are not nearly so consistently uniform, and distinctly show a change with time. With the experience at Colába of the behaviour of No. 1 vertical force instrument, to be referred to presently, it was deemed at least safe to assume for this instrument also that the co-efficient which is ordinarily supposed to be independent of temperature effects, may, owing to some instrumental defects, be made up of one large portion which is constant and independent of any vitiating factor; while the other small part may vary conjointly with temperature and time. These conditions may be made expressible by the equation

$$\text{Scale co-efficient} = A + b\,(t^\circ - 80^\circ) + cT \qquad (98)$$

where A is the co-efficient at 80° for the initial time; b and c some constants respectively for temperature and time; and T being the time reckoned by months from the initial month. Solving the equations of condition of some convenient period by the method of least squares, the values of the constants are derived and shown in table 182*a*.

236. Then, again, as observed in paragraph 229, a more elaborate and complete set of deflection experiment is made once every year, and an independent value of the scale co-efficient from deflection experiments at several distances is derived by the method of least squares by the formula

$$\frac{\delta Y}{\delta s} = \frac{Y + f}{s - S} \qquad (99)$$

where Y is the disturbing force as before, f some small force (very near to zero) given by the difference of the mean readings of the magnetograph when the deflector is off and when the deflector is on, in various positions during the whole experiment (or the natural change of force in the interval), s the mean scale reading during the experiment when the deflector is on, and S the mean scale reading when the deflector is off.

This enables us to secure the best approximation to the value of the scale co-efficient, as 'f' that is the small natural change in force during each experiment is duly allowed for so as to have the probable errors of observations involved in the derivation of the disturbing force Y as small as possible.

237. These annual values of the co-efficients along with the observed monthly values of the corresponding month and those theoretically derived from formula (98) are given side by side in table 182*b* in columns 7, 4, 5, respectively. The differences shown in column 8 are (except for the year 1903 when the instrument was heavily disturbed by gunfire in the adjacent battery ground and the magnet had consequently to be lifted up on its Ys and put back in the correct position) very consistent and the method adopted for the final values of the constant A indicated in column 10, is as follows.

TABLE 182*a*.

Group.	Period.	A	b	c	Probable error.	Probable error ÷ co-efficient.	Adopted initial Time T_0. Year.	month.
1	2	3	4	5	6	7	8	
1	May 1893 to March 1899	+·000936	−·00000104	+·000000324	±·000004	$\pm\frac{1}{234}$	1893	4·5
2	April 1899 to March 1900	+·000956	−·00000041	+·000000513	±·000004	$\pm\frac{1}{239}$	1899	3·5
3	April 1900 to May 1901	+·000924	+·00000274	−·000000769	±·000005	$\pm\frac{1}{189}$	1900	3·5
4	June 1901 to January 1902	+·000906	+·00000316	−·000000079	±·000005	$\pm\frac{1}{187}$	1901	5·5
5	February 1902 to January 1903	+·000941	−·00000047	−·000001040	±·000004	$\pm\frac{1}{232}$	1902	1·5
6	February 1903 to January 1904	+·001002	−·00000242	−·000001710	±·000005	$\pm\frac{1}{194}$	1903	1·5
7	January 1904 to January 1905	+·000976	−·00000082	+·000001204	±·000002	$\pm\frac{1}{489}$	1904	0·5
8	January 1905 to January 1906	+·001001	−·00000269	−·000000933	±·000005	$\pm\frac{1}{194}$	1905	0·5

TABLE 182*b*.

$t^\circ - 80^\circ$	Monthly deflections. Group.	Date.	Scale co-efficient.	A + b (t − 80) + cT.	Large sets of deflections. Date.	Scale co-efficient.	Column 7 minus column 5.	Means derived from column 8.	A plus ½ value in column 9.
1	2	3	4	5	6	7	8	9	10
10°·3		14th April 1893 ...	·000878	·000925	14th April 1893 ...	·00872	As the instrument was freshly adjusted this set was not taken in the calculations.		
8°·1	1	14th March 1894 ...	·000939	·000931	14th March 1894 ...	·000914	−·000017		
10·6	1	24th April 1895 ...	·000922	·000933	24th April 1895 ...	·000909	−·000024		
11·2	1	15th April 1896 ...	·000929	·000935	15th April 1896 ...	·000920	−·000015	−·00015	·00929
7·6	1	24th March 1897 ...	·000938	·000943	24th March 1897 ...	·000929	−·000014		
7·7	1	23rd March 1898 ...	·000952	·060947	23rd March 1898 ...	·000942	−·000005		
8·5	1	23rd March 1899 ...	·000949	·000950	23rd March 1899 ...	·000936	−·000014		
8·5	2	21st March 1900 ...	·000954	·000959	22nd March 1900 ...	·000936	−·000023	−·000023	·000945
12·7	3	27th May 1901 ...	·000943	·000948	27th May 1901 ...	·000934	−·000014	−·000014	·000917
7·6	4	17th January 1902 ...	·000937	·000929	17th January 1902 ...	·000925	−·000004	−·000004	·000904
7·8	5	19th January 1903 ...	·000920	·000926	19th January 1903 ...	·000948	+·000022	+·000022	·000952
6·1	6	25th January 1904 ...	·000973	·000968	25th January 1904 ...	·000955	−·000013	−·000013	·000996
6·9	7	11th January 1905 ...	·000982	·000984	11th January 1905 ...	·000967	−·000017	−·000017	·000968
7·4	8	17th January 1906 ...	·000964	·000970	17th January 1906 ...	·000954	−·000016	−·000016	·000993

TABLE 182*c*.

Period. Beginning.	End.	Adopted initial time T_0 Year.	Month.	Adopted value of constants in equation Scale co-efficient = A + b (t° − 80°) + cT. A	b	c
1	2	3	4	5	6	7
May 1893	March 1899	1893	4·5	+·000929	−·00000104	+·000000324
April 1899	March 1900	1899	3·5	+·000945	−·00000041	+·000000513
April 1900	May 1901	1900	3·5	+·000917	+·00000274	−·000000769
June 1901	January 1902	1901	5·5	+·000904	+·00000316	−·000000079
February 1902	January 1903	1902	1·5	+·000952	−·00000047	−·000001040
February 1903	January 1904	1903	1·5	+·000996	−·00000242	−·000001710
January 1904	December 1904	1904	0·5	+·000968	−·00000082	+·000001203
January 1905	December 1905	1905	0·5	+·000993	−·00000269	−·000000934

It is clear that as each of the monthly deflections at a single distance is an independent observation, it must have a larger probable error than the more elaborate experiment made once a year at several distances. But as in a given period the number of determinations is greater in the former than in the latter, the quality of weight lacking in the individual results would be approximated at least more nearly in the general result—the value of A. Hence equal weight is attached to the value of A derived from each set, and the mean of the two values has been adopted. Thus half the differences in column 9 are added to the constant A and appear in column 10, table 182*b*, and these values together with the contributions of the other constants b and c shown in table 182*c* multiplied by the figures of the temperature and time indicated for each particular month, constitute the final values of the co-efficients which have been adopted in the reductions.

238. A glance at the table 182*c* will show that the contributions of the temperature constant are very small and uncertain and the scale co-efficient is, if at all, but little influenced by it. The final co-efficients derived from the above data are collected in table 183.

TABLE 183.—*Scale Co-efficients : V. F. No. 2 Magnetograph for an inch of ordinate.**

Unity $= 1\gamma =$ ·00001 C. G. S.

Years.	Month.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1894	402	402	402	402	401	401	402	402	402	403	403	404
1895	404	404	404	403	402	402	403	404	404	404	405	405
1896	405	406	405	404	403	404	405	406	406	406	406	407
1897	408	408	408	407	405	405	406	407	407	408	408	409
1898	409	409	409	408	407	407	408	409	409	409	409	410
1899	412	412	411	409	409	409	410	410	411	411	411	411
1900	412	412	412	411	412	413	411	409	408	407	407	406
1901*	159	158	159	160	161	161	160	159	159	159	159	159
1902	159	163	162	162	162	162	161	161	161	161	161	161
1903	168	169	168	167	165	165	165	165	165	165	165	165
1904	165	165	165	165	165	165	166	166	166	167	167	167
1905	167	168	167	166	164	164	164	164	164	164	163	164

* From 1901 the scale co-efficients are given for 1 c. m. of ordinate on the photographic paper.

239. The instrument was adjusted in 1893 and the balance has not been touched in this respect during the period under examination. The enclosure was initially exhausted but a very minute unlocated leak allowed the gauge to rise slowly. Whenever it reached about 5 inches of pressure of mercury, the pump was employed and the pressure was reduced again to about 2 inches. This operation had to be performed every two or three years and it was this which constituted the only disturbance the instrument was subjected to. Once only in 1903 did the firing of heavy guns in the vicinity disturb the balance seriously and that necessitated its lifting on the Ys and resetting it in the correct position on the agate plane. Hence as no actual readjustment in the conditions of the balance itself had been made, the scale co-efficients should have given, apart from observational errors, consistent uniform values. The method employed therefore in smoothing the small inequalities enables the best probable values of the co-efficient under the conditions obtaining during the period, to be secured.

240. In passing it may be remarked that the comparison of the simultaneous record of this instrument with that of Watson's magnetograph installed at Alibag extending over a period of two years show remarkably close and accordant results.

3. Temperature Co-efficient of the V. F. No. 2 Magnetograph.

241. For the determination of the temperature co-efficient of this instrument heating experiments were made in January 1895. The underground chamber was heated to a temperature of 105° and gradually allowed to cool down to the normal temperature. The observations extended over three

days, and were reduced in the usual way. No correction for the actual change of force has been applied to the result, as no such correction could be made available. In table below is given the summary of the results of the observations along with those of other magnetographs.

TABLE 184.—*Results of heating experiments made in the magnetograph room from the 17th to 19th of January 1895.*

	Period. Beginning.	Period. End.	Vertical Force No. 2, No. 1 and H. F. Magnetograph. Scale reading corrected for diurnal change in case of Horizontal Force only.	Differences.	Readings of Thermometers.	Differences.	$\frac{\Sigma\Delta s}{\Sigma\Delta t}$
	1	2	3	4	5	6	7
Vertical Force—Magnetograph No. 2.	d. h. m.	d. h. m.					
	16 22 16	17 ·10 31	21·46		85·8		
				– 0·62		+ 10·1	
	17 15 46	17 19 16	20·84		95·9		
				– 0·67		+ 10·9	
	19 3 16	19 9 16	21·51		85·9		
	Sums and quotient ...		.....	– 1·29	...	+ 21·0	– ·061
	Means ...		21·06	...	90·6	...	...
	Temperature coefficient $= \frac{\delta V}{\delta s} \frac{\Sigma(\Delta s)}{\Sigma(\Delta t)} = (\cdot 000929)\ (-\cdot 061) = -\cdot 000057.$						
Vertical Force—Magnetograph No. 1.	16 22 17	17 10 31	33·55		87·6		
				– 2·48		+ 10·9	
	17 15 47	17 20 47	31·07		98·5		
				– 2·68		+ 12·0	
	19 3 17	19 9 17	33·75		86·5		
	Sums and quotient ..		.....	– 5·16	...	+ 22·9	– ·225
	Means ...		32·36	...	92·87	...	
	Temperature coefficient $= \frac{\delta V}{\delta s} \frac{\Sigma(\Delta s)}{\Sigma(\Delta t)} = (\cdot 000712)\ (-\cdot 225) = -\cdot 000160.$						
Horizontal Force-Magnetograph.	16 22 19	17 10 34	27·65		88·5		
				– 0·84		+ 8·2	
	17 19 19	17 21 4	26·81		96·7		
				– 0·86		+ 9·6	
	19 7 19	19 9 19	27·67		87·1		
	Sums and quotient ...		......	– 1·70	...	+ 17·8	– ·096
	Means ...		27·23	...	92·2	...	
	Temperature coefficient $= \frac{\delta H}{\delta s} \frac{\Sigma(\Delta s)}{\Sigma(\Delta t)} = (\cdot 000368)\ (-\cdot 096) = -\cdot 000035.$						

242. Another experiment was performed in January 1907. As the values of these constants for all the instruments had to be derived for final adoption, particular attention and care were devoted to ensure the best possible results. The temperature of the room was gradually raised to 101°·5 and then by gradually opening up the ventilators, etc., it was lowered steadily. The experiment was performed on what promised to be a fairly quiet day and was commenced at 4 p.m. and completed at 7 a.m. of the following morning, the night hours being preferred as being the least disturbed. The results of the observations were duly corrected for natural change of force as derived from the Alibag record. Table 185 gives the details of the result.

TABLE 185.—*Results of heating and cooling experiments made in the magnetograph room on 21st, 24th and 29th January 1907, for the determination of Temperature Coefficient of Vertical Force No. 2.*

Period.	Vertical Force No. 2 Magnetograph.				
	Ordinate.	Difference δs.	Temperature.	Difference δt°.	$\frac{\Sigma \delta s}{\Sigma \delta t^\circ}$
January 1907	6·105		85·5		
d. h. m.		·191		− 10·8	
21 20 27	6·296		74·7		
to		·206		− 10·2	
22 4 47	6·090		84·9		
Sum and quotient ...		0·397	......	− 21·0	− ·019
Temperature coefficient $= \frac{\delta V}{\delta s} \times \frac{\Sigma(\delta s)}{\Sigma(\delta t)} = ·00165 \times -·019 = -·000031.$					
January 1907	6·155		86·0		
d. h. m.		·250		− 11·7	
24 18 47	6·405		74·3		
to		·246		− 10·8	
25 5 46	6·159		85·1		
Sum and quotient ...		·496	......	− 22·5	− ·022
Temperature coefficient $= \frac{\delta V}{\delta s} \times \frac{\Sigma(\delta s)}{\Sigma(\delta t)} = ·00165 \times -·022 = -·000036.$					
January 1907	6·112		85·3		
d. h. m.		− ·328		16·2	
29 16 16	5·784		101·5		
to		− ·244		12·6	
30 14 15	6·028		88·9		
Sum and quotient ...		− ·572	......	28·8	− ·020
Temperature coefficient $= \frac{\delta V}{\delta s} \times \frac{\Sigma(\delta s)}{\Sigma(\delta t)} = ·00165 \times -·020 = -·000034.$					

243. Before the larger experiment of heating the underground room in January 1907 above referred to was undertaken, attempts were made to secure the temperature coefficient of V. F. No. 2 instrument alone by reducing and raising the temperature of the enclosure by the use of thick felt (spongio piline), immersed alternately in ice-cold and boiling water, as a jacket to the enclosure. The experiment was troublesome, but was carefully performed allowing the thermometer full time to acquire the artificial temperature and to remain steady at that temperature for some considerable time. This operation allowed the use of the V. F. No. 1 instrument for supplying the corrections for natural change of force. The results of two such complete experiments conducted in January 1907 are given in table 185.

It will be seen that these results are fairly closely in accordance with that derived from the larger experiment of January 1907, and the mean value of the coefficient $-3{\cdot}4\gamma$ for 1° F. derived from these experiments has been adopted without any hesitation in the reductions throughout.

The omission from consideration of the value of the coefficient derived from the experiment of January 1895 which after all is not very divergent, was considered justifiable for the following reason. The experiment was performed on what unfortunately happened to be days of moderate disturbance (*vide* table 381, Chapter X), and as the application of the correction due to actual change of force cannot for obvious reasons on such days at least be neglected as unimportant, the determination must be taken as vitiated to a certain extent. The results of both the V. F. instruments as will be seen from the table, suffer considerably in this respect in the experiment. The horizontal force magnetograph shows no appreciable difference between the values of the coefficient, both previously and subsequently derived (*vide* paragraph 77, Chapter II) as the results have been fairly accurately corrected for natural change of force by the indications of another variation instrument—Grubb's H. F. Magnetometer. For the V. F. No. 2 Magnetograph the temperature coefficient equal to $-3{\cdot}4\gamma$ for 1° F. hence has been accepted and adopted in the reductions as the best available value for the coefficient.

4. Use of the V. F. No. 2 Instrument.

Reduction of the absolute observations to the mean of the day.

244. Knowing the values of the scale and temperature coefficients of the instrument we can now proceed to make use of it for the derivation of the necessary corrections to the absolute observations in order to secure the monthly mean values of vertical force. The process is shown in detail from the year 1894 to 1905 in table 186. In column 2 are entered the monthly means of the observed inclination results—double sets of observation twice a week. Column 3 gives the mean date of these observations in the month. In columns 4 and 5 appear the ordinate of the H. F. Magnetograph and the temperature of the enclosure, respectively, both being taken simultaneously at the time of the inclination observations. From the last two columns is derived the mean horizontal force corresponding to the time of the inclination observations. Combining the results of columns 2 and 6 the mean absolute vertical force at the time of the inclination observations is derived, and entered in column 7. In columns 8 and 9 are entered the ordinate and temperature observation of the V. F. instrument at the time of inclination observations. These last two columns are utilised for supplying the necessary correction for the derivation of the mean monthly vertical force from column 7. The values of the monthly mean ordinates are entered in column 10. Column 11 gives the monthly mean temperature of the enclosure and column 12 finally gives the vertical force monthly means duly corrected for temperature.

245. No discussion of the zero series in this instrument has been attempted as it is obviously impracticable. It will be readily seen from the process of derivation of the zeros that it is an involved operation and dependent upon the use of the results of two absolute observations, those of Horizontal Force and inclination with their probable errors, and of the two variation instruments with their defects. The inherent defect in one of them—the V. F. instrument, the traces of which are subject to breaks or what are called dislocations of the curve on the slightest provocation or concussion, or sometimes even without any known cause—makes it almost impossible to rely with anything like certainty upon the zeros of the instrument though in the reductions they are allowed for when detected. However the data necessary for the derivation of the zeros is fully contained in the tables from which the series may be secured if desired.

V. F. Magnetograph as a recorder of diurnal inequality.

246. The procedure in connection with the tabulation of the hourly ordinates has already been referred to in detail in Chapter II. And in this instrument specially for the purpose of securing the unbroken continuity so essestial for the diurnal curve, it has been found absolutely necessary to tabulate the results from 10 a.m. to 10 a.m. of the following day, and not from 0 hour to 24 hour. The errors which are usually introduced by such dislocations of the curve are generally of a large magnitude—greater than the average correction due to aperiodic change; and if it is considered essential to free the inequality from the effects of the latter, the above procedure which prevents the vitiation of the curve from the effects of dislocation is more than amply justified, as in no other way is it possible to eliminate the effects of such vitiation.

TABLE 186.—*Reductions of monthly and annual Means of Absolute Vertical Force.*

Month.	Mean observed absolute inclination.	Mean date of inclination observations.	Mean ordinate of Horizontal Force Magnetograms at times of inclination observations.	Mean temperature of Horizontal Force enclosure at times of inclination observations.	Mean Horizontal Force at the times of inclination observations.	Mean Vertical Force at the times of inclination observations derived from columns 2 and 6.	Mean ordinate of Vertical Force Magnetograms at times of inclination observations.	Mean temperature of Vertical Force enclosure at times of inclination observations.	Mean monthly ordinate of Vertical Force Magnetograms.	Mean monthly temperature of Vertical Force enclosure.	Mean monthly Vertical Force.
1	2	3	4	5	6	7	8	9	10	11	12
					1888.						
	° ′		inch.	°			inch.	°	inch.	°	
January ...	20 10.1	10.0	0.8671	87.40	.374176	.137120	2.7686	86.44	2.7786	86.46	.137181
	9.0	25.5	0.7932	87.60	.374089	.137268	2.6970	86.62	2.6769	86.73	
February ...	8.3	15.6	0.8560	87.42	.374331	.137268	2.6998	86.62	2.6933	86.66	.137257
March ...	7.6	16.3	0.8087	89.19	.374354	.137192	2.6222	88.64	2.6304	88.66	.137218
April ...	9.9	15.1	0.6464	91.42	.374318	.137461	2.5152	91.00	2.5175	91.04	.137473
May ...	10.8	14.8	0.5263	93.18	.374316	.137572	2.4709	92.66	2.4455	92.81	.137508
June ...	11.0	17.0	3.7707	93.94	.374289	.137588	2.3833	93.54	2.3757	93.54	.137562
July ...	10.6	16.8	3.8008	92.31	.374364	.137566	2.3972	91.82	2.4075	91.87	.137606
August ...	9.4	17.1	3.7244	90.99	.374267	.137382	2.4779	90.38	2.4690	90.40	.137358
September ...	9.2	16.0	3.6108	90.74	.374318	.137376	2.4770	90.11	2.4614	90.11	.137329
October ...	13.1	15.8	3.6164	91.08	.374440	.137902	2.5341	90.52	2.5074	90.56	.137824
November ...	13.6	16.2	3.4016	91.60	.374134	.137851	2.4016	90.89	2.3967	90.93	.137841
December ...	14.5	16.0	3.4191	90.86	.374314	.138029	2.4755	90.27	2.4432	90.16	.137914
Means ...	...	...	...	...	...	...	...	...	...	...	.137506
					1889.						
January ...	20 19.4	14.8	3.3807	89.66	.374277	.138621	2.4777	88.99	2.4911	88.99	.138661
February ...	19.4	13.5	3.3942	89.14	.374351	.138650	2.4557	88.45	2.4450	88.51	.138627
March ...	17.0	15.2	3.2381	90.16	.374287	.138328	2.4272	89.53	2.4457	89.61	.138394
April ...	16.6	15.7	3.1977	91.51	.374342	.138299	2.4125	90.86	2.4111	90.92	.138302
May ...	18.4	17.3	3.0621	93.19	.374350	.138526	2.4124	92.68	2.4068	92.65	.138503
June ...	19.5	16.0	2.9543	93.67	.374275	.138634	2.3209	93.36	2.3236	93.32	.138638
July ...	18.5	15.8	2.9733	91.99	.374506	.138596	2.3409	91.42	2.3465	91.41	.138613
August ...	19.4	16.3	2.8435	91.20	.374419	.138676	2.4154	90.51	2.4202	90.51	.138691
September ...	19.2	15.0	2.7707	90.94	.374433	.138656	2.4075	90.29	2.4169	90.29	.138685
October ...	18.9	14.9	2.7253	91.11	.374500	.138644	2.3185	90.40	2.3084	90.43	.138617
November ...	20.5	15.2	2.5785	90.78	.374402	.138807	2.4109	89.28	2.4037	89.26	.138784
December ...	20.5	16.8	2.5542	88.63	.374337	.138781	2.4469	87.70	2.4535	87.75	.138806
Means ...	...	...	...	...	...	...	...	...	...	...	.138610
					1890.						
January ...	20 20.7	17.2	2.4601	88.16	.374314	.138797	2.4052	87.22	2.4163	87.25	.138830
February ...	20.4	16.0	2.5220	88.42	.374399	.138791	2.3904	87.46	2.4024	87.47	.138825
March ...	21.6	10.8	2.4375	89.60	.374434	.138954	2.3759	88.72	2.4019	88.69	.138992
	22.3	28.0	2.3250	90.10	.374308	.138992	1.8365	89.20	1.7814	89.21	
April ...	22.6	13.0	2.3352	91.23	.374397	.139031	1.7078	90.33	1.7226	90.32	.139114
	23.1	27.0	2.4164	92.30	.374534	.139178	1.7182	91.55	1.7515	91.41	
May ...	23.1	16.2	2.2202	93.06	.374410	.139130	1.6560	92.30	1.6559	92.32	.139133
June ...	23.6	16.9	2.1750	93.31	.374441	.139203	2.8545	92.47	2.8709	92.45	.139145
July ...	24.4	14.8	2.2087	91.01	.374559	.139348	2.9507	90.10	2.9632	90.00	.139375
August ...	25.7	15.2	2.0803	89.71	.374535	.139499	3.0122	88.80	3.0033	88.85	.139478
September ...	23.9	8.8	2.0040	89.66	.374381	.139220	2.9752	88.80	2.9892	88.80	.139284
	24.1	24.5	1.9784	89.05	.374330	.139226	2.9911	88.10	3.0110	88.15	
October ...	25.3	17.2	1.8366	89.42	.374252	.139345	3.0042	88.42	2.9894	88.47	.139295
November ...	26.7	15.9	1.8225	89.51	.374347	.139553	2.9541	88.51	2.9513	88.55	.139547
December ...	26.4	15.8	1.7414	89.67	.374306	.139502	2.9573	88.86	2.9781	88.81	.139574
Means ...	...	...	...	...	...	...	...	...	...	...	.139216

TABLE 186—*Reductions of monthly and annual Means of Absolute Vertical Force.*

Month.	Mean observed absolute inclination.	Mean date of inclination observations.	Mean ordinate of Horizontal Force Magnetograms, at times of inclination observations.	Mean temperature of Horizontal Force enclosure at times of inclination observations.	Mean Horizontal Force at the times of inclination observations.	Mean Vertical Force at the times of inclination observations derived from columns 2 and 6.	Mean ordinate of Vertical Force Magnetograms, at times of inclination observations.	Mean temperature of Vertical Force enclosure at times of inclination observations.	Mean monthly ordinate of Vertical Force Magnetograms.	Mean monthly temperature of Vertical Force enclosure.	Mean monthly Vertical Force.
1	2	3	4	5	6	7	8	9	10	11	12
					1891.						
	° ′		inch	°			inch	°	inch	°	
January ...	20 26.9	16.1	1.8192	88.81	.374529	.139647	2.9451	87.88	2.9699	87.80	.139724
February ...	28.0	15.0	1.7177	87.70	.374393	.139730	3.1321	86.69	3.1378	86.78	.139761
March ...	28.0	16.8	1.5512	88.67	.374231	.139672	3.0028	87.68	3.0151	87.66	.139712
April ...	27.1	15.6	1.4879	91.25	.374302	.139585	2.8793	90.52	2.8892	90.48	.139619
May ...	27.7	15.3	1.3893	93.36	.374356	.139682	2.7864	92.70	2.7863	92.76	.139690
June ...	{ 29.1	10.5	1.3514	94.82	.374403	.139872	2.6957	94.35	2.6980	94.35	} .139878
	{ 28.7	26.3	1.3729	95.00	.374437	.139836	2.7103	94.60	2.7180	94.61	
July ...	28.9	17.2	1.2461	93.53	.374345	.139827	2.7189	92.92	2.7371	93.04	.139920
August ...	29.7	16.0	1.2469	92.14	.374408	.139949	2.7444	91.35	2.7572	91.36	.140003
September ...	29.3	14.8	1.0397	91.14	.374231	.139833	2.7466	90.40	2.7526	90.39	.139858
October ...	{ 29.8	11.0	1.0560	90.08	.374253	.139904	2.7821	89.17	2.7796	89.15	} .139935
	{ 31.3	26.6	1.0145	90.03	.374199	.140036	3.2366	89.10	3.2307	89.13	
November ...	31.5	15.0	1.0221	89.80	.374349	.140149	3.2244	88.96	3.2499	88.95	.140218
December ...	31.0	14.8	0.9643	88.98	.374386	.140101	3.2493	88.01	3.2589	87.98	.140124
Means ...	...	...	...	...	...	...	...	...	...	...	.139870
					1892.						
January ...	20 32.5	15.2	0.6996	88.33	.373933	.140117	3.3511	87.20	3.3669	87.16	.140156
February ...	32.3	14.1	0.6741	88.56	.374061	.140142	3.3572	87.50	3.3604	87.47	140147
March ...	33.0	14.4	0.5790	88.90	.373979	.140197	3.2960	87.91	3.3019	88.07	.140236
April ...	34.5	13.7	0.6303	92.69	.374270	.140491	2.9407	92.35	2.9485	92.66	.140562
May ...	33.9	16.7	0.3893	95.39	.374067	.140343	2.8584	95.20	2.8575	95.25	.140346
June ...	34.5	17.3	0.4676	95.34	.374112	.140433	2.8179	94.90	2.8494	94.92	.140578
July ...	34.2	17.0	3.6679	94.39	.374079	.140385	2.9348	93.82	2.9559	93.93	.140492
August ...	34.3	15.9	3.6795	92.20	.374145	.140420	2.9044	91.62	2.9397	91.61	.140560
September ...	30.4	16.2	3.6627	90.11	.374289	.139991	3.0371	89.24	3.0395	89.15	.139988
October ...	30.1	16.0	3.4932	90.02	.374258	.139943	3.0197	89.04	3.0296	89.07	.139983
November ...	33.5	14.8	3.5987	89.43	374485	.140449	3.0907	88.42	3.0964	88.40	.140467
December ...	35.9	16.2	3.4009	88.82	.374408	.140718	3.1035	87.67	3.1074	87.61	.140724
Means ...	...	...	...	...	...	...	...	...	...	...	.140353
					1893.						
January ...	20 35.2	16.8	3.5329	87.77	.374338	.140605	3.1940	86.48	3.1786	86.56	.140564
February ...	34.9	15.4	3.5208	86.95	.374445	.140608	3.1647	85.75	3.1769	85.66	.140635
March ...	33.9	17.3	3.4989	88.30	.374426	.140475	3.0127	87.37	3.0446	87.33	.140583
April ...	34.8	16.0	3.3819	91.42	.374406	.140582	2.8397	90.77	2.8451	90.76	.140604
May ...	35.4	15.8	3.3401	93.92	.374534	.140702	2.2978	91.41	2.3089	91.52	.140750
June ...	36.1	16.2	3.2234	94.21	.374398	.140741	2.2710	91.70	2.2802	91.75	.140780
July ...	35.8	16.0	3.2379	92.41	.374379	.140695	2.2574	89.96	2.2769	89.93	.140772
August ...	33.4	14.8	3.2965	91.94	.374510	.140446	2.2354	89.37	2.2530	89.40	.140517
September ...	34.5	15.2	3.0705	91.99	.374403	.140543	2.2035	89.29	2.2207	89.32	.140613
October ...	34.5	16.8	2.9597	91.94	.374359	.140527	2.1767	89.31	2.1868	89.32	.140567
November ...	35.6	15.4	2.8500	91.94	.374186	.140598	2.1579	89.32	2.1631	89.41	.140622
December ...	37.1	15.2	2.8884	90.94	.374255	.140809	2.1466	88.29	2.1520	88.20	.140828
Means ...	...	...	...	...	...	...	...	...	...	...	.140653

TABLE 186.—*Reduction of monthly and annual Means of Absolute Vertical Force.*

Month.	Mean observed absolute Inclination.	Mean date of Inclination observations.	Mean ordinate of Horizontal Force Magnetograms, at times of Inclination observations.	Mean temperature of Horizontal Force enclosure at times of Inclination observations.	Mean Horizontal Force at the times of Inclination observations.	Mean Vertical Force at the times of Inclination observations derived from columns 2 and 6.	Mean ordinate of Vertical Force Magnetograms, at times of Inclination observations.	Mean temperature of Vertical Force enclosure at times of Inclination observations.	Mean monthly ordinate of Vertical Force Magnetograms.	Mean monthly temperature of Vertical Force enclosure.	Mean monthly Vertical Force.
1	2	3	4	5	6	7	8	9	10	11	12
					1894.						
	° ′		inch.	°			inch.	°	inch.	°	
January ...	20 35·5	15·9	2·9094	89·23	·374218	·140598	2·1087	86·34	2·1259	86·39	·140669
February ...	37·3	13·3	2·8301	89·16	·374219	·140822	2·0981	86·37	2·1077	86·45	·140864
March ...	38·7	16·2	2·7544	90·36	·374332	·141039	2·1719	87·54	2·0699	87·63	·140632
April ...	39·9	15·0	2·6976	92·40	·374381	·141205	2·0140	89·61	2·0201	89·72	·141234
May ...	40·6	14·8	2·5662	94·33	·374433	·141312	1·9629	91·53	1·9609	91·73	·141311
June ...	41·0	15·2	2·5024	95·03	·374341	·141329	1.9169	92·23	1·9243	92·27	·141360
July ...	41·9	16·8	2·4134	93·11	·374215	·141390	1.9769	90·36	1·9884	90·61	·141444
August ...	41·3	17·2	2·2978	91·91	·374148	·141290	1·9681	89·31	1·9658	89·37	·141283
September	41·4	16·0	2·2752	91·21	·374138	·141299	1·9174	88·54	1·9497	88·52	·141428
October ...	41·5	15·7	2·2554	90·82	·374295	·141371	1·9385	88·06	1·9361	88·17	·141365
November ...	43·8	16·2	2·2269	90·03	·374332	·141671	1·9431	87·24	1·9471	87·34	·141690
December ...	44·8	16·0	2·2234	89·10	·374289	·141782	1·9328	86·41	1·9456	86·57	·141839
Means ...	20 40·6	15·7	2·4960	91·39	·374278	·141259	1·9958	88·63	1·9951	88·73	·141260
					1895.						
January ...	20 45·0	14·4	2·2149	88·51	·374232	·141785	1·8701	85·76	1·8766	85·89	·141815
February ...	46·4	13·6	2·1547	88·51	·374250	·141965	1·8639	86·15	1·8640	86·24	·141968
March ...	46·4	15·2	2·1279	90·46	·374339	·141997	1·5408	88·02	1·5287	88·12	·141951
April ...	45·9	15·8	2·1165	92·07	·374451	·141978	1·3107	89·28	1·3093	89·36	·141975
May ...	46·6	17·2	1·9784	94·36	·374555	·142079	1·2579	91·59	1·2601	91·53	·142086
June ...	48·7	16·0	1·8747	95·10	·374337	·142285	1·2015	92·40	1·2135	92·36	·142332
July ...	49·4	15·8	1·9312	93·78	·374404	·142397	1·2668	90·97	1·2170	90·93	·142195
August ...	48·9	16·2	1·8749	91·86	·374389	·142328	1·2037	89·26	1·2106	89·28	·142357
September ...	49·5	15·0	1·8783	91·05	·374469	·142433	1·1973	88·32	1·2087	88·33	·142479
October ...	49·9	14·9	1·6073	91·38	·374505	·142498	1·1919	88·71	1·1894	88·70	·142488
November ...	51·8	15·2	1·5943	91·13	·374481	·142725	1·1777	88·52	1·1849	88·51	·142754
December ...	53·8	16·8	1·6167	90·34	·374630	·143031	1·1842	87·61	1·1908	87·60	·143058
Means ...	20 48·5	15·5	1·9141	91·55	·374420	·142291	1·3555	88·88	1·3545	88·90	·142288
					1896.						
January ...	20 54·1	17·2	1·4514	89·79	·374463	·143005	1·5201	87·00	1·5223	87·10	·143017
February ...	54·6	15·7	1·5314	89·42	·374381	·143037	1·5343	86·51	1·5362	86·63	·143049
March ...	55·3	16·8	1·5646	90·49	·374617	·143215	1·5218	87·77	1·5240	87·79	·143225
April ...	55·5	15·5	1·5290	93·31	·374682	·143265	1·4743	90·70	1·4718	90·74	·143256
May ...	56·7	15·2	1·2817	95·36	·374547	·143364	1·4524	92·82	1·4549	92·97	·143379
June ...	57·3	15·8	1·3947	95·56	·374782	·143529	1·4336	92·91	1·4463	92·91	·143580
July ...	57·2	17·2	1·3541	92·68	·374623	·143453	1·4482	89·99	1·4650	90·10	·143525
August ...	54·3	16·0	1·1457	90·72	·374468	·143034	1·4244	88·22	1·4424	88·23	·143107
September ...	56·2	14·8	1·2499	90·79	·374624	·143331	1·4141	88·17	1·4331	88·29	·143412
October ...	54·4	16·2	1·0508	91·67	·374542	·143074	1·4031	89·14	1·4158	89·25	·143130
November ...	56·1	14·9	0·9952	91·89	·374579	·143301	1·4108	89·26	1·4146	89·27	·143316
December ...	55·2	14·8	1·0106	90·71	·374648	·143215	1·4068	87·91	1·4125	87·87	·143237
Means ...	20 55·6	15·8	1·2966	91·87	·374580	·143235	1·4537	89·20	1·4616	89·26	·143269

TABLE 186.—*Reduction of monthly and annual Means of Absolute Vertical Force.*

Month.	Mean observed absolute Inclination.	Mean date of Inclination observations.	Mean ordinate of Horizontal Force Magnetograms, at times of Inclination observations.	Mean temperature of Horizontal Force enclosure at times of Inclination observations.	Mean Horizontal Force at the times of Inclination observations.	Mean Vertical Force at the times of Inclination observations derived from columns 2 and 6.	Mean ordinate of Vertical Force Magnetograms, at times of Inclination observations.	Mean temperature of Vertical Force enclosure at times of Inclination observations.	Mean monthly ordinate of Vertical Force Magnetograms.	Mean monthly temperature of Vertical Force enclosure.	Mean monthly Vertical Force.
1	2	3	4	5	6	7	8	9	10	11	12
			1897.								
	° ′		inch.	°			inch.	°	inch.	°	
January ...	20 56·1	15·1	1·0861	88·76	·374675	·143338	1·4297	85·92	1·4407	85·94	·143384
February ...	55·8	14·0	1·0858	87·99	·374644	·143288	1·4421	85·11	1·4563	85·17	·143348
March ...	57·3	15·9	1·0116	88·83	·374644	·143476	1·4309	86·22	1·4462	86·30	·143541
April ...	58·6	16·2	0·7784	91·40	·374442	·143559	1·3897	88·97	1·4067	88·97	·143628
May ...	58·9	16·0	0·7047	93·99	·374549	·143638	1·3442	91·55	1·3625	91·64	·143715
June ...	59·5	14·9	0·7014	95·36	·374678	·143764	1·3252	92·83	1·3467	92·95	·143855
July ...	58·3	16·2	0·7591	93·93	·374813	·143665	1·3423	91·32	1·3688	91·39	·143775
August ...	59·4	16·8	0·7127	92·13	·374633	·143734	1·3634	89·77	1·3828	89·79	·143814
September ...	21 0·1	15·5	0·6807	91·74	·374699	·143847	1·3686	89·29	1·3822	89·42	·143906
October ...	0·8	15·2	0·5801	91·24	·374573	·143887	1·3825	88·84	1·3842	88·93	·143897
November ...	1·8	15·8	0·4901	90·31	·374520	·143989	1·4080	87·92	1·4102	87·87	·143996
December ...	3·0	18·6	0·4021	88·99	·374457	·144115	1·4155	86·30	1·4216	86·49	·144146
Means ...	20 59·1	15·8	0·7494	91·22	·374611	·143692	1·3868	88·67	1·4007	88·74	·143750
			1898.								
	° ′										
January ...	21 3·8	16·0	3·4482	88·00	·374464	·144218	1·4582	85·24	1·4561	85·38	·144214
February ...	4·1	13·0	3·4940	88·74	·374622	·144317	1·4628	85·87	1·4618	85·86	·144313
March ...	3·9	15·0	3·4218	89·60	·374585	·144278	1·4260	87·01	1·4327	87·06	·144307
April ...	5·2	15·2	3·3206	92·12	·374447	·144387	1·3938	89·54	1·3945	89·62	·144393
May ...	4·8	16·8	3·2455	94·41	·374515	·144363	1·3386	91·93	1·3509	91·96	·144414
June ...	5·5	15·5	3·2484	94·39	·374580	·144476	1·3478	91·84	1·3575	91·82	·144514
July ...	6·3	15·2	3·1963	92·91	·374463	·144531	1·3961	90·16	1·3985	90·10	·144539
August ...	6·6	15·7	3·1674	91·67	·374549	·144602	1·3961	89·10	1·4119	89·05	·144664
September ...	8·6	16·2	2·9911	91·07	·374368	·144782	1·4306	88·43	1·4246	88·45	·144759
October ...	8·2	16·0	2·9709	91·60	·374408	·144747	1·4191	89·05	1·4183	89·00	·144742
November ...	8·3	14·8	2·8842	91·62	·374359	·144741	1·4283	89·02	1·4288	89·04	·144744
December ...	8·7	16·2	2·9478	90·81	·374646	·144902	1·4444	88·12	1·4435	88·30	·144904
Means ...	21 6·2	15·5	3·1947	91·41	·374500	·144529	1·4118	88·78	1·4149	88·80	·144542
			1899.								
	°										
January ...	21 9·8	16·7	2·9911	88·20	·374640	·145037	1·5364	85·32	1·5370	85·24	·145036
February ...	11·6	15·5	2·9247	88·19	·374477	·145200	1·4996	85·47	1·5027	85·34	·145209
March ...	11·8	17·1	2·8582	89·59	·374429	·145206	1·4628	87·11	1 4660	87·10	·145219
April ...	11·6	16·0	2·7571	92·32	·374498	·145208	1·4214	89·77	1·4230	89·74	·145214
May ...	13·0	15·8	2·5172	94·16	·374406	·145348	1·3961	91·68	1·3982	91·69	·145357
June ...	12·9	16·2	2·6010	94·57	·374505	·145374	1·3892	92·04	1·4022	92·14	·145430
July ...	13·9	16·0	2·6241	92·87	·374498	·145496	1·4145	90·24	1·4166	90·26	·145505
August ...	14·6	14·8	2·6472	92·66	·374550	·145604	1 4191	89·96	1·4231	90·00	·145621
September ...	15·6	15·2	2·4941	92·46	·374408	·145675	1 4398	89·78	1·4422	89·80	·145686
October ...	16·8	16·8	2·4450	92 99	·374432	·145834	1·4605	90·33	1·4574	90·31	·145820
November ...	17·0	15·5	2·4652	92·62	·374568	·145912	1·4697	89·96	1·4699	90·00	·145914
December ...	18·2	15·2	2·3640	91·64	·374540	·146052	1 4835	88·94	1·4864	88·91	·146063
Means ...	21 13·9	15·9	2·6407	91·86	·374496	·145495	1·4494	89·22	1·4521	89·21	·145506

TABLE 186.—*Reduction of monthly and annual Means of Absolute Vertical Force.*

Month.	Mean observed absolute Inclination.	Mean date of Inclination observations.	Mean ordinate of Horizontal Force Magnetograms, at times of Inclination observations.	Mean temperature of Horizontal Force enclosure at times of Inclination observations.	Mean Horizontal Force at the times of Inclination observations.	Mean Vertical Force at the times of Inclination observations derived from columns 2 and 6.	Mean ordinate of Vertical Force Magnetograms, at times of Inclination observations.	Mean temperature of Vertical Force enclosure at times of Inclination observations.	Mean monthly ordinate of Vertical Force Magnetograms.	Mean monthly temperature of Vertical Force enclosure.	Mean monthly Vertical Force.
1	2	3	4	5	6	7	8	9	10	11	12
					1900.						
	° ′		inch.	°			inch.	°	inch.	°	
January ...	21 18·5	15·8	2·3814	89·61	·374490	·146070	1·6100	86·82	1·6165	86·85	·146098
February ...	20·1	14·3	2·4478	88·72	·374489	·146271	1·6353	85·94	1·6373	86·02	·146282
March ...	20·6	16·2	2·2137	90·13	·374393	·146296	1·6169	87·41	1·6219	87·52	·146321
April ...	20·1	15·0	2·2715	92·09	·374570	·146302	1·5847	89·51	1·5931	89·69	·146343
May ...	21·1	14·8	2·1068	93·96	·374335	·146336	1·5663	91·50	1·5777	91·59	·146386
June ...	20·8	15·2	2·1733	94·76	·374543	·146380	1·5640	92·39	1·5725	92·44	·146417
July ...	21·3	16·8	2·1993	93·53	·374532	·146438	1·5847	91·03	1·5898	91·14	·146463
August ...	23·1	17·2	2·1617	91·76	·374531	·146664	1·5916	89·31	1·5960	89·37	·146684
September ...	23·6	16·0	2·0808	91·15	·374570	·146742	1·5824	88·74	1·5817	88·83	·146742
October ...	24·0	15·8	2·0606	91·23	·374580	·146796	1·5755	88·80	1·5718	88·73	·146779
November ...	24·5	16·2	2·0085	90·98	·374615	·146873	1·5824	88·48	1·5788	88·59	·146862
December ...	25·4	16·0	1·9796	90·64	·374469	·146929	1·5939	88·02	1·5915	88·13	·146923
Means ...	21 21·9	15·8	2·1737	91·55	·374510	·146508	1·5906	89·00	1·5940	89·07	·146525
					1901.						
	°		c. m.	°			c. m.	°	c. m.	°	
January ...	21 26·4	14·8	5·0870	89·06	·374582	·147098	4·4480	86·32	4·4690	86·30	·147130
February ...	26·6	13·5	5·1380	87·55	·374516	·147098	4·5010	85·00	4·5230	85·09	·147136
March ...	27·5	15·3	4·7340	89·62	·374467	·147192	4·4480	87·10	4·4510	87·27	·147203
April ...	27·4	15·8	4·6460	92·50	·374588	·147226	4·3200	90·03	4·3580	90·17	·147292
May ...	28·5	17·3	4.4040	94·42	·374566	·147357	4·2730	91·88	4·3160	91·90	·147427
June ...	29·2	16·0	4·2870	94·71	·374627	·147469	4·2680	92·19	4·3170	92·21	·147549
July ...	30·1	15·8	4·2940	92·77	·374530	·147544	4·3670	90·07	4·4180	90·03	·147625
August ...	31·4	16·2	4·1100	91·17	·374480	·147688	4·4540	88·50	4·4610	88·55	·147701
September ...	31·6	15·0	4·0520	90·84	·374467	·147708	4·4190	88·31	4·4350	88·41	·147736
October ...	31·8	14·7	3·9270	91·36	·374391	·147703	4·4310	88·81	4·4350	88·92	·147713
November ...	32·4	15·3	3·6990	91·39	·374438	·147797	4·4540	88·81	4·4750	88·78	·147829
December ...	33·7	15·0	3·7430	90·16	·374344	·147923	4·5240	87·59	4·5480	87·54	·147959
Means ...	21 29·7	15·4	4·3430	91·30	·374500	·147484	4·4090	88·72	4·4340	88·76	·147525
					1902.						
	°										
January ...	21 33·4	15·7	3·5820	89·51	·374320	·147876	4·6580	86·89	4·7050	86·88	·147951
February ...	33·8	16·0	3·6770	89·06	·374455	·147980	4·7340	86·52	4·7520	86·54	·148010
March ...	33·7	16·1	3·6700	90·72	·374511	·147990	4·6520	88·26	4·7040	88·36	·148077
April ...	33·9	15·0	3·3840	92·98	·374504	·148012	4·5880	90·52	4·6520	90·61	·148119
May ...	34·9	16·3	3·0310	95·16	·374385	·148091	4·5650	92·80	4·6140	92·81	·148170
June ...	34·6	15·0	2·9870	95·81	·374499	·148098	4·5590	93·31	4·6220	93·30	·148200
July ...	36·0	14·8	2·8920	94·83	·374478	·148266	4·6290	92·38	4·6970	92·27	·148371
August ...	38·2	15·3	2·7970	93·84	·374425	·148522	4·7160	91·53	4·7550	91·53	·148585
September ...	37·5	15·8	2·7520	92·69	·374309	·148388	4·7510	90·13	4·8200	90·07	·148497
October ...	38·2	15·6	2·6640	92·50	·374394	·148510	4·8160	89·94	4·8470	90·03	·148563
November ...	39·9	16·0	2·3850	92·32	·374396	·148725	4·8680	89·86	4·8920	89·82	·148763
December ...	39·5	15·8	2·4220	91·10	·374360	·148661	4·7690	88·59	4·8040	88·55	·148716
Means ...	21 36·1	15·6	3·0200	92·54	·374420	·148260	4·6920	90·61	4·7390	90·06	·148335

TABLE 186.—*Reductions of monthly and annual Means of Absolute Vertical Force.*

Month.	Mean observed absolute Inclination.	Mean date of Inclination observation.	Mean ordinate of Horizontal Force magnetograms, at times of Inclination observations.	Mean temperature of Horizontal Force enclosure at times of Inclination observations.	Mean Horizontal Force at the times of Inclination observation.	Mean Vertical Force at the times of Inclination observation derived from columns 2 and 6.	Mean ordinate of Vertical Force magnetograms, at times of Inclination observations.	Mean temperature of Vertical Force enclosure at times of Inclination observations.	Mean monthly ordinate of Vertical Force Magnetograms.	Mean monthly temperature of Vertical Force enclosure.	Mean monthly Vertical Force.
1	2	3	4	5	6	7	8	9	10	11	12
1903.											
	° ′		c. m.	°			c. m.	°	c. m.	°	
January ...	21 40·7	16·3	2·1950	89·22	·374275	·148778	4·7050	86·58	4·7460	86·62	·148848
February ...	40·3	15·0	2·3710	87·75	·374404	·148779	4·7690	85·09	4·7420	85·10	·148733
March ...	41·3	15·0	2·1800	88·84	·374283	·148857	4·7400	86·25	4·6890	86·29	·148772
April ...	40·7	14·0	2·0180	90·66	·374301	·148788	4·6470	88·16	4·6250	88·37	·148758
May ...	41·0	16·1	1·8280	93·19	·374289	·148822	4·4890	90·72	4·4820	90·83	·148814
June ...	42·0	15·9	1·5410	93·68	·374397	·148991	4·4480	91·24	4·4380	91·16	·148972
July ...	43·7	17·2	1·5930	92·60	·374432	·149219	4·6000	90·06	4·5410	90·19	·149126
August ...	45·4	16·1	1·5560	90·99	·374318	·149388	4·6230	88·55	4·5930	88·54	·149339
September ...	45·3	14·8	1·3290	90·80	·374220	·149336	4·6410	88·29	4·6090	88·29	·149283
October ...	45·4	16·2	0·9100	90·73	·374156	·149323	4·6700	88·23	4·6280	88·20	·149253
November ...	47·6	16·7	0·4000	89·66	·374043	·149556	4·7690	87·04	4·7070	87·27	·149462
December ...	47·6	14·8	0·8060	88·82	·374076	·149569	4·7980	86·08	4·7660	85·97	·149512
Means ...	21 43·4	15·7	1·5610	90·58	·374266	·149117	4·6580	88·02	4·6300	88·07	·149073
1904.											
	° ′										
January ...	21 48·1	15·2	6·4890	87·51	·374170	·149670	5·1420	84·84	5·1560	84·91	·149695
February ...	48·7	14·0	6·6570	88·32	·374119	·149725	5·1600	85·75	5·1640	85·83	·149735
March ...	48·0	14·7	6·9440	89·08	·374168	·149657	5·1480	86·50	5·1600	86·64	·149682
April ...	47·3	15·3	6·2680	91·18	·373880	·149453	5·0720	88·82	5·0970	88·90	·149497
May ...	47·5	16·8	6·1880	93·20	·374047	·149545	5·0550	90·87	5·1130	90·86	·149641
June ...	48·2	15·5	6·0630	93·50	·373994	·149612	5·1300	91·10	5·1620	91·14	·149666
July ...	49·0	15·2	6·4670	92·09	·374134	·149769	5·2410	89·72	5·2510	89·70	·149785
August ...	48·5	15·8	6·2980	91·64	·374105	·149694	5·2530	89·16	5·2850	89·19	·149748
September ...	48·8	16·2	5·9820	91·32	·374012	·149695	5·3050	88·88	5·3310	88·89	·149738
October ...	49·9	15·9	5·8570	92·16	·373932	·149802	5·2940	89·76	5·3430	89·73	·149883
November ...	51·7	14·9	5·5930	91·96	·373899	·150016	5·3870	89·40	5·3810	89·39	·150006
December ...	52·7	16·2	5·7110	90·27	·374013	·150188	5·4570	87·70	5·4650	87·64	·150199
Means ...	21 49·0	15·5	6·2100	91·02	·374039	·149735	5·2203	88·54	5·2423	88·57	·149773
1905.											
	° ′										
January ...	21 53·5	16·9	5·6660	88·68	·373962	·150268	5·3580	86·01	5·3940	86·12	·150332
February ...	55·3	15·6	5·5200	86·82	·373904	·150473	5·4280	84·06	5·4770	84·06	·150555
March ...	55·0	17·3	5·7470	88·10	·374086	·150508	5·4220	85·49	5·4570	85·43	·150564
April ...	54·0	15·9	5·5200	90·21	·373950	·150327	5·3750	87·79	5·4000	87·76	·150367
May ...	54·8	15·8	5·4020	93·37	·374077	·150479	5·2180	90·91	5·2880	90·88	·150593
June ...	56·2	16·2	4·8960	94·90	·374008	·150628	5·1650	92·32	5·2180	92·37	·150717
July ...	59·5	16·0	5·0940	93·56	·374066	·151069	5·2760	91·07	5·3130	90·99	·151127
August ...	59·3	14·8	4·9180	92·52	·374016	·151024	5·3460	89·93	5·3760	89·94	·151073
September ...	22 0·5	15·3	4·5950	92·59	·373957	·151152	5·2990	90·06	5·3090	90·01	·151166
October ...	21 59·3	16·8	4·7490	93·53	·374008	·151020	5·1950	90·94	5·2580	90·87	·151121
November ...	59·9	15·5	4·2720	93·67	·373954	·151074	5·2530	91·11	5·2710	91·11	·151103
December ...	22 1·0	15·2	4·3450	91·67	·374032	·151245	5·3460	88·99	5·3780	88·88	·151293
Means ...	21 57·4	15·9	5·0600	91·63	·374002	·150772	5·3067	89·06	5·3449	89·03	·150834

The result of the procedure may be open to some objection as it no doubt transfers the effects of the dislocations to the aperiodic change as a part of the instrumental defect, but as mathematical analysis requires the 25th hour of the inequality to be of the same magnitude as the 1st hour, the error is distributed and the inequality from hour to hour at any rate remains practically unaffected.

247. The tabulated ordinates are duly entered hence in the forms from 10 a.m. to 10 a.m. and sums and means are derived in the usual way. Form F appended gives details of one month's result. The variation shown in the last row but one is then finally changed into force inequality by the scale coefficient of the instrument for the particular month.

5. Temperature corrections to diurnal inequality.

248. Table 187 gives the temperature figures in the enclosure of the V. F. Magnetographs No. 1 and No. 2 taken five times a day at 6, 10, 14, 16, and 22 hours. The variation indicated by these figures it will be seen is very minute. And with the temperature coefficient $-3{\cdot}4\gamma$ for 1° F., it is appreciably significant and equals $0{\cdot}3\gamma$ at only one hour, namely at 10 a.m.

249. For the purpose of securing the character of the continuous registration of temperature in the enclosure for 24 hours as also for definitely deciding whether or not, the thermometer readings in the magnetograph enclosures are a correct measure of the actual changes of temperature of the magnet itself, special experiments were conducted for three months, and eye readings of the continuous registration of the temperature phenomenon in the enclosure have been recorded for the period. The instrument was opened up, the magnet was supported on its Ys and a small thin brass bracket shoe closely fitting the magnet was attached to it. The bracket was provided with a tube attachment in which the bulb of an open scale thermometer* specially ordered for the purpose was closely fitted, the bulb being in actual contact with the metallic tube. The arrangement was so devised as to put the bulb of the thermometer in as good a metallic contact with the magnet as was possible so that the thermometer readings could be accepted with confidence as denoting the changes in the temperature of the magnet itself. In the original position about 8 inches away from the magnet where the old thermometer stood in the enclosure, was placed another similar open scale thermometer. All things were replaced and the enclosure was closed in the same condition as before.

250. The results of observations have already been given in table 54 from which it will be seen that in December, January and March or winter months when the variation is about the largest in the underground room, the greatest amplitude recorded by the thermometer in the usual place in the enclosure is $0^\circ{\cdot}15$ or $0^\circ{\cdot}16$ at 10 or 11 hours. But the actual maximum temperature of the magnet is reached somewhat later—between 11 and 12 noon—and what is of greater significance, the range is appreciably smaller. In columns 4 and 7 the differences are exhibited, from which it will readily be seen that the differences are from a third to a half of the variations themselves. The variation for the month of April tells a similar tale ; only it is less pronounced in amplitude. It is of course difficult to generalise from the data of a few months, but without any hesitation two facts must be recognised : (1) that the temperature variation of the magnet is somewhat smaller in amplitude than that recorded by the thermometer and (2) that the phase is different. In the light of these facts it will at once become apparent why one would hesitate to make use of the data like those indicated in table 187 for the application of the minute corrections, about which such uncertainty prevails, and which with a small temperature coefficient of $-3{\cdot}4\gamma$ brings up the magnitude of the correction applicable to a few hours only (10, 11 and 12 hours) to the *just* appreciable and significant amount of $0{\cdot}3\gamma$ to $0{\cdot}5\gamma$. Even in the analysis for Fourier coefficents, aperodic corrections up to $0{\cdot}5\gamma$ are usually omitted. It seems best under the circumstances to accept the variations as practically compensated for temperature and merely to indicate here, the nature of the possible residual errors without attempting their application which may not improbably result in vitiating an otherwise correct record.

251. The investigation serves at any rate the purpose of indicating how unsafe it is to rely upon the record of a thermograph placed outside the enclosure of the magnetographs and to utilize its readings for the application of the temperature corrections of magnets inside the enclosure. To this subject we shall presently recur.

252. It also shows how absolutely essential it is not only to have a small temperature coefficient (if possible) for the magnet, but to secure as small a variation of temperature itself in the enclosure as possible which besides should be correctly measured by open scale thermometers to allow of $0^\circ{\cdot}1$ F to be read off accurately. To rely upon the readings of a thermometer the length of a division of the scale of which is about $\frac{1}{20}$th of an inch can hardly ensure the necessary degree of accuracy, however large the number of such

* 1° F. = 0·2 inch.

FORM

Government Observatory, Bombay, Month of August 1904,

Tabulated by	Checked by	Colaba Civil Hour.	10	11	12	13	14	15	16	17	18	19	20	21
·000	·000	Date.												
5th August 1904, K. B. P.	10th August 1904, A.	1	4·987	5·000	5·095	5·147	5·175	5·237	5·245	5·222	5·182	5·180	5·190	5·200
K. B. P. ...	A.	2	5·120	·150	·190	·155	·185	·212	·210	·220	·210	·192	·195	·200
8th August 1904, K. B. P.	A.	3	·150	·145	·180	·220	·232	·200	·192	·210	·210	·185	·170	·170
8th August 1904, K. B. P.	A.	4	·105	·090	·127	·180	·240	·270	·290	·260	·200	·200	·207	·225
9th August 1904, K. B. P.	A.	5	·055	·092	·130	·200	·250	·280	·245	·222	·197	·205	·207	·212
K. B. P. ...	A.	6	·117	·137	·190	·240	·235	·275	·282	·232	·200	·200	·202	·207
17th August 1904, K. B. P.	·000 24th August 1904, A.	7	*·107* ·092	*·087* ·072	*·135* ·120	*·250* ·235	*·295* ·280	·322	·300	·247	·205	·200	·202	·225
K. B. P. ...	A.	8	·145	·200	·237	·267	·297	·300	·267	·245	·200	·200	·215	·215
K. B. P. ...	A.	9	·120	·147	·147	·275	·277	·277	·267	·240	·200	·200	·215	·222
K. B. P. ...	A.	10	·107	·160	·177	·205	·237	·245	·227	·205	·200	·200	·215	·237
K. B. P. ...	A.	11	·035	·100	·142	·180	·230	·230	·250	·250	·210	·210	·222	·230
K. B. P. ...	A.	12	4·995	·037	·115	·167	·237	·305	·300	·240	·200	·205	·210	·230
·000 27th August 1904, K. B.	·000 28th August 1904, A.	13	5·087	·120	·115	·125	·182	·210	·220	·225	·220	·200	·195	·205
K. B. ...	A.	14	·140	·120	·110	·180	·232	·240	·267	·270	·225	·205	·207	·215
K. B. ...	A.	15	·152	·182	·135	·140	·150	·235	·242	·230	·195	·180	·200	·215
K. B. ...	A.	16	·110	·070	·070	·110	·140	·175	·205	·190	·170	·180	·187	·185
K. B. ...	A.	17	·137	·130	·147	·180	·190	·192	·200	·200	·200	·215	·200	·200
·000 31st August 1904, K. B.	·000 27th August 1904, A.	18	·125	·120	·120	·122	·122	·137	·165	·170	·200	·200	·200	·210
K. B. ...	·000 30th August 1904, A.	19	·190	·155	·182	·240	·275	·247	·230	·185	·195	·190	·187	·200
K. B. ...	A.	20	·020	·052	·095	·165	·240	·255	·250	·230	·220	·205	·202	·212
K. B. ...	·000 31st August 1904, A.	21	·082	·127	·200	·215	·227	·232	·212	·195	·212	·207	·207	·207
K. B. ...	A.	22	·130	·167	·205	·260	·277	·297	·305	·267	·222	·230	·230	·230
K. B. ...	A.	23	·050	·035	·060	·127	·182	·210	·215	·210	·192	·192	·200	·215
K. B. ...	A.	24	·100	·095	·120	·165	·225	·245	·227	·220	·222	·207	·205	·215
K. B. P. ...	A.	25	·020	·057	·122	·197	·210	·225	·247	·220	·207	·207	·205	·207
K. B. K. ...	A.	26	4·940	·000	·060	·130	·200	·247	·262	·232	·200	·200	·207	·215
K. B. P. ...	·000 1st September 1904, A.	27	5·085	·080	·092	·130	·167	·195	·220	·195	·190	·187	·197	·215
K. B. P. ...	A.	28	4·977	·047	0·80	·137	·195	·230	·220	·160	·147	·162	·170	·180
·000 5th September 1904, K. B.	·000 8th September 1904, A.	29	·980	4·962	·032	·092	·197	·245	·250	·210	·157	·155	·167	·185
K. B. ...	A.	30	5·015	·990	4·982	·072	·132	·162	·167	·162	·170	·162	·192	·215
·000 7th September 1904, K. B.	A.	31	4·942	·950	·980	·065	·127	·180	·222	·220	·180	·162	·172	·180
		Sum ...	33·325	33·804	34·772	36·338	37·560	38·312	38·401	37·784	37·138	37·023	37·180	37·479
		Mean .	5·075	5·090	5·122	5·172	5·212	5·236	5·239	5·219	5·198	5·194	5·199	5·209
		Variation.	−·125	−·110	−·078	−·028	+·012	+·036	+·039	+·019	−·002	−·006	−·001	+·009
Scale coefficient ·0166 M. M. G. S. Unit.	Variations in M. M. G. S. Unit.		−00207	−00183	−00129	−00046	+00020	+00060	+00065	+00032	−00003	−00010	−00002	+00015

Hourly sums and means taken by M., 7th September 1904.
Do. do. checked by A., 3rd October 1904.

Variations taken by M., 26th September 1904.
Do. checked by A., 3rd October 1904.

F.

Hourly Abstract V. F. No. 2 Magnetograph.

Date.	22	23	0	1	2	3	4	5	6	7	8	9	Sum.	Mean.	
1	5·200	5·207	5·207	5·205	5·200	5·205	5·200	5·235	5·245	5·240	5·185	5·110	4·299	5·1791	
2	·200	·205	·215	·210	·205	·202	·202	·225	·245	·262	·235	·187			
3	·205	·230	·230	·230	·232	·220	·225	·260	·282	·280	·185	·117			
4	·235	·230	·222	·232	·232	·237	·247	·287	·302	·240	·132	·062			
5	·225	·220	·232	·232	·230	·240	·232	·260	·295	·302	·235	·137			
6	·227	·232	·230	·230	·230	·230	·222	·245	·270	·260	·200	·135			
7	·232	·232	·232	·240	·242	·242	·245	·275	·310	·262	·197	·187			
8	·240	·242	·242	·247	·252	·262	·262	·295	·320	·267	·190	·110			
9	·235	·237	·242	·245	·255	·252	·252	·275	·300	·280	·215	·137			
10	·225	·240	·240	·232	·232	·232	·240	·252	·290	·270	·190	·075			
11	·232	·235	·240	·230	·230	·232	·257	·265	·297	·267	·190	·057			
12	·232	·230	·215	·225	·235	·230	·242	·262	·295	·282	·170	·110			
13	·215	·230	·230	·230	·225	·220	·220	·235	·285	·260	·130	·040			
14	·227	·230	·230	·227	·225	·230	·235	·240	·277	·270	·240	·200			
15	·217	·222	·225	·230	·240	·230	·227	·235	·267	·245	·247	·190			
16	·205	·215	·222	·220	·220	·232	·230	·237	·275	·245	·232	·170			
17	·212	·220	·225	·230	·230	·227	·245	·255	·280	·247	·200	·125			
18	·227	·220	·220	·215	·225	·230	·230	·237	·280	·280	·247	·212			
19	·207	·215	·225	·227	·225	·227	·240	·247	·280	·247	·172	·110			
20	·225	·230	·225	·225	·235	·240	·245	·255	·267	·200	·095	·020			
21	·222	·230	·232	·240	·232	·232	·240	·260	·282	·240	·157	·120			
22	·240	·240	·240	·240	·245	·240	·242	·272	·315	·247	·187	·130			
23	·217	·225	·227	·230	·227	·232	·232	·245	·290	·280	·215	·142			
24	·222	·220	·222	·225	·230	·230	·232	·245	·295	·247	·137	·065			
25	·220	·220	·222	·222	·222	·225	·232	·250	·300	·235	·145	4·980			
26	·220	·227	·230	·225	·230	·230	·232	·247	·275	·260	200	5·137			
		·235	*·250*	*·252*	*·250*	*·260*	*·247*	*·270*	*·312*	*·305*	*·200*	*5·052*			
27	·220	·170	·185	·187	·185	·195	·182	·205	·247	·240	·135	4·987			
28	·170	·185	·187	·192	·200	·195	·190	·215	·257	·240	·195	5·060			
29	·175	·177	·192	·190	·202	·195	·207	·215	·257	·260	·180	·110			
30	·190	·200	·200	·182	·212	·220	·232	·242	·290	·220	·125	·032			
31	·182	·200	·207	·200	·200	·202	·212	·207	·267	·240	·165	·090	123·752	5·1563	
	37·701	37·881	37·958	37·960	38·050	38·081	38·196	38·745	38·802	38·980	36·793	34·409	892·672		
	5·216	5·222	5·224	5·225	5·227	5·228	5·232	5·250	5·252	5·257	5·187	5·110	28·795	5·200	– 5
	+ ·016	+ ·022	+ ·024	+ ·025	+ ·027	+ ·028	+ ·032	+ ·050	+ ·052	+ ·057	– ·013	– ·090			
	+00027	+00037	+00040	+00041	+00045	+00046	+00053	+00083	+00086	+00095	– 00022	– 00149			

The figures in italics are those corrected for dislocation.
Daily sums and means taken by M.
Do. do. checked by A.

Unity = 1° F.

TABLE 187.—*Inequalities of Temperature in the Vertical Force Magnetograph Enclosure.*

Years.	January						February.						March.						April.					
	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.
1873 ...	+·13	+·03	·00	·07	-·08	86°·62	+·15	+·03	-·08	-·18	+·09	86°·60	+·14	·00	-·09	-·16	+·11	87°·50	+·14	-·05	-·10	-·11	+·14	90°·50
1874 ...	-·09	+·05	+·04	+·02	-·04	83·76	-·08	+·06	+·05	·00	-·03	83·10	-·07	+·05	+·05	+·02	-·04	83·93	-·14	+·03	+·05	+·04	·00	85·70
1875 ...	-·06	+·04	+·07	+·02	-·07	84·58	-·11	+·06	+·06	+·02	-·05	83·47	-·13	+·04	+·03	+·02	+·02	85·87	-·10	·00	+·06	+·04	+·02	88·50
1876 ...	-·01	+·14	-·01	-·08	-·04	86·57	+·01	+·15	-·02	-·11	-·05	85·95	-·06	+·25	-·04	-·09	-·08	86·77	-·06	+·15	+·02	-·06	-·05	88·96
1877 ...	-·08	+·16	-·01	-·03	-·02	88·01	-·03	+·21	-·02	-·11	-·03	87·15	-·02	+·18	-·02	-·11	-·03	88·17	-·11	+·19	-·02	-·03	-·05	89·73
1878 ...	+·04	+·14	-·01	-·06	-·12	87·90	+·04	+·16	-·03	-·06	-·10	87·33	-·08	+·16	+·05	-·09	-·04	88·44	-·04	+·14	+·01	-·08	-·01	90·21
1879 ...	-·02	+·07	-·03	-·05	+·02	86·90	-·10	+·05	+·02	+·04	-·01	87·18	-·01	+·16	-·02	-·09	-·04	87·56	-·06	+·08	·00	+·02	-·03	89·37
1880 ...	-·12	+·05	+·05	+·05	-·06	84·35	+·02	+·09	-·01	-·11	+·01	84·09	-·08	+·09	-·02	-·05	+·06	85·54	-·11	+·09	+·05	-·02	-·02	88·42
1881 ...	-·06	+0·6	+·01	·00	+·01	85·68	-·13	+·06	+·03	+·03	+·01	85·31	-·06	+·11	-·04	-·04	+·02	86·41	-·02	+·19	-·01	-·08	-·07	87·54
1882 ...	+·22	+·05	-·08	-·09	-·12	86·10	+·29	+·11	-·13	-·16	-·14	85·50	+·17	+·10	-·08	-·13	-·07	86·22	+·14	+·05	-·06	-·08	-·04	88·25
1883 ...	+·23	+·07	-·08	-·11	-·11	86·67	+·24	+·07	-·08	-·11	-·13	85·78	+·24	+·09	-·07	-·13	-·11	86·02	+·16	-·05	-·05	-·05	·00	88·68
1884 ...	-·09	+·13	+·01	-·02	-·03	83·54	-·02	+·14	+·02	-·04	-·08	83·38	+·05	+·11	-·05	-·07	-·06	85·20	+·06	+·09	-·04	-·07	-·04	87·54
1885 ...	-·02	+·12	-·03	-·06	-·02	86·38	-·02	+·25	-·05	-·08	-·08	85·60	+·10	+·17	-·10	-·12	-·03	86·69	+·11	+·14	-·07	-·11	-·04	88·88
1886 ...	-·13	+·13	+·03	-·01	-·02	87·55	-·07	+·12	-·04	-·05	+·05	86·60	+·04	+·12	-·02	-·05	-·08	87·77	+·05	+·09	-·04	-·07	-0·5	89·64
1887 ...	-·03	+·10	-·02	-·05	·00	86·97	-·03	+·06	-·02	-·06	+·02	86·29	+·07	+·07	-·03	-·07	-·03	87·48	+0·6	+·04	-·04	-·07	-·01	89·52
1888 ...	+·01	+·03	-·01	-·04	+·02	86·57	-0·2	+·04	-·01	-·01	+·02	86·66	+·03	+·06	-·05	-·05	·00	88·66	+·07	+·11	-·04	-·08	-·06	91·04
1889 ...	-·03	+·09	-·03	-·03	-·02	88·99	·00	+·10	-·03	-·05	-·03	88·51	+·02	+·12	-0·5	-·06	-·03	89·61	+·06	+·12	-·06	-·08	-·05	90·92
1890 ...	-·03	+·14	-·03	-·05	-·02	87·25	-·02	+·16	-·04	-·06	-·04	87·47	-·01	+·15	-·05	-·03	-·17	88·80	-·04	+·08	-·02	-·03	-·03	90·61
1891 ...	-·08	+·12	+·01	·00	-·03	87·80	-·08	+·12	-·02	-·01	-·01	86·78	-·04	+·11	-·01	-·02	-·05	87·66	+·02	+·08	-·04	-·04	-·01	90·48
1892 ...	-·07	+·09	+·01	-·02	-·02	87·16	-·07	+·06	+·01	+·01	·00	87·47	-·05	+·11	-·03	-·02	+·01	88·07	+·02	+·07	-·04	-·06	·00	92·66
1893 ...	-·12	+·13	+·03	-·01	-0·3	86·56	-·11	+·06	+·02	+·03	-·02	85·66	-·04	+·09	-·04	-·02	+·01	87·33	+·04	+·02	-·06	-·03	+·05	90·76
1894 ...	-·08	+·26	-·05	-·09	-·02	88·27	-·03	+·19	-·07	-·05	-·01	88·26	+·01	+·22	-·07	-·14	+·01	89·51	+·02	+·15	-·06	-·07	-·02	91·84
1894 ..	-·09	+·26	+·05	-·09	-·02	86·39	-·02	+·19	-·03	-·07	-·06	86·45	+·02	+·16	-·07	-·16	+·02	87·63	+·04	+·16	-·07	-·08	-·07	89·72
1895 ...	-·10	+·18	-·07	-·02	+·02	85·89	-·14	+·17	-·10	+·14	-·08	86·24	-·07	+·16	-·05	-·03	-·03	88·12	-·01	+·10	-·06	-0·5	+·01	89·36
1896 ...	-·10	+·23	-·03	-·05	-·07	87·10	-·09	+·24	-·05	-·07	-·05	86·63	+·01	+·19	-·10	-·12	·00	87·79	+·04	+·13	-·08	-·07	·00	90·74
1897 ...	-·04	+·15	-·04	-·06	-·03	85·94	-·01	+·17	-·06	-·07	-·04	85·17	+·04	+·17	-·08	-·14	-·01	86·30	+·04	+·14	-·08	-·10	·00	88·97
1898 ...	-·09	+·15	-·03	-·05	+·01	85·38	-·04	+·18	-·04	-·06	-·04	85·86	-·02	+·22	-·06	-·11	-·04	87·06	+·01	+·20	-·08	-·08	-·04	89·62
1899 ...	-·07	+·18	·00	-·02	-·07	85·24	-·10	+·32	-·10	-·07	-·07	85·34	-·01	+·25	-·10	-·11	-·04	87·10	·00	+·17	-·06	-·08	-·02	89·74
1900 ...	-·08	+·27	-·08	-·07	-·03	86·85	-·02	+·27	-·12	-·11	-·01	86·02	+·05	+·19	-·14	-·12	·00	87·52	+·01	+·21	-·11	-·11	-·01	89·69
1901 ...	-·01	+·25	-·05	-·09	-·07	86·30	-·01	+·18	-·04	-·10	-·04	85·09	+·06	+·21	-·15	-·16	+·01	87·27	+·07	+·17	-·13	-·14	+·02	90·17
1902 ...	·00	+·21	-·11	-·11	+·03	86·88	+·06	+·22	-·15	-·13	·00	86·54	+·05	+·21	-·15	-·16	+·05	88·36	+·07	+·18	-·09	-·13	-·02	90·61
1903 ...	-·08	+·16	-·10	-·06	+·06	86·62	-·05	+·12	-·04	-·03	+·02	85·10	+·01	+·17	-·13	-·08	+·02	86·29	+·10	+·07	-·10	-·10	+·04	88·37
1904 ...	·00	+·13	-·02	-·06	-·05	84·91	-·04	+·16	-·05	-·07	-·01	85·83	+·03	+·21	-·09	-·10	-·04	86·64	+0·4	+·15	-·05	-·09	-·05	88·90
1905 ...	-·09	+·13	-·05	-·05	+·04	86·12	-·03	+·17	-·07	-·06	-·01	84·06	+·05	+·21	-·10	-·12	-·04	85·43	+·10	+·21	-·14	-·18	·00	87·76

Unity = 1° F.

TABLE 187.—*Inequalities of Temperature in Vertical Force Magnetograph Enclosures.*

Years.	May.						June.						July.						August.					
	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.
						°						°						°						°
1873 ...	+·17	-·03	-·09	-·17	+·11	92·18	+·07	+·03	+·04	·00	-·13	92·64	-·01	-·01	+·05	+·04	-·06	89·64	-·10	+·04	+·04	+·01	·00	88·43
1874 ...	-·12	+.01	+·06	+·04	+·02	88·96	-·07	+·01	+·06	+·03	-·01	90·70	·00	-·01	-·02	·00	+·01	89·14	-·08	·00	+·02	+·04	·00	87·64
1875 ...	-·11	+·02	+·04	+·02	+·02	91·23	-·04	+·01	·00	+·01	·00	93·60	-·05	+·04	+·03	·00	-·02	91·97	-·06	+·05	+·06	+·02	-·06	90·72
1876 ...	-·10	+·11	+·02	-·01	·00	91·36	-·10	+·03	+·03	+·05	·00	92·63	-·03	+·07	+·01	-·03	-·01	91·02	-·04	+·12	-·02	-·02	-·02	90·59
1877 ...	-·10	+·08	+·02	-·04	+·02	91·81	-·06	+·05	+·02	-·01	-·01	93·75	-·04	+·05	+·01	+·03	-·03	93·36	-·05	+·04	+·01	+·02	·60	92·80
1878 ...	-·06	+·03	+·01	-·02	+·02	92·16	-·11	+·03	+·02	+·03	+·01	93·92	-·02	+·04	·00	·00	-·01	92·01	-·06	+·03	·00	+·01	+·03	90·67
1879 ...	-·05	+·03	+·02	+·01	+·01	91·24	-·01	-·01	·00	+·01	+·01	91·75	-·02	+·02	-·01	-·02	+·02	91·37	·00	+ 01	-·03	-·03	+·03	90·46
1880 ...	-·01	+·02	-·01	-·03	+·03	89·92	-·02	+·02	+·02	-·01	-·03	90·93	-·01	·00	-·01	·00	·00	89·04	-·05	·00	+·03	+·02	·00	88·58
1881 ...	-·05	+·08	-·03	-·04	+·04	89·89	-·02	+·04	-·02	·00	+·02	90·61	-·02	+·05	-·02	-·02	-·01	89·33	-·07	·00	·00	+·02	+·03	89·06
1882 ...	+·25	+·02	-·10	-·10	-·05	90·30	+·22	+·03	-·06	-·07	-·12	90·62	+·16	+·04	-·06	-·08	-·06	89·58	+·19	+·01	-·06	-·08	+·08	89·05
1883 ...	-·24	-·01	+·13	+·16	-·04	92.22	+·10	+·05	-·05	-·04	-·08	92·54	+·17	+·03	-·04	-·05	-·09	90·65	+·21	+·04	-·07	-·08	-·08	89·83
1884 ...	+·06	+·03	-·05	-·04	·00	90·31	-·02	+·02	·00	·00	+·01	91·88	·00	+·08	·00	-·02	-·05	91·14	-·02	+·05	-·02	-·02	+·01	89·97
1885 ...	+·06	+·05	-·07	-·07	·00	91·40	-·02	+·05	-·01	-·01	-·01	92·99	·00	+·04	·00	-·03	-·01	92·25	-·06	+·03	+·01	+·01	-·01	90·54
1886 ...	+·03	+·04	-·02	-·01	-·02	92·53	-·03	+·05	·00	+·01	-·02	92·76	-·04	+·04	+·03	+·04	-·05	89·91	-·01	+·05	·00	-·02	-·02	88·82
1887 ...	+·04	-·01	-·04	-·04	+·04	91·89	-·03	+·04	+·02	·00	-·02	91·90	-·06	+·03	+·02	+·01	-·02	89·58	-·02	+·01	·00	·00	·00	88·77
1888 ...	+·02	+·01	-·03	-·04	+·01	92·81	-·04	+·03	+·01	·00	·00	93·54	-·04	+·06	·00	+·01	-·04	91·87	-·04	+·05	+·01	-·01	-·02	90·40
1889 ...	+·03	+·06	-·04	-·06	-·01	92·65	-·05	+·08	·00	-·01	-·02	93·32	-·05	+·07	·00	-·02	-·01	91·41	-·01	+·04	-·01	·00	·00	90·51
1890 ...	+·04	+·09	-·07	-·07	-·02	92·32	-·07	+·08	·00	·00	-·03	92·52	-·08	+·10	+·02	+·01	-·03	90·00	-·08	+·05	-·01	+·05	-·02	88·85
1891 ...	+·01	+·06	-·03	-·02	-·02	92·76	-·03	+·04	-·03	·00	-·01	94·48	-·08	+·10	-·01	-·02	·00	93·04	-·03	+·07	-·02	-·01	-·02	91·36
1892 ...	-·01	+·09	-·05	·00	-·02	95·25	-·05	+·10	+·01	-·01	-·03	94·92	-·03	+·11	-·00	-·03	-·03	93·93	-·11	+·16	+·02	-·02	-·07	91·61
1893 ...	+·02	+·07	-·06	-·06	+·04	93·67	-·06	+·11	+·01	-·02	-·04	93·78	-·07	+·10	-·01	-·02	-·01	91·63	-·08	+·09	+·01	-·01	-·02	91·10
1894 ...	+·06	+·13	-·08	-·08	-·02	93·88	-·08	+·13	-·01	-·03	+·01	94·44	-·12	+·15	-·02	-·03	+·01	92·60	-·06	+·09	-·06	-·03	+·05	91·25
1894 ...	+·05	+·12	-·08	-·08	-·03	91·73	-·07	+·10	+·01	-·01	-·01	92·27	-·11	+·16	-·03	-·02	-·01	90·61	-·05	+·12	-·05	-·03	·00	89·37
1895 ...	-·04	+·06	-·02	·00	·00	91·53	-·04	+·13	-·02	-·04	-·03	92·36	-·08	+·12	·00	-·03	-·02	90·93	-·03	+·10	-·02	-·04	-·01	89·28
1896 ...	+·04	+·11	-·06	-·06	-·02	92·97	-·06	+·12	-·01	-·03	·00	92·91	-·06	+·12	·00	-·03	-·02	90·10	-·05	+·11	-·01	-·05	-·01	88·23
1897 ...	+·05	+·09	-·05	-·07	·00	91·64	-·06	+·09	-·06	-·03	+·04	92·95	-·04	+·10	-·03	-·03	-·01	91·39	-·03	+·09	-·02	-·02	-·02	89·79
1898 ...	-·01	+·14	-·05	-·06	-·04	91·96	-·06	+·12	-·02	-·01	-·02	91·82	-·08	+·11	-·02	+·01	·00	90·10	-·07	+·09	-·02	-·01	·00	89·05
1899 ...	·00	+·13	-·07	-·07	-·01.	91·69	-·05	+·13	-·05	-·02	·00	92·14	-·10	+·08	-·02	·00	+·03	90·26	·00	+·03	-·02	·00	+·01	90·00
1900 ...	·00	+·15	-·06	-·06	-·01	91·59	-·04	+·08	-·04	-·02	+·03	92·44	-·04	+·15	-·03	-·05	-·03	91·14	-·05	+·10	-·02	-·01	-·01	89·37
1901 ..	-·04	+·15	-·11	-·10	+·02	91·90	-·02	+·14	-·04	-·08	+·02	92·21	-·04	+·15	-·03	-·04	-·03	90·03	-·05	+·17	-·04	-·05	-·01	88·55
1902 ...	+·07	+·09	-·09	-·11	+·03	92·81	-·10	+·09	·00	+·02	-·01	93·30	-·07	-·12	-·04	-·02	-·01	92·27	-·02	+·18	-·09	-·06	·00	91·53
1903 ...	+·01	+·12	-·08	-·05	+·02	90·83	-·03	+·08	-·04	·00	-·02	91·16	-·05	-·12	-·04	-·05	+·01	90·19	-·04	+·12	-·03	-·04	·00	88·54
1904 ...	+·01	+·09	-·04	-·06	-·02	90·86	-·03	+·10	-·03	-·02	-·01	91·14	-·06	+·06	-·02	·00	+·03	89·70	-·02	+·10	-·01	-·03	-·02	89·19
1905 ...	+·07	+·09	-·09	-·05	-·03	90·88	-·04	+·08	-·02	-·02	+·02	92·37	-·10	+·13	+·01	-·03	·00	90·99	-·05	+·05	-·02	·00	+·01	89·94

Unity = 1° F.

TABLE 187.—*Inequalities of Temperature in Vertical Force Magnetograph Enclosures.*

Years.	September.						October.						November.						December.					
	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.
						°						°						°						°
1873 ...	-·08	+·03	+·06	+·04	-·05	87·74	-·11	+·01	+·04	+·02	+·02	87·76	-·11	+·03	+·05	+·04	+·01	87·77	-·08	+·03	+·06	+·03	-·05	86·32
1874 ...	-·10	+·01	+·07	+·08	-·06	87·17	-·10	+·01	+·05	+·06	-·04	87·40	-·12	+·01	+·07	+·06	-·02	86·61	-·10	+·02	+·07	+·06	-·04	86·10
1875 ...	-·04	+·07	+·06	-·02	-·05	89·57	-·08	+·14	+·05	-·03	-·06	89·05	-·09	+·18	+·04	-·06	-·08	88·89	-·08	+·14	-·04	-·04	-·04	88·09
1876 ...	-·11	+·11	+·02	-·01	-·03	90·21	-·02	+·22	-·06	-·13	-·01	90·10	-·07	+·22	-·04	-·07	-·03	89·77	-·06	+·18	-·01	-·06	-·07	88·94
1877 ...	-·03	+·11	-·03	-·03	-·02	92·12	-·04	+·05	+·05	+·01	-·09	92·04	-·08	+·11	+·05	-·02	-·07	91·19	-·01	+·11	·00	-·08	-·03	90·16
1878 ...	-·05	·00	+·02	·00	+·03	90·82	-·08	+·01	+·03	+·04	+·01	90·91	-·03	-·01	·00	+·01	+·02	90·34	-·05	+·01	-·01	-·02	+·07	88·63
1879 ...	-·05	+·06	+·01	·00	·00	89·93	-·01	+·09	+·04	-·06	-·07	89·76	-·05	+·11	+·05	-·05	-·04	88·45	-·07	+·08	+·05	-·03	-·02	86·24
1880 ...	+·02	+·04	·00	-·04	·00	87·84	-·03	+·06	-·01	-·04	+·03	87·97	-·03	+·04	+·02	-·01	·00	87·50	-·08	+·06	+·02	·00	·00	86·33
1881 ...	·00	+·01	-·02	+·02	-·01	89·95	+·18	+·10	-·06	-·12	-·15	88·90	+·20	+·05	-·03	-·08	-·15	88·35	+·27	+·08	-·06	-·10	-·17	86·80
1882 ...	+·15	+·05	-·06	-·10	-·06	88·71	+·13	+·06	-·03	-·06	-·11	88·76	+·21	+·08	-·07	-·11	-·12	87·90	+·26	+·05	-·11	-·12	-·08	86·94
1883 ...	+·16	+·03	-·04	-·07	-·11	88·91	+·22	+·05	-·07	-·09	-·11	88·76	+·25	+·10	-·06	-·12	-·19	87·54	-·11	+·10	+·05	·00	-·05	85·15
1884 ...	-·01	+·05	-·03	-·02	-·01	89·24	-·01	+·08	+·01	-·02	-·05	88·70	-·05	+·08	+·01	-·01	-·05	87·59	-·07	+·04	+·05	+·02	-·03	86·69
1885 ...	+·04	+·07	-·03	-·05	-·01	89·59	-·04	+·06	·00	-·01	-·01	89·81	+·04	+·14	-·01	-·08	-·07	90·10	-·01	+·12	+·01	+·05	+·06	88·88
1886 ...	+·01	+·06	-·03	-·03	·00	88·68	·00	+·09	-·03	-·06	-·02	88·98	-·07	+·06	+·03	+·01	-·02	88·79	·00	+·05	-·01	-·05	-·01	88·02
1887 ...	-·01	+·06	-·01	-·02	-·03	88·10	+·01	+·07	-·01	-·05	-·01	88·01	-·04	+·08	+·01	-·01	-·03	87·85	-·04	+·09	·00	-·03	-·01	86·64
1888 ...	·00	+·06	-·01	-·03	-·02	90·11	-·01	+·07	-·01	-·03	-·01	90·56	·00	+·05	·00	-·02	-·04	90·93	-·03	+·07	·00	-·02	-·04	90·16
1889 ...	·00	+·08	-·02	-·04	-·01	90·29	-·04	+·07	-·01	-·01	-·02	90·43	-·06	+·10	+·01	·00	-·04	89·26	-·07	+·12	+·01	-·02	-·07	87·75
1890 ...	-·06	+·05	-·01	+·02	·00	88·50	-·05	+·11	-·04	-·02	-·01	88·47	-·06	+·05	-·02	+·04	-·01	88·55	-·06	+·11	-·02	·00	-·01	88·81
1891 ...	-·05	+·10	·00	-·01	-·04	90·39	-·03	+·09	-·01	-·04	+·01	89·14	-·08	+·10	+·01	·00	·00	88·95	-·09	+·07	·00	·00	·00	87·98
1892 ...	-·09	+·10	+·04	·00	-·04	89·15	-·05	+·12	·00	·00	-·05	89·07	-·11	+·11	+·02	+·01	-·01	88·40	-·07	+·10	+·01	-·01	-·02	87·61
1893 ...	-·04	+·08	-·04	-·02	+·02	91·15	-·07	+·14	-·02	-·03	-·02	91·19	-·06	+·15	+·01	-·04	-·05	91·33	-·08	+·21	+·01	-·05	-·11	90·09
1894 ...	-·02	+·17	-·04	-·08	-·03	90·38	-·07	+·18	-·05	-·05	+·01	90·08	-·12	+·17	·00	-·04	-·02	89·22	-·08	+·17	-·04	-·07	·00	88·48
1894 ...	-·03	+·15	-·02	-·06	-·06	88·52	-·07	+·13	-·06	-·06	+·03	88·17	-·08	+·18	-·05	-·05	-·01	87·34	-·08	+·16	-·07	-·04	+·04	86·57
1895 ...	-·05	+·17	-·03	-·09	·00	88·33	-·06	+·19	-·01	-·09	-·01	88·70	-·07	+·14	-·03	-·06	+·03	88·57	-·07	+·22	·00	-·07	-·07	87·60
1896 ...	+·03	+·17	-·07	-·08	-·03	88·29	-·03	+·20	-·05	-·10	-·04	89·25	-·06	+·23	-·07	-·11	·00	89·27	-·10	+·22	+·01	-·05	-·06	87·87
1897 ...	-·05	+·17	-·04	-·03	-·04	89·42	-·09	+·15	-·04	-·02	+·01	88·93	-·11	+·12	+·02	·00	-·05	87·87	-·14	+·19	-·01	+·05	-·08	86·49
1898 ...	-·06	+·17	-·04	-·04	-·04	88·45	-·04	+·15	-·03	-·05	-·01	89·00	-·11	+·26	+·01	-·06	-·09	89·04	-·08	+·19	-·05	-·02	-·03	88·30
1899 ...	·00	+·13	-·05	-·06	-·02	89·80	-·02	+·19	-·08	-·08	-·03	90·31	-·06	+·24	-·06	-·09	-·04	90·00	-·10	+·31	-·06	-·09	-·06	88·91
1900 ...	-·05	+·08	-·06	+·02	-·01	88·83	-·07	+·22	+·01	-·11	-·05	88·73	-·01	+·27	-·11	-·13	-·03	88·59	-·07	+·27	-·04	-·11	-·05	88·13
1901 ...	+·01	+·17	-·09	-·10	-·01	88·41	-·03	+·26	-·09	-·11	-·05	88·92	-·04	+·21	-·06	-·07	-·06	88·78	-·05	+·22	-·09	-·09	+·02	87·54
1902 ...	-·01	+·17	-·08	-·07	·00	90·07	+·01	+·16	-·08	-·09	+·02	90·03	-·05	+·13	-·03	-·04	-·01	89·82	-·03	+·11	-·03	-·06	·00	88·55
1903 ...	-·01	+·19	-·11	-·10	+·01	88·29	-·04	+·24	-·05	-·10	-·04	88·20	-·10	+·19	-·04	-·03	-·04	87·27	-·05	+·16	-·04	-·03	+·01	85·97
1904 ...	·02	+·12	-·04	-·05	-·03	88·89	-·01	+·13	-·04	-·07	·00	89·73	-·08	+·15	-·04	-·06	·00	89·39	-·06	+·11	-·04	-·02	·00	87·64
1905 ...	-·03	+·10	-·02	-·03	-·02	90·01	-·03	+·22	-·08	-·11	-·01	90·87	-·07	+·29	-·02	-·10	-·09	91·11	-·10	+·18	·00	-·02	-·02	88·88

Unity = 1° F.

TABLE 187.—*Inequalities of Temperature in Vertical Force Magnetograph Enclosures.*

Years.	April to September.						October to March.						Year.					
	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.	6	10	14	16	22	Monthly mean.
						°						°						°
1873 ...	+·03	·00	·00	−·03	·00	90·19	+·02	+·02	·00	−·05	+·02	87·09	+·03	+·01	·00	−·04	+·01	88·64
1874 ...	−·08	+·01	+·04	+·04	−·01	88·22	−·09	+·03	+·05	+·04	−·03	85·15	−·09	+·02	+·05	+·04	−·02	86·66
1875 ...	−·07	+·03	+·04	+·01	−·01	90·93	−·09	+·10	+·05	−·01	−·05	86·66	−·08	+·07	+·04	·00	−·03	88·79
1876 ...	−·07	+·10	+·01	−·01	−·02	90·79	−·03	+·19	−·03	−·09	−·05	88·02	−·05	+·15	−·01	−·05	−·03	89·41
1877 ...	−·06	+·09	·00	−·01	−·01	92·26	−·04	+·14	+·01	−·06	−·04	89·45	−·05	+·11	·00	−·03	−·03	90·86
1878 ...	−·06	+·04	+·01	−·01	+·01	91·63	−·03	+·08	·00	−·03	−·03	88·92	−·04	+·06	+·01	−·02	−·01	90·28
1879 ...	−·03	+·03	·00	·00	+·01	90·69	−·04	+·09	+·02	−·04	−·03	87·68	−·04	+·06	+·01	−·02	−·01	89·18
1880 ...	−·03	+·03	+·01	−·01	·00	89·12	−·05	+·06	+·01	−·03	+·01	85·96	−·04	+·05	+·01	−·02	·00	87·54
1881 ...	−·03	+·06	−·02	−·02	·00	89·40	+·07	+·08	−·02	−·05	−·07	86·91	+·02	+·07	−·02	−·03	−·04	88·15
1882 ...	−·18	+·03	−·07	−·08	−·07	89·42	+·21	+·07	−·08	−·11	−·11	86·90	+·20	+·05	−·07	−·10	−·09	88·16
1883 ...	+·09	+·01	−·02	−·02	−·07	90·47	+·18	+·08	−·05	−·09	−·12	86·65	+·14	+·05	−·04	−·06	−·09	88·56
1884 ...	+·01	+·05	−·02	−·03	−·01	90·01	−·03	+·10	+·01	−·02	−·05	85·85	−·01	+·07	−·01	−·03	−·03	87·93
1885 ...	+·02	+·06	−·03	−·04	−·01	90·94	+·01	+·14	−·03	−·05	−·02	87·91	+·01	+·10	−·03	−·05	−·02	89·43
1886 ...	·00	+·05	−·01	−·01	−·03	90·39	−·04	+·09	−·01	−·03	−·02	87·95	−·02	+·07	−·01	−·02	−·02	89·17
1887 ...	·00	+·03	−·01	−·02	−·01	89·96	−·01	+·08	−·01	−·04	−·01	85·54	−·01	+·05	−·01	−·03	−·01	87·75
1888 ...	·00	+·05	−·01	−·02	−·02	91·63	·00	+·05	−·01	−·03	−·01	88·92	·00	+·05	−·01	−·03	−·01	90·28
1889 ...	·00	+·07	−·02	−·03	−·02	91·52	−·03	+·10	−·02	−·03	−·03	89·09	−·02	+·09	−·02	−·03	−·03	90·30
1890 ...	−·05	+·08	−·01	·00	−·02	90·47	−·04	+·12	−·03	−·02	−·03	88·22	−·04	+·10	−·02	−·01	−·02	89·35
1891 ...	−·03	+·07	−·02	−·02	−·02	92·08	−·07	+·10	·00	−·01	−·01	88·05	−·05	+·09	−·01	−·01	−·01	90·07
1892 ...	−·04	+·10	·00	−·02	−·03	92·92	−·07	+·10	·00	·00	−·01	87·96	−·06	+·10	·00	−·01	−·02	90·44
1893 ...	−·03	+·08	−·02	−·03	+·01	92·01	−·08	+·13	·00	−·02	−·04	88·69	−·06	+·10	−·01	−·02	−·01	90·35
1894 ...	−·03	+·14	−·04	−·05	·00	92·40	−·06	+·20	−·05	−·07	·00	88·97	−·05	+·17	−·05	−·06	·00	90·68
1894 ...	−·03	+·13	−·04	−·05	−·03	90·37	−·05	+·18	−·04	−·08	·00	87·09	−·04	+·16	−·04	−·06	−·01	88·73
1895 ...	−·04	+·11	−·02	−·04	−·01	90·30	−·08	+·18	−·04	−·02	−·02	87·52	−·06	+·14	−·03	−·03	−·02	88·91
1896 ...	−·01	+·13	−·04	−·05	−·01	90·54	−·06	+·22	−·05	−·08	−·04	87·98	−·04	+·17	−·04	−·07	−·02	89·26
1897 ...	−·01	+·11	−·05	−·05	·00	90·69	−·06	+·16	−·03	−·04	−·03	86·78	−·04	+·14	−·04	−·04	−·02	88·74
1898 ...	−·04	+·14	−·04	−·03	−·02	90·17	−·06	+·19	−·03	−·06	−·03	87·44	−·05	+·16	−·04	−·04	−·03	88·80
1899 ...	−·02	+·11	−·04	−·04	·00	90·60	−·06	+·25	−·07	−·08	−·05	87·82	−·04	+·18	−·06	−·06	−·03	89·21
1900 ...	−·03	+·13	−·05	−·04	−·01	90·51	−·03	+·25	−·08	−·11	−·03	87·64	−·03	+·19	−·07	−·07	−·02	89·07
1901 ...	−·01	+·16	−·07	−·08	·00	90·21	−·01	+·22	−·08	−·10	−·03	87·32	−·01	+·19	−·08	−·09	−·01	88·76
1902 ...	−·01	+·14	−·06	−·06	·00	91·76	+·01	+·17	−·09	−·10	+·01	88·36	·00	+·16	−·08	−·08	+·01	90·06
1903 ...	·00	+·12	−·07	−·06	+·01	89·56	−·05	+·17	−·07	−·05	·00	86·57	−·03	+·14	−·07	−·06	+·01	88·07
1904 ...	−·01	+·10	−·03	−·04	−·02	89·78	−·03	+·15	−·05	−·06	−·02	87·36	−·02	+·13	−·04	−·05	−·02	88·57
1905 ...	−·01	+·11	−·05	−·05	·00	90·32	−·04	+·20	−·05	−·08	−·02	87·74	−·03	+·15	−·05	−·06	−·01	89·03

readings may be, for the errors of the readings would not in that case be usually of the nature of probable errors, but partake of the character of constant errors. It was because at Colaba the coefficient was fairly small and the variation of temperature very minute, that the inequalities have been saved from serious vitiation from temperature effects.

Aperiodic correction.

253. It now remains finally to correct the variations when prepared for analysis for the aperiodic change. Tables 188, 189, 190 give the progressive change derived from differences of months, days and hours. It will be seen from the tables below that the corrections as a rule are very small and after careful examination wherever necessary, such correction has been employed as best suited the conditions of the month. Invariably however the corrections have not been applied as they fall within the allowable limit $\pm 0{\cdot}6\gamma$ and only for a few months when they became significantly large have they been applied.

TABLE 188.—*Average progressive increase per day of V. F. Magnetograph No. 2 derived from monthly means.*

Unity = $0{\cdot}1\gamma$ = ·000001 C. G. S.

Years.	Months.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
1894 ...	− 1	− 4	− 6	− 7	− 7	− 1	0	− 2	− 2	− 1	0	− 1	− 3
1895 ...	− 2	0	− 4	− 11	− 10	− 3	− 1	− 2	− 2	− 2	0	0	− 3
1896 ...	+ 1	0	− 5	− 6	− 2	+ 2	+ 3	0	− 3	− 3	+ 1	+ 2	− 1
1897 ...	+ 2	+ 1	− 3	− 6	− 4	+ 1	+ 3	+ 1	0	+ 2	+ 4	+ 2	0
1898 ...	− 1	+ 1	− 1	− 5	− 4	+ 2	+ 5	+ 4	+ 1	0	+ 2	+ 4	+ 1
1899 ...	+ 8	+ 3	− 5	− 5	− 2	0	0	+ 1	+ 2	+ 2	+ 3	+ 4	+ 1
1900 ...	+ 4	+ 1	− 3	− 3	− 1	− 2	+ 6	+ 5	+ 3	+ 1	+ 1	+ 3	+ 1
1901 ...	+ 4	0	− 3	− 3	− 0	+ 4	+ 4	+ 1	0	+ 1	+ 3	+ 3	+ 1
1902 ...	+ 2	0	− 3	− 3	− 3	0	+ 3	+ 3	+ 2	+ 1	− 1	− 1	0
1903 ...	+ 2	0	− 3	− 1	+ 1	+ 3	+ 5	+ 2	+ 1	+ 3	+ 4	+ 3	+ 2
1904 ...	+ 1	− 1	− 3	− 3	0	+ 3	+ 3	+ 1	0	+ 1	+ 3	+ 4	+ 1

TABLE 189.—*Average progressive increase per day of Vertical Force Magnetograph No. 2 derived from the daily means of the first and the last day of each month.*

Unity = $0{\cdot}1\gamma$ = ·000001 C. G. S.

	Years.	Months.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Vertical Force Magnetograph No. 2.	1894 ...	+ 1	− 5	− 6	− 8	− 9	− 4	+ 6	− 4	− 3	− 2	+ 2	− 2	− 3
	1895 ...	− 1	− 7	− 7	− 19	− 9	+ 2	− 3	− 1	− 1	− 1	+ 1	− 2	− 4
	1896 ...	+ 4	+ 1	− 7	− 6	− 3	+ 4	+ 5	− 3	0	− 4	− 3	+ 3	− 1
	1897 ...	+ 2	− 1	− 2	− 6	− 4	+ 2	+ 7	− 2	0	+ 2	+ 4	+ 2	0
	1898 ...	− 2	− 1	+ 5	− 7	− 9	+ 5	+ 2	+ 4	+ 3	− 1	+ 4	+ 5	+ 1
	1899 ...	+ 2	+ 9	− 5	− 6	− 2	0	0	+ 1	+ 7	0	+ 4	+ 2	+ 1
	1900 ...	+ 5	0	− 4	− 5	− 2	+ 1	+ 11	0	+ 5	0	+ 1	+ 3	+ 1
	1901 ...	+ 3	+ 2	− 5	− 2	− 1	+ 6	+ 5	− 1	− 2	+ 1	+ 4	+ 5	+ 1
	1902 ...	+ 1	+ 1	− 5	+ 1	− 3	+ 3	+ 5	+ 1	+ 4	+ 3	− 4	+ 2	+ 1
	1903 ...	+ 3	− 2	0	− 8	+ 6	+ 2	+ 6	+ 4	+ 1	+ 5	− 2	+ 6	+ 2
	1904 ...	0	− 1	− 4	− 2	0	+ 6	+ 2	− 1	+ 2	+ 1	+ 4	+ 5	+ 1

TABLE 190.—*Average progressive increase per day of Vertical Force Magnetograph No. 2 derived from a single tabulated reading at 10 hour on the first day of each month.*

Unity = $0{\cdot}1\gamma$ = ·000001 C. G. S.

Years.	Months.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1894	− 2	− 9	+ 1	− 10	− 6	− 1	+ 4	− 9	− 7	+ 9	+ 2	− 6
1895	+ 3	− 62	− 1	− 20	− 13	− 4	+ 2	− 3	+ 1	− 1	+ 4	− 3
1896	+ 9	− 8	− 7	− 3	− 2	− 1	+ 2	− 5	+ 3	0	− 3	0
1897	+ 7	− 4	− 7	− 9	− 3	+ 1	+ 10	− 4	0	+ 4	0	+ 5
1898	− 3	− 8	+ 3	− 7	− 2	+ 4	− 3	− 4	+ 11	− 4	+ 9	+ 3
1899	− 11	+ 8	− 4	− 12	+ 7	0	− 4	+ 1	+ 4	+ 2	+ 9	0
1900	+ 5	− 2	− 5	− 1	− 2	− 11	+ 11	+ 2	− 8	+ 2	+ 5	+ 7
1901	+ 3	− 8	− 1	− 9	− 4	+ 11	+ 4	− 5	+ 1	0	+ 10	+ 8
1902	+ 1	− 5	− 4	− 1	− 2	+ 2	+ 5	− 3	+ 7	+ 6	− 5	− 6
1903	+ 7	− 9	0	− 16	+ 1	+ 2	+ 6	− 2	+ 3	+ 14	− 5	+ 6
1904	0	0	− 6	+ 3	+ 3	+ 8	− 3	+ 2	− 1	+ 6	+ 7	+ 7
1905	0	+ 5	− 6	− 19	+ 4	+ 2	+ 8	− 7	− 6	+ 2	+ 9	0

254. Tables 191 to 202 give the variations of each month so derived from the year 1894 to 1905.

6. Variation Instrument (Magnetograph No. 1).

255. As already referred to, the instrument was installed in 1872 and the record has run uninterruptedly from 1873 to 1905.

The measurements involving the determination of the angular values of the scale attached to the reading telescope and of an inch of ordinate on the magnetograms are as follow:—

Distance from the back of the mirror to scale	= 65·05 inches.
Distance from the back of the mirror to the recording cycluder	= 60·08 inches.
Thickness of the mirror	= ·115 inch.
Thickness of the glass plate	= ·18 inch.
Thickness of the lens	= ·60 inch.

Whence the virtual distance of the mirror from the scale allowing for the reduction due to the angle subtended at the mirror by the telescope and scale = 64·94 inches; and the virtual distance between back of mirror and the recording cylinder = 59·78 inches.

From the above the angular movement of the magnet corresponding to a change of unity in the scale division equals 5′·30 or ·00154; and the angular movement of the magnet corresponding to a change of 1 inch of ordinate equals 28′·75 or ·00836 and of 1 c.m. of ordinate equals 11′·32 or ·00329.

The corresponding factors derived from the above, for changing the scale reading into an ordinate of 1 inch or *vice versa* are respectively ·184 and 5·43; for changing the scale reading into ordinate of 1 c.m or *vice versa* we have ·468 and 2·138 respectively.

256. In the theory of the instrument already referred to, it is of course assumed that the knife edge of the instrument is a mathematical straight line, which ensures the constancy of the co-efficient for any reasonable tilt of the balance that is for a change of the scale readings: this would of course be nearly assured also if the section of the edge was sensibly curved and the curvature was strictly uniform. The V. F. No. 1 magnetograph, as will be seen presently, suffered from two unusual defects by which its coefficient appeared to be influenced: (1) by temperature; and (2) by different positions taken by the balance on its knife edge, its sensitiveness being different for different readings of the scale. The variation of the scale coefficient with the lapse of time which is common to all instruments, and with temperature which is exceptional to this instrument alone, can both be duly allowed for by the formulæ and process already described in detail for the V. F. No. 2 instrument. The variation of the coefficient with the different angular positions of the balance however is a new and exceptional feature and it is obvious that additional provision for the elimination of these vitiating effects has to be made in the theory of the instrument, and this differentiating factor alone has been dealt with below.

TABLES 191 & 192.—*Vertical Force Magnetograph No. 2—showing the mean Diurnal Inequalities for each month of the years 1894 and 1895 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1894. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 34	+ 34	+ 46	+ 41	+ 35	+ 35	+ 41	+ 47	+ 70	+ 53	+ **31**	+ 30	+ 41
1 16	+ 37	+ 14	+ 46	+ 43	+ 35	+ 35	+ 41	+ 48	+ 73	+ 54	+ 29	+ 31	+ 40
2 16	+ 33	+ 27	+ 43	+ 32	+ 32	+ 36	+ 45	+ 47	+ 66	+ 52	+ 31	+ 27	+ 39
3 16	+ 21	+ 9	+ 31	+ 29	+ 29	+ 39	+ 47	+ 51	+ 66	+ 39	+ 17	+ 21	+ 33
4 16	+ 7	− 2	+ 29	+ 23	+ 38	+ 54	+ 65	+ 58	+ 68	+ 38	+ 16	+ 27	+ 35
5 16	+ 2	− 2	+ 28	+ 36	+ 66	+ 83	+ 94	+ 91	+ 92	+ 46	+ 19	+ 24	+ 48
6 16	+ 5	0	+ 53	+ **99**	+ **136**	+ **125**	+ **137**	+ **154**	+ **158**	+ **77**	+ 5	+ 13	+ **80**
7 16	+ 19	+ 8	+ **75**	+ 80	+ 91	+ 97	+ 70	+ 92	+ 85	+ 69	+ 26	+ 25	+ 61
8 16	+ 80	+ 18	+ 33	− 8	− 9	+ 12	− 39	− 37	− 82	− 8	+ 13	+ **62**	+ 3
9 16	+ **91**	+ 23	− 41	− 99	− 125	− 88	− 127	− 150	− 205	− 104	− 21	+ 52	− 66
10 16	− 5	− 16	− 134	− 143	− **174**	− 170	− **174**	− **189**	− 270	− **191**	− **66**	− 12	− 129
11 16	− **77**	− 43	− **180**	− **161**	− 154	− **194**	− 171	− 164	− **272**	− 187	− 60	− **73**	− **145**
12 16	− 43	− 14	− 140	− 122	− 114	− 158	− 117	− 119	− 189	− 83	− 1	− 72	− 98
13 16	− 27	+ 19	− 48	− 51	− 37	− 73	− 39	− 58	− 59	+ 17	+ 21	− 61	− 33
14 16	− 57	+ 14	+ 38	+ 14	+ 9	− 4	+ 16	0	+ 45	+ 68	+ 4	· 66	+ 7
15 16	− 60	− 20	+ 49	+ 51	+ 49	+ 44	+ 41	+ 37	+ 84	+ 44	− 21	− 49	+ 21
16 16	− 48	− 46	+ 8	+ 47	+ 51	+ 54	+ 39	+ 52	+ 64	− 19	− 39	− 20	+ 12
17 16	− 48	− **63**	− 33	+ 6	+ 16	+ 39	+ 20	+ 23	+ 5	− 66	− 48	− 35	− 15
18 16	− 22	− 35	− 33	− 19	− 16	− 5	− 12	− 28	+ 6	− 18	+ 2	− 6	− 15
19 16	+ 12	+ 7	+ 11	− 5	− 24	− 26	− 39	− 25	+ 22	+ 12	+ 5	+ 4	− 4
20 16	+ 6	+ 6	+ 16	+ 15	− 3	− 2	− 2	− 6	+ 30	+ 6	− 6	+ 3	+ 5
21 16	+ 2	+ 1	+ 19	+ 24	+ 10	+ 13	+ 8	+ 12	+ 31	+ 13	− 3	+ 12	+ 12
22 16	+ 14	+ 20	+ 32	+ 31	+ 25	+ 22	+ 26	+ 26	+ 50	+ 42	+ 18	+ 25	+ 28
23 16	+ 27	+ **42**	+ 48	+ 39	+ 32	+ 30	+ 33	+ 37	+ 65	+ 49	+ 28	+ 35	+ 39
Range ...	168	105	255	260	310	319	311	343	430	268	97	135	225
Average progressive increase per day.	− 1	− 4	− 6	7	− 7	− 1	0	− 2	− 2	− 1	0	− 1	− 3

Unity = ·1γ = ·000001 C. G. S.

1895. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 32	+ **40**	+ 41	+ 52	+ 47	+ 55	+ 51	+ 46	+ 54	+ 38	+ 36	+ 29	+ 43
1 16	+ 33	+ 38	+ 41	+ 48	+ 49	+ 58	+ 51	+ 52	+ 59	+ 41	+ 32	+ 27	+ 44
2 16	+ 32	+ 34	+ 33	+ 37	+ 45	+ 53	+ 51	+ 54	+ 58	+ 41	+ 36	+ 26	+ 42
3 16	+ 26	+ 29	+ 25	+ 37	+ 49	+ 56	+ 52	+ 53	+ 59	+ 38	+ 32	+ 20	+ 40
4 16	+ 19	+ 17	+ 19	+ 40	+ 53	+ 62	+ 59	+ 58	+ 59	+ 42	+ 17	+ 19	+ 39
5 16	+ 16	+ 12	+ 27	+ 64	+ 86	+ 101	+ 90	+ 92	+ 82	+ 50	+ 21	+ 19	+ 55
6 16	+ 26	+ 13	+ 50	+ **128**	+ **129**	+ **159**	+ **136**	+ **149**	+ **147**	+ **71**	0	+ 4	+ **84**
7 16	+ 54	+ 21	+ 52	+ 79	+ 67	+ 115	+ 91	+ 93	+ 92	+ 69	+ 17	+ 20	+ 64
8 16	+ **69**	+ 10	− 4	− 19	− 58	− 20	− 4	− 59	− 70	− 8	+ 35	+ **47**	− 7
9 16	− 3	− 39	− 95	− 126	− 189	− 168	− 102	− 188	− 193	− 95	0	+ 14	− 99
10 16	− 111	− 105	− 125	− 197	− **224**	− **248**	− **170**	− **221**	− 252	− **158**	− **64**	− **53**	− 161
11 16	− **149**	− **128**	− **168**	− **213**	− 192	− 243	− 160	− 181	− **255**	− 153	− 60	− **60**	− **163**
12 16	− 101	− 46	− 145	− 143	− 129	− 188	− 136	− 118	− 177	− 65	− 15	− 51	− 109
13 16	− 39	+ 19	− 44	− 52	− 23	− 91	− 78	− 38	− 32	+ 15	− 13	− 45	− 35
14 16	+ 9	+ 30	+ 60	+ 16	+ 43	− 13	− 22	+ 29	+ 67	+ 48	− 33	− 42	+ 16
15 16	+ 32	+ 25	+ **74**	+ 50	+ 78	+ 52	+ 9	+ 65	+ 105	+ 36	− 34	− 33	+ 38
16 16	+ 7	− 5	+ 24	+ 42	+ 64	+ 68	+ 24	+ 65	+ 77	− 13	− 32	− 19	+ 25
17 16	− 36	− 55	− 24	+ 9	+ 23	+ 49	+ 13	+ 24	+ 4	− 60	− 32	− 19	− 9
18 16	− 9	− 24	− 8	− 8	− 21	+ 6	− 11	− 29	− 8	− 18	− 8	+ 2	− 11
19 16	+ 8	+ 20	+ 24	+ 9	− 16	− 9	− 29	− 20	+ 7	+ 4	− 8	+ 11	0
20 16	+ 10	+ 11	+ 32	+ 22	+ 9	+ 15	− 5	− 2	+ 10	+ 4	− 6	+ 6	+ 9
21 16	+ 17	+ 14	+ 31	+ 30	+ 25	+ 33	+ 15	+ 16	+ 21	+ 6	+ 11	+ 18	+ 20
22 16	+ 28	+ 29	+ 36	+ 42	+ 37	+ 45	+ 31	+ 26	+ 38	+ 31	+ 30	+ 28	+ 33
23 16	+ 30	+ 38	+ 43	+ 52	+ 45	+ 51	+ 42	+ 36	+ 50	+ 39	+ **39**	+ 31	+ 41
Range ...	218	168	242	341	353	407	306	370	402	229	103	107	247
Average progressive increase per day.	− 2	0	− 4	− 11	− 10	− 3	− 1	− 2	− 2	− 2	0	0	− 3

TABLES 193 & 194.—*Vertical Force Magnetograph No. 2—showing the mean Diurnal Inequalities for each month of the years 1896 and 1897 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1896. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 33	+ 19	+ 38	+ 56	+ 56	+ 41	+ 36	+ 50	+ 60	+ 39	+ 32	+ 19	+ 40
1 16	+ 27	+ 23	+ 33	+ 53	+ 52	+ 44	+ 41	+ 54	+ 63	+ 40	**+ 34**	+ 15	+ 40
2 16	+ 21	+ 16	+ 30	+ 42	+ 47	+ 36	+ 38	+ 54	+ 62	+ 32	+ 30	+ 16	+ 35
3 16	+ 17	+ 7	+ 24	+ 38	+ 44	+ 37	+ 41	+ 51	+ 56	+ 26	+ 28	+ 9	+ 31
4 16	+ 5	+ 9	+ 22	+ 36	+ 46	+ 42	+ 44	+ 56	+ 59	+ 26	+ 22	+ 7	+ 31
5 16	− 1	+ 3	+ 26	+ 49	+ 69	+ 71	+ 72	+ 78	+ 73	+ 33	+ 26	+ 7	+ 42
6 16	+ 8	− 4	+ 44	**+101**	**+106**	**+ 90**	**+110**	**+131**	**+134**	+ 48	+ 16	− 2	+ 65
7 16	+ 17	+ 8	+ 49	+ 75	+ 60	+ 50	+ 61	+ 68	+ 91	**+ 61**	+ 25	0	+ 47
8 16	**+ 51**	**+ 38**	− 13	− 16	− 51	− 26	− 25	− 57	− 47	+ 17	+ 11	**+ 37**	− 7
9 16	+ 26	+ 19	− 81	− 132	− 166	− 99	− 102	− 159	− 172	− 60	− 48	+ 15	− 80
10 16	− 86	− 23	**− 124**	**− 197**	**− 219**	**− 150**	**− 158**	**− 198**	− 235	− 130	**− 118**	− 42	− 140
11 16	**− 109**	**− 48**	− 122	− 196	− 201	− 150	− 153	− 182	**− 256**	**− 143**	− 108	**− 66**	**− 144**
12 16	− 82	− 32	− 64	− 137	− 140	− 116	− 126	− 128	− 175	− 76	− 50	− 34	− 97
13 16	− 28	− 2	+ 8	− 58	− 44	− 55	− 76	− 49	− 47	− 6	− 2	− 11	− 31
14 16	− 21	+ 5	**+ 59**	+ 17	+ 25	+ 2	+ 12	+ 9	+ 49	+ 30	+ 22	− 1	+ 17
15 16	+ 3	− 6	+ 46	+ 55	+ 64	+ 43	+ 58	+ 48	+ 78	+ 24	+ 14	+ 8	+ 36
16 16	+ 8	− 20	+ 1	+ 51	+ 67	+ 46	+ 59	+ 52	+ 45	− 11	− 8	+ 4	+ 24
17 16	− 9	− 31	− 42	+ 16	+ 39	+ 23	+ 34	+ 26	− 2	− 31	− 21	− 6	0
18 16	+ 10	− 20	− 24	− 8	+ 4	+ 1	− 1	− 1	− 6	− 12	+ 3	− 4	− 5
19 16	+ 9	0	+ 3	+ 4	+ 2	− 13	− 24	− 4	+ 12	+ 3	+ 10	− 2	0
20 16	+ 15	0	+ 10	+ 20	+ 17	0	− 5	+ 4	+ 27	+ 5	+ 11	+ 1	+ 9
21 16	+ 23	0	+ 15	**+ 33**	+ 33	+ 14	+ 13	+ 20	+ 35	+ 14	+ 14	+ 4	+ 18
22 16	+ 31	+ 11	+ 26	+ 42	+ 43	+ 32	+ 22	+ 32	+ 44	+ 29	+ 28	+ 13	+ 29
23 16	+ 35	+ 24	+ 39	+ 52	+ 51	+ 39	+ 31	+ 44	+ 52	+ 37	+ 32	+ 16	+ 38
Range ...	160	86	183	298	325	240	268	329	390	204	152	103	209
Average progressive increase per day.	+ 1	0	− 5	− 6	− 2	+ 2	+ 3	0	− 3	− 3	+ 1	+ 2	− 1

Unity = ·1γ = ·000001 C. G. S.

1897. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 38	+ 27	+ 31	+ 54	+ 47	+ 42	+ 35	+ 49	+ 59	+ 44	+ 17	+ 19	+ 38
1 16	+ 35	+ 28	+ 29	+ 50	+ 47	+ 40	+ 38	+ 52	+ 57	+ 39	+ 17	+ 16	+ 37
2 16	+ 31	+ 24	+ 26	+ 44	+ 43	+ 37	+ 34	+ 50	+ 59	+ 39	+ 11	+ 13	+ 34
3 16	+ 25	+ 15	+ 18	+ 31	+ 41	+ 36	+ 33	+ 46	+ 59	+ 33	+ 6	+ 11	+ 29
4 16	+ 29	+ 13	+ 16	+ 28	+ 46	+ 39	+ 36	+ 46	+ 59	+ 38	+ 9	+ 4	+ 30
5 16	+ 27	+ 10	+ 22	+ 41	+ 74	+ 68	+ 59	+ 68	+ 78	+ 44	+ 4	+ 4	+ 42
6 16	+ 25	+ 15	+ 28	**+ 94**	**+114**	**+ 95**	**+102**	**+120**	**+136**	+ 62	− 24	− 9	**+ 63**
7 16	+ 50	**+ 37**	**+ 60**	+ 72	+ 64	+ 62	+ 85	+ 80	+ 92	**+ 63**	+ 4	− 6	+ 55
8 16	**+ 56**	+ 36	+ 31	− 2	− 45	− 8	+ 20	− 42	− 56	− 11	+ 15	+ 18	+ 1
9 16	− 47	− 18	− 24	− 92	− 160	− 90	− 65	− 153	− 182	− 108	− 6	+ 11	− 78
10 16	**− 167**	− 79	− 89	− 169	**− 207**	− 160	− 150	**− 206**	**− 235**	**− 166**	**− 41**	− 25	− 141
11 16	− 165	**− 110**	**− 144**	**− 197**	− 190	**− 175**	**− 155**	− 186	− 233	− 160	− 31	**− 27**	**− 148**
12 16	− 80	− 77	− 123	− 149	− 146	− 144	− 121	− 136	− 169	− 89	+ 25	− 9	− 101
13 16	− 21	− 24	− 55	− 60	− 60	− 72	− 58	− 60	− 57	− 9	**+ 38**	− 7	− 37
14 16	+ 8	+ 17	+ 24	+ 4	+ 14	− 14	− 1	+ 7	+ 37	+ 35	+ 2	− 17	+ 10
15 16	+ 35	+ 32	+ 52	+ 42	+ 55	+ 26	+ 17	+ 48	+ 81	+ 47	− 17	− 17	+ 33
16 16	+ 9	+ 15	+ 26	+ 37	+ 58	+ 48	+ 24	+ 61	+ 63	+ 13	− 20	− 3	+ 28
17 16	− 24	− 17	− 17	+ 13	+ 36	+ 36	+ 11	+ 36	+ 1	− 24	− 21	− 9	+ 2
18 16	+ 2	− 5	− 12	+ 2	+ 7	+ 8	− 10	− 4	− 8	− 7	− 9	− 1	− 3
19 16	+ 13	+ 9	+ 9	+ 3	+ 8	+ 9	− 8	+ 2	+ 6	+ 4	− 6	+ 1	+ 4
20 16	+ 18	+ 4	+ 17	+ 24	+ 23	+ 13	+ 4	+ 13	+ 21	+ 12	− 2	+ 4	+ 13
21 16	+ 28	+ 8	+ 21	+ 33	+ 35	+ 25	+ 17	+ 25	+ 35	+ 22	+ 3	+ 4	+ 21
22 16	+ 35	+ 15	+ 25	+ 44	+ 46	+ 34	+ 26	+ 37	+ 46	+ 35	+ 12	+ 9	+ 30
23 16	+ 41	+ 25	+ 33	+ 48	+ 49	+ 40	+ 33	+ 45	+ 55	+ 43	+ 19	**+ 20**	+ 38
Range ...	223	147	204	291	321	270	257	326	371	229	79	47	211
Average progressive increase per day.	+ 2	+ 1	− 3	− 6	− 4	+ 1	+ 3	+ 1	0	+ 2	+ 4	+ 2	0

TABLES 195 & 196.—*Vertical Force Magnetograph No. 2—showing the mean Diurnal Inequalities for each month of the years 1898 and 1899 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1898. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 25	+ 20	+ 28	+ 44	+ 44	+ 42	+ 33	+ 55	+ 57	+ 43	+ 24	+ 19	+ 36
1 16	+ 18	+ 20	+ 22	+ 45	+ 41	+ 40	+ 35	+ 60	+ 81	+ 40	+ 20	+ 14	+ 36
2 16	+ 16	+ 17	+ 20	+ 36	+ 36	+ 34	+ 31	+ 58	+ 59	+ 36	+ 19	+ 13	+ 31
3 16	+ 11	+ 15	+ 10	+ 33	+ 33	+ 34	+ 33	+ 57	+ 61	+ 32	+ 13	+ 6	+ 28
4 16	+ 7	+ 12	+ 14	+ 35	+ 37	+ 36	+ 33	+ 60	+ 58	+ 25	+ 11	+ 4	+ 28
5 16	+ 4	+ 10	+ 15	+ 42	+ 62	+ 67	+ 58	+ 80	+ 74	+ 42	+ 13	+ 7	+ 39
6 16	0	+ 5	+ 22	+ **81**	+**113**	+**100**	+ **98**	+**135**	+**140**	+ **77**	− 8	− 10	+ **63**
7 16	+ 10	+ 17	+ **55**	+ 41	+ 83	+ 74	+ 69	+ 86	+ 90	+ 52	+ 5	+ 16	+ 50
8 16	+ **46**	+ 1	+ 31	− 56	− 16	− 2	− 5	− 40	− 62	− 28	+ 2	+ **57**	− 6
9 16	− 9	− 34	− 12	− 132	− 133	− 98	− 82	− 151	− 187	− 118	− 28	+ 17	− 81
10 16	− **112**	− 72	− 56	− **157**	− **186**	− 168	− 144	− **199**	− 264	− **163**	− **70**	− **57**	− 137
11 16	− 103	− **88**	− 94	− 157	− 177	− **192**	− **146**	− 197	− **272**	− 149	− 65	− 55	− **141**
12 16	− 38	− 44	− **99**	− 98	− 139	− 151	− 113	− 159	− 180	− 68	− 4	− 6	− 92
13 16	+ 4	+ 19	− 40	− 7	− 59	− 70	− 67	− 93	− 55	+ 5	+ **35**	− 1	− 27
14 16	+ 9	+ **39**	+ 24	+ 47	+ 4	− 10	− 13	− 27	+ 38	+ 42	+ 25	− 21	+ 13
15 16	+ 24	+ 37	+ 41	+ 62	+ 42	+ 39	+ 24	+ 22	+ 78	+ 36	+ 6	− 8	+ 34
16 16	+ 16	+ 15	+ 17	+ 40	+ 46	+ 61	+ 48	+ 44	+ 65	+ 6	− 18	− 7	+ 28
17 16	− 9	− 21	− 18	+ 1	+ 28	+ 46	+ 38	+ 29	+ 20	− 27	− 22	− 16	+ 4
18 16	+ 7	− 10	− 21	− 15	+ 2	+ 9	+ 6	+ 10	+ 5	− 1	− 9	− 2	− 2
19 16	+ 7	− 2	− 7	− 1	+ 4	+ 3	− 13	+ 10	+ 21	+ 2	− 2	+ 3	+ 2
20 16	+ 11	0	− 3	+ 11	+ 20	+ 13	0	+ 19	+ 30	+ 13	+ 2	+ 3	+ 10
21 16	+ 19	+ 8	+ 6	+ 25	+ 34	+ 22	+ 17	+ 36	+ 38	+ 23	+ 6	+ 2	+ 20
22 16	+ 17	+ 16	+ 19	+ 37	+ 43	+ 35	+ 27	+ 47	+ 47	+ 34	+ 19	+ 8	+ 29
23 16	+ 24	+ 19	+ 26	+ 42	+ 43	+ 39	+ 32	+ 55	+ 55	+ 42	+ 23	+ 12	+ 34
Range ...	158	127	154	238	299	292	244	334	412	240	105	114	204
Average progressive increase per day.	− 1	+ 1	− 1	− 5	− 4	+ 2	+ 5	+ 4	+ 1	0	+ 2	+ 4	+ 1

Unity = ·1γ = ·000001 C. G. S.

1899. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 30	+ 20	+ 30	+ 39	+ 40	+ 34	+ 30	+ 37	+ 52	+ 38	+ 21	+ 21	+ 33
1 16	+ 26	+ 21	+ 24	+ 35	+ 36	+ 34	+ 28	+ 38	+ 54	+ 36	+ 18	+ 19	+ 31
2 16	+ 26	+ 18	+ 21	+ 31	+ 34	+ 34	+ 29	+ 39	+ 50	+ 31	+ 13	+ 12	+ 28
3 16	+ 18	+ 13	+ 16	+ 20	+ 29	+ 28	+ 30	+ 40	+ 46	+ 30	+ 10	+ 9	+ 24
4 16	+ 16	+ 7	+ 15	+ 22	+ 34	+ 27	+ 34	+ 43	+ 45	+ 26	+ 6	+ 11	+ 24
5 16	+ 16	+ 10	+ 18	+ 30	+ 58	+ 54	+ 64	+ 67	+ 60	+ 29	+ 8	+ 9	+ 35
6 16	+ 19	+ 16	+ 25	+ **69**	+**100**	+ **81**	+ **91**	+**108**	+**107**	+ 52	− 7	+ 6	+ **56**
7 16	+ 22	+ 15	+ 58	+ 54	+ 50	+ 66	+ 56	+ 78	+ 88	+ **61**	+ 18	+ 16	+ 48
8 16	+ 8	− 16	+ 28	− 16	− 54	0	− 38	− 34	− 29	− 4	+ 9	+ **26**	− 10
9 16	− 85	− 77	− 30	− 100	− 156	− 78	− 112	− 141	− 159	− 100	− 23	− 11	− 89
10 16	− **179**	− **117**	− 103	− 148	− **197**	− 126	− **148**	− **191**	− 208	− 158	− **66**	− 69	− 142
11 16	− 157	− 116	− **144**	− **162**	− 166	− **155**	− 148	− 166	− **215**	− **166**	− 46	− **89**	− **144**
12 16	− 52	− 48	− 118	− 114	− 108	− 123	− 96	− 109	− 161	− 100	+ 7	− 48	− 89
13 16	+ 27	+ 18	− 39	− 38	− 26	− 66	− 25	− 45	− 58	− 12	+ 15	− 22	− 23
14 16	+ 64	+ **78**	+ 37	+ 25	+ 31	− 11	+ 24	+ 17	+ 28	+ 36	− 16	− 8	+ 25
15 16	+ **80**	+ 68	+ **62**	+ 56	+ 64	+ 35	+ 55	+ 60	+ 65	+ 47	− 31	+ 8	+ 47
16 16	+ 43	+ 31	+ 28	+ 58	+ 60	+ 42	+ 57	+ 66	+ 48	+ 22	− 19	+ 14	+ 37
17 16	− 16	− 15	− 8	+ 29	+ 37	+ 22	+ 28	+ 34	+ 11	− 9	+ 4	+ 5	+ 10
18 16	+ 4	0	− 2	− 3	+ 5	+ 2	− 4	− 18	+ 5	+ 3	+ 3	+ 11	0
19 16	+ 10	+ 10	+ 3	+ 2	+ 7	− 1	− 11	− 3	+ 16	+ 11	+ 10	+ 12	+ 5
20 16	+ 13	+ 12	+ 12	+ 13	+ 16	+ 10	− 2	+ 7	+ 27	+ 21	+ 9	+ 12	+ 12
21 16	+ 16	+ 17	+ 17	+ 28	+ 26	+ 21	+ 11	+ 20	+ 38	+ 28	+ 14	+ 17	+ 21
22 16	+ 21	+ 19	+ 22	+ 34	+ 38	+ 31	+ 22	+ 27	+ 43	+ 35	+ 19	+ 19	+ 27
23 16	+ 24	+ 20	+ 26	+ 37	+ 38	+ 36	+ 25	+ 32	+ 49	+ 42	+ **24**	+ 23	+ 31
Range ...	259	195	206	231	297	236	239	299	322	227	90	115	200
Average progressive increase per day.	+ 8	+ 3	− 5	− 5	− 2	0	0	+ 1	+ 2	+ 2	+ 3	+ 4	+ 1

TABLES 197 & 198.—*Vertical Force Magnetograph No. 2—showing the Mean Diurnal Inequalities for each month of the years 1900 and 1901 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1900. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 26	+ 23	+ 31	+ 48	+ 45	+ 35	+ 40	+ 36	+ 47	+ 37	+ 26	+ 8	+ 33
1 16	+ 23	+ 27	+ 29	+ 44	+ 42	+ 34	+ 38	+ 36	+ 47	+ 37	+ 24	+ 6	+ 32
2 16	+ 19	+ 19	+ 26	+ 42	+ 36	+ 30	+ 35	+ 35	+ 47	+ 35	+ 16	+ 3	+ 29
3 16	+ 19	+ 18	+ 23	+ 36	+ 33	+ 26	+ 33	+ 37	+ 45	+ 31	+ 13	+ 1	+ 26
4 16	+ 16	+ 15	+ 20	+ 32	+ 37	+ 24	+ 36	+ 41	+ 51	+ 29	+ 13	0	+ 26
5 16	+ 15	+ 10	+ 25	+ 38	+ 55	+ 53	+ 64	+ 69	+ 65	+ 33	+ 14	+ 3	+ 37
6 16	+ 14	+ 12	+ 33	+ 87	+ 103	+ 82	+ 102	+ 112	+ 122	+ 53	− 6	− 11	+ 59
7 16	+ 42	+ 29	+ 52	+ 68	+ 68	+ 59	+ 84	+ 70	+ 100	+ 72	+ 7	− 10	+ 53
8 16	+ 86	+ 35	+ 16	− 17	− 33	− 8	+ 6	− 39	− 42	0	+ 4	+ 12	+ 2
9 16	+ 11	− 13	− 46	− 88	− 130	− 80	− 83	− 128	− 180	− 111	− 38	+ 5	− 73
10 16	− 126	− 87	− 106	− 166	− 185	− 141	− 158	− 180	− 249	− 173	− 80	− 24	− 140
11 16	− 142	− 117	− 156	− 197	− 188	− 156	− 190	− 173	− 251	− 172	− 62	− 35	− 153
12 16	− 74	− 68	− 127	− 163	− 143	− 100	− 152	− 122	− 158	− 94	− 6	− 20	− 102
13 16	− 38	− 15	− 47	− 70	− 63	− 41	− 90	− 54	− 30	− 4	+ 31	+ 4	− 35
14 16	− 26	+ 14	+ 28	+ 1	− 2	− 17	− 20	+ 16	+ 62	+ 47	+ 15	+ 8	+ 10
15 16	+ 7	+ 21	+ 46	+ 49	+ 40	+ 26	+ 35	+ 63	+ 97	+ 51	− 11	+ 2	+ 35
16 16	+ 13	+ 10	+ 31	+ 60	+ 55	+ 30	+ 66	+ 74	+ 80	+ 22	− 19	+ 9	+ 36
17 16	+ 1	− 5	+ 8	+ 36	+ 40	+ 19	+ 46	+ 40	+ 16	− 6	− 13	+ 5	+ 16
18 16	+ 16	+ 3	+ 6	+ 9	+ 19	+ 2	+ 5	− 12	− 6	0	0	+ 2	+ 4
19 16	+ 19	+ 9	+ 12	+ 9	+ 19	+ 9	0	− 7	+ 7	+ 7	+ 6	+ 4	+ 8
20 16	+ 18	+ 10	+ 21	+ 20	+ 24	+ 16	+ 9	+ 4	+ 16	+ 15	+ 7	+ 3	+ 14
21 16	+ 19	+ 16	+ 28	+ 35	+ 36	+ 27	+ 23	+ 20	+ 30	+ 25	+ 13	+ 7	+ 23
22 16	+ 22	+ 16	+ 31	+ 43	+ 44	+ 33	+ 32	+ 28	+ 39	+ 31	+ 20	+ 8	+ 29
23 16	+ 26	+ 21	+ 17	+ 47	+ 45	+ 38	+ 38	+ 34	+ 44	+ 37	+ 25	+ 10	+ 32
Range ...	228	152	208	284	291	238	292	292	373	245	111	47	212
Average progressive increase per day.	+ 4	+ 1	− 3	− 3	− 1	− 2	+ 6	+ 5	+ 3	+ 1	+ 1	+ 3	+ 1

Unity = ·1γ = ·000001 C. G. S.

1901. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year
0 16	+ 8	+ 22	+ 21	+ 34	+ 32	+ 40	+ 26	+ 19	+ 45	+ 32	+ 27	+ 13	+ 27
1 16	+ 6	+ 19	+ 17	+ 32	+ 32	+ 35	+ 21	+ 22	+ 45	+ 29	+ 25	+ 6	+ 24
2 16	+ 2	+ 17	+ 11	+ 27	+ 27	+ 31	+ 19	+ 22	+ 41	+ 27	+ 27	+ 6	+ 21
3 16	0	+ 11	+ 8	+ 22	+ 26	+ 27	+ 24	+ 21	+ 43	+ 24	+ 21	+ 6	+ 19
4 16	− 2	+ 9	+ 6	+ 18	+ 27	+ 31	+ 26	+ 24	+ 45	+ 24	+ 17	+ 5	+ 19
5 16	− 5	+ 8	+ 6	+ 22	+ 47	+ 56	+ 46	+ 51	+ 57	+ 29	+ 17	+ 2	+ 28
6 16	− 6	+ 6	+ 19	+ 67	+ 105	+ 87	+ 82	+ 94	+ 111	+ 51	+ 10	− 5	+ 52
7 16	− 10	+ 19	+ 43	+ 61	+ 85	+ 58	+ 75	+ 59	+ 92	+ 59	+ 27	+ 2	+ 47
8 16	+ 54	+ 35	+ 14	− 5	− 8	− 5	+ 3	− 29	− 35	− 11	+ 10	+ 29	+ 4
9 16	+ 72	+ 11	− 33	− 91	− 122	− 82	− 78	− 116	− 162	− 91	− 38	+ 19	− 59
10 16	+ 16	− 38	− 81	− 147	− 169	− 138	− 118	− 164	− 237	− 126	− 97	− 32	− 111
11 16	− 40	− 76	− 121	− 160	− 166	− 163	− 146	− 142	− 245	− 140	− 87	− 52	− 128
12 16	− 27	− 51	− 91	− 120	− 122	− 132	− 123	− 97	− 161	− 78	− 24	− 8	− 86
13 16	− 11	− 9	− 8	− 45	− 52	− 60	− 58	− 16	− 46	− 10	+ 14	+ 10	− 24
14 16	− 37	+ 3	+ 64	+ 21	+ 6	− 6	+ 6	+ 32	+ 46	+ 33	0	− 10	+ 13
15 16	− 30	0	+ 70	+ 54	+ 40	+ 34	+ 42	+ 65	+ 92	+ 41	− 8	− 8	+ 33
16 16	− 10	− 8	+ 30	+ 54	+ 45	+ 39	+ 58	+ 76	+ 83	+ 14	− 3	+ 8	+ 32
17 16	− 2	− 13	− 8	+ 26	+ 29	+ 24	+ 34	+ 32	+ 32	− 6	− 5	+ 6	+ 12
18 16	− 3	− 2	− 3	+ 14	+ 8	+ 6	+ 3	− 16	+ 3	+ 3	+ 5	− 3	+ 1
19 16	+ 2	+ 3	− 2	+ 6	+ 8	+ 11	− 3	− 3	+ 11	+ 10	+ 6	0	+ 4
20 16	+ 3	+ 6	+ 5	+ 13	+ 18	+ 16	+ 5	+ 3	+ 21	+ 14	+ 11	0	+ 10
21 16	+ 5	+ 8	+ 8	+ 27	+ 26	+ 27	+ 14	+ 13	+ 32	+ 19	+ 16	+ 6	+ 17
22 16	+ 6	+ 16	+ 14	+ 34	+ 31	+ 35	+ 22	+ 17	+ 37	+ 27	+ 22	+ 8	+ 22
23 16	+ 8	+ 21	+ 21	+ 35	+ 35	+ 37	+ 24	+ 17	+ 40	+ 30	+ 25	+ 11	+ 25
Range ...	112	111	191	227	274	250	228	258	356	199	124	81	180
Average progressive increase per day.	+ 4	0	− 3	− 3	0	+ 4	+ 4	+ 1	0	+ 1	+ 3	+ 3	+ 1

TABLES 199 & 200.—*Vertical Force Magnetograph No. 2—showing the Mean Diurnal Inequalities for each month of the years 1902 and 1903 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1902. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 25	+ 20	+ 29	+ 37	+ 34	+ 37	+ 31	+ 31	+ 50	+ 34	+ 13	+ 18	+ 30
1 16	+ 24	+ 18	+ 28	+ 37	+ 34	+ 37	+ 32	+ 29	+ 53	+ 35	+ 13	+ 13	+ 29
2 16	+ 22	+ 16	+ 26	+ 34	+ 28	+ 34	+ 32	+ 32	+ 52	+ 32	+ 14	+ 10	+ 28
3 16	+ 16	+ 15	+ 24	+ 28	+ 29	+ 31	+ 32	+ 34	+ 48	+ 31	+ 13	+ 6	+ 26
4 16	+ 14	+ 11	+ 23	+ 29	+ 29	+ 37	+ 34	+ 37	+ 58	+ 32	+ 11	+ 6	+ 27
5 16	+ 13	+ 8	+ 26	+ 39	+ 52	+ 71	+ 56	+ 60	+ 72	+ 40	+ 11	+ 5	+ 38
6 16	+ 13	+ 7	+ 45	**+ 83**	**+ 92**	**+107**	**+106**	**+108**	**+137**	+ 56	− 6	− 2	**+ 62**
7 16	+ 35	+ 16	**+ 53**	+ 73	+ 70	+ 83	+100	+ 92	+118	**+ 71**	+ 5	+ 2	+ 60
8 16	**+100**	**+ 33**	+ 15	+ 5	− 19	+ 2	+ 19	− 14	− 23	+ 3	+ 13	**+ 24**	+ 13
9 16	+ 81	− 3	− 60	− 76	−125	−100	− 79	−161	−147	− 89	− 26	+ 14	− 64
10 16	− 41	− 51	−130	−154	**−173**	−164	−138	**−213**	−246	**−167**	**− 68**	− 34	−132
11 16	**−114**	**− 81**	**−144**	**−180**	−173	**−191**	**−161**	−184	**−266**	−166	− 45	**− 53**	**−147**
12 16	−110	− 52	−100	−133	−121	−141	−137	−114	−195	− 98	+ 11	− 31	−102
13 16	− 99	− 13	− 18	− 45	− 36	− 65	− 76	− 43	− 69	− 16	**+ 26**	− 5	− 38
14 16	− 84	+ 5	+ 39	+ 21	+ 19	− 2	− 23	+ 32	+ 32	+ 29	+ 5	− 5	+ 6
15 16	− 33	+ 10	+ 47	+ 42	+ 45	+ 34	+ 29	+ 68	+ 69	+ 39	− 6	− 11	+ 28
16 16	+ 13	− 2	+ 21	+ 31	+ 50	+ 50	+ 42	+ 71	+ 68	+ 18	− 3	+ 5	+ 30
17 16	+ 14	− 8	− 11	+ 2	+ 26	+ 26	+ 26	+ 32	+ 21	− 3	− 11	+ 2	+ 10
18 16	+ 16	+ 2	− 8	− 2	+ 2	+ 2	+ 8	− 8	+ 6	0	− 10	+ 2	+ 1
19 16	+ 21	+ 7	+ 6	0	+ 11	+ 8	+ 2	+ 8	+ 8	+ 6	− 3	+ 6	+ 7
20 16	+ 19	+ 8	+ 15	+ 13	+ 16	+ 18	+ 10	+ 13	+ 24	+ 21	0	+ 3	+ 13
21 16	+ 17	+ 13	+ 16	+ 28	+ 26	+ 26	+ 16	+ 23	+ 35	+ 26	0	+ 5	+ 19
22 16	+ 19	+ 16	+ 24	+ 34	+ 34	+ 37	+ 27	+ 27	+ 45	+ 32	+ 13	+ 11	+ 27
23 16	+ 22	+ 15	+ 28	+ 37	+ 32	+ 37	+ 29	+ 31	+ 48	+ 37	+ 14	+ 14	+ 29
Range ..	214	114	197	263	265	298	267	321	403	238	94	79	209
Average progressive increase per day.	+ 2	0	− 3	− 3	− 3	0	+ 3	+ 3	+ 2	+ 1	− 1	− 1	0

Unity = ·1γ = ·000001 C. G. S.

1903. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 13	+ 15	+ 29	+ 47	+ 33	+ 49	+ 31	+ 30	+ 48	+ 33	+ 31	+ 20	+ 32
1 16	+ 11	+ 17	+ 27	+ 43	+ 30	+ 46	+ 35	+ 31	+ 49	+ 36	+ 25	+ 21	+ 31
2 16	+ 11	+ 15	+ 18	+ 40	+ 30	+ 43	+ 33	+ 35	+ 53	+ 36	+ 25	+ 21	+ 30
3 16	+ 10	+ 8	+ 17	+ 35	+ 28	+ 45	+ 33	+ 36	+ 53	+ 23	+ 18	+ 13	+ 27
4 16	+ 8	+ 7	+ 20	+ 30	+ 31	+ 46	+ 36	+ 45	+ 59	+ 30	+ 15	+ 7	+ 28
5 16	+ 5	+ 3	+ 18	+ 38	+ 59	+ 92	+ 69	+ 74	+ 76	+ 36	+ 18	+ 8	+ 41
6 16	+ 10	+ 2	+ 24	**+ 82**	**+104**	**+120**	**+111**	**+129**	**+124**	+ 58	+ 7	+ 7	**+ 65**
7 16	+ 23	+ 22	**+ 55**	+ 68	+ 71	+ 76	+ 81	+ 74	+ 64	**+ 61**	**+ 38**	+ 2	+ 53
8 16	**+ 64**	**+ 47**	+ 45	− 13	− 20	− 15	− 15	− 51	− 89	− 7	+ 20	+ 21	− 1
9 16	+ 49	+ 25	+ 5	−102	−134	−122	−120	−163	−205	− 92	− 87	**+ 25**	− 77
10 16	− 66	− 30	− 60	−185	**−183**	−190	−177	**−206**	**−257**	−175	**− 89**	− 20	−136
11 16	**−102**	**− 66**	**−123**	**−205**	+178	**−224**	**−186**	−185	−247	**−185**	− 84	**− 41**	**−152**
12 16	− 71	− 59	−116	−150	−130	−173	−139	−122	−145	−102	− 21	− 33	−105
13 16	− 26	− 41	− 59	− 57	− 45	− 99	− 63	− 35	− 23	+ 7	+ 13	− 8	− 36
14 16	− 25	− 17	+ 12	+ 23	+ 12	− 13	+ 7	+ 30	+ 71	+ 58	+ 7	− 12	+ 13
15 16	− 16	− 7	+ 34	+ 60	+ 54	+ 46	+ 64	+ 71	+112	+ 58	+ 2	− 10	+ 39
16 16	+ 10	+ 2	+ 13	+ 60	+ 59	+ 68	+ 78	+ 87	+ 89	+ 21	− 8	− 3	+ 40
17 16	+ 16	+ 7	− 7	+ 23	+ 38	+ 43	+ 51	+ 48	+ 23	− 10	− 18	− 16	+ 16
18 16	+ 16	+ 2	− 7	+ 8	+ 3	+ 12	+ 8	− 5	+ 2	− 3	− 5	− 12	+ 2
19 16	+ 18	+ 7	− 7	+ 5	+ 2	+ 12	− 5	− 7	+ 15	0	+ 3	− 5	+ 3
20 16	+ 15	+ 8	+ 5	+ 18	+ 18	+ 21	+ 7	+ 3	+ 23	+ 10	+ 10	− 3	+ 11
21 16	+ 13	+ 7	+ 12	+ 32	+ 30	+ 31	+ 16	+ 15	+ 38	+ 25	+ 15	+ 3	+ 20
22 16	+ 8	+ 14	+ 17	+ 38	+ 35	+ 46	+ 26	+ 26	+ 38	+ 35	+ 23	+ 13	+ 26
23 16	+ 11	+ 17	+ 25	+ 42	+ 35	+ 45	+ 26	+ 28	+ 43	+ 35	+ 28	+ 20	+ 30
Range ...	166	113	178	287	287	344	297	335	381	246	127	66	217
Average progressive increase per day.	+ 2	0	− 3	− 1	+ 1	+ 3	+ 5	+ 2	+ 1	+ 3	+ 4	+ 3	+ 2

TABLES 201 & 202.—*Vertical Force Magnetograph No. 2—showing the Mean Diurnal Inequalities for each month of the years 1904 and 1905 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1904. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 23	+ 28	+ 28	+ 46	+ 41	+ 33	+ 37	+ 40	+ 56	+ 43	**+ 32**	+ 23	+ 36
1 16	+ 26	+ 30	+ 28	+ 43	+ 41	+ 30	+ 37	+ 41	+ 58	+ 47	+ 28	+ 25	+ 36
2 16	+ 20	+ 31	+ 26	+ 41	+ 41	+ 31	+ 38	+ 45	+ 60	+ 45	+ 28	+ 18	+ 35
3 16	+ 18	+ 23	+ 21	+ 33	+ 40	+ 31	+ 37	+ 46	+ 60	+ 42	+ 23	+ 13	+ 32
4 16	+ 20	+ 20	+ 23	+ 31	+ 43	+ 41	+ 41	+ 53	+ 65	+ 42	+ 23	+ 18	+ 35
5 16	+ 18	+ 16	+ 28	+ 48	+ 71	+ 74	+ 75	+ 83	+ 81	+ 48	+ 23	+ 10	+ 48
6 16	+ 25	+ 20	+ 45	**+111**	**+120**	**+117**	**+124**	+ 86	**+144**	**+ 77**	+ 8	− 2	**+ 73**
7 16	+ 40	+ 35	**+ 76**	+ 86	+ 82	+ 31	+ 98	**+ 95**	+ 96	+ 58	+ 23	− 2	+ 60
8 16	**+ 56**	**+ 38**	+ 59	− 21	− 21	− 2	+ 5	− 22	− 65	− 12	+ 15	0	+ 2
9 16	− 25	− 5	− 21	− 117	− 140	− 38	− 108	− 149	− 209	− 92	− 25	− 10	− 78
10 16	**− 147**	− 94	− 92	− 185	**− 195**	− 186	**− 204**	**− 207**	**− 274**	− 164	**− 87**	− 40	− 156
11 16	− 140	**− 125**	**− 122**	**− 195**	− 188	**− 193**	− 178	− 183	− 257	**− 179**	− 72	**− 52**	**− 157**
12 16	− 54	− 78	− 104	− 127	− 145	− 135	− 134	− 129	− 156	− 117	− 3	− 10	− 99
13 16	+ 2	− 15	− 43	− 49	− 61	− 66	− 66	− 46	− 30	− 22	+ 18	**+ 28**	− 29
14 16	+ 16	+ 10	+ 20	+ 7	+ 15	− 2	− 7	+ 20	+ 58	+ 38	− 2	+ 25	+ 16
15 16	+ 33	+ 12	+ 25	+ 41	+ 45	+ 41	+ 46	+ 60	+ 85	+ 52	− 13	− 8	+ 35
16 16	+ 10	+ 7	+ 5	+ 61	+ 61	+ 61	+ 70	+ 65	+ 56	+ 12	− 27	− 18	+ 30
17 16	− 18	− 16	− 20	+ 25	+ 38	+ 41	+ 48	+ 32	0	− 32	− 25	− 30	+ 4
18 16	+ 7	− 12	− 21	− 3	+ 2	+ 8	+ 2	− 3	+ 3	− 10	− 12	− 10	− 4
19 16	+ 15	+ 3	− 7	− 7	− 5	− 2	− 13	− 10	+ 10	+ 5	− 5	− 5	− 2
20 16	+ 13	+ 5	+ 3	+ 10	+ 10	+ 8	+ 2	− 2	+ 23	+ 8	− 7	− 3	+ 6
21 16	+ 16	+ 13	+ 8	+ 25	+ 25	+ 20	+ 13	+ 15	+ 28	+ 20	+ 5	− 2	+ 15
22 16	+ 20	+ 18	+ 13	+ 38	+ 36	+ 33	+ 23	+ 27	+ 41	+ 37	+ 22	+ 12	+ 27
23 16	+ 26	+ 28	+ 28	+ 43	+ 40	+ 31	+ 28	+ 37	+ 50	+ 45	+ 27	+ 20	+ 34
Range ...	203	163	198	306	315	310	328	302	418	256	119	80	230
Average progressive increase per day.	+ 1	− 1	− 3	− 3	0	+ 3	+ 3	+ 1	0	+ 1	+ 3	+ 4	+ 1

Unity = ·1γ = ·000001 C. G. S.

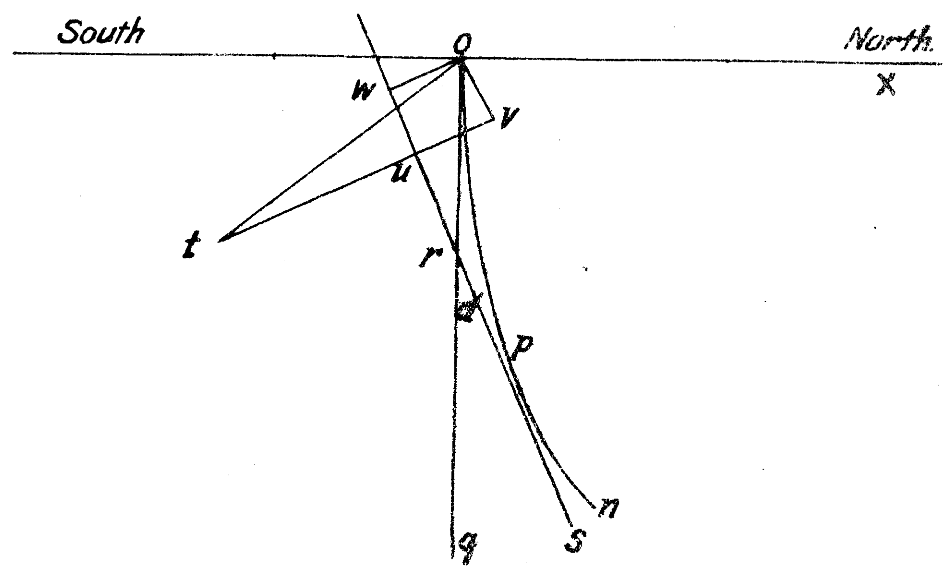
1905. Bombay Civil Time H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 16	+ 27	+ 45	+ 43	+ 56	+ 52	+ 46	+ 41	+ 36	+ 66	+ 52	+ 42	+ 36	+ 45
1 16	+ 20	+ 40	+ 38	+ 53	+ 49	+ 43	+ 39	+ 38	+ 66	+ 48	+ 44	+ 34	+ 43
2 16	+ 18	+ 37	+ 33	+ 46	+ 46	+ 48	+ 41	+ 39	+ 69	+ 54	+ 42	+ 34	+ 42
3 16	+ 17	+ 34	+ 28	+ 37	+ 44	+ 36	+ 38	+ 43	+ 69	+ 48	+ 31	+ 30	+ 38
4 16	+ 15	+ 25	+ 27	+ 41	+ 52	+ 46	+ 46	+ 49	+ 74	+ 49	+ 33	+ 28	+ 40
5 16	+ 17	+ 29	+ 33	+ 55	+ 71	+ 74	+ 79	+ 84	+ 98	+ 61	+ 23	+ 25	+ 54
6 16	+ 15	+ 35	+ 53	**+110**	**+128**	**+123**	**+125**	**+146**	**+174**	+ 107	+ 13	+ 21	**+ 87**
7 16	+ 22	+ 71	**+ 80**	+ 91	+ 92	+ 80	+ 79	+ 107	+ 82	**+108**	+ 33	+ 28	+ 73
8 16	**+ 78**	**+ 97**	+ 52	− 2	0	− 20	− 13	− 33	− 105	− 3	+ 18	**+ 52**	+ 10
9 16	+ 72	+ 50	− 27	− 106	− 136	− 126	− 120	− 169	− 243	− 148	− 24	+ 30	− 79
10 16	− 27	− 67	− 109	− 189	− 203	− 192	**− 195**	**− 243**	**− 305**	− 241	**− 103**	− 51	− 160
11 16	− 95	− 151	**− 155**	**− 221**	**− 226**	**− 226**	− 195	− 223	− 280	**− 243**	− 93	**− 74**	**− 182**
12 16	**− 100**	**− 160**	− 130	− 169	− 198	− 159	− 141	− 144	− 179	− 138	− 28	− 71	− 135
13 16	− 70	− 113	− 50	− 75	− 112	− 85	− 72	− 54	− 43	− 25	− 3	− 51	− 63
14 16	− 48	− 59	+ 13	+ 17	− 15	0	− 8	+ 33	+ 52	+ 66	− 10	− 38	0
15 16	− 25	− 24	+ 25	+ 43	+ 41	+ 48	+ 36	+ 84	+ 110	+ 72	− 16	− 34	+ 30
16 16	− 2	− 7	− 5	+ 46	+ 64	+ 61	+ 57	+ 95	+ 87	+ 23	− 44	− 23	+ 29
17 16	− 15	− 15	− 32	+ 18	+ 59	+ 44	+ 48	+ 56	+ 23	− 39	− 57	− 31	+ 5
18 16	− 5	− 15	− 22	− 3	+ 20	+ 16	+ 21	− 2	+ 2	− 2	− 2	− 7	0
19 16	+ 5	+ 22	+ 7	+ 12	+ 5	+ 3	+ 2	− 3	+ 16	+ 16	+ 5	+ 5	+ 8
20 16	+ 10	+ 20	+ 10	+ 18	+ 20	+ 15	+ 13	+ 8	+ 25	+ 16	+ 5	+ 3	+ 14
21 16	+ 8	+ 22	+ 17	+ 35	+ 36	+ 30	+ 26	+ 13	+ 38	+ 16	+ 10	+ 2	+ 21
22 16	+ 18	+ 34	+ 30	+ 46	+ 49	+ 41	+ 34	+ 28	+ 51	+ 39	+ 33	+ 23	+ 35
23 16	+ 28	+ 45	+ 42	+ 50	+ 52	+ 46	+ 38	+ 33	+ 62	+ 49	**+ 46**	+ 31	+ 43
Range ...	178	257	235	331	354	349	320	389	479	351	149	126	269
Average progressive increase per day.	0	+ 5	− 6	− 19	+ 4	+ 2	+ 8	− 7	− 6	+ 2	+ 9	0	− 1

257. In the report of the Observatory for 1871-1872 it has been mentioned that the agate knife edge was, under examination, seen to be sensibly curved with an estimated radius of curvature, of about ·006 inch; and also that within the range of about 4° of tilt as determined from the scale readings, the sensitiveness varied so as to be twice as great at the extreme ends of scale as at the middle; and this when the retaining force acting on the balance had been made as great as the horizontal force at Colaba, *viz.* about ·37400 C. G. S. It was also noticed that if the sensitiveness was made much greater than this the balance remained steady only for small oscillations—within 2° —, but when this was exceeded it became unstable and overset on either side. The deflection observations performed from 1872 to 1883, as will be seen presently, show even a worse result, namely, that the diminution in the value of the scale coefficient due to a change of 10 divisions of the scale (equivalent to about 1° of arc), from the middle position of the scale, is roughly about 20γ.

258. The necessity hence of evaluating correct coefficients under such circumstances different for different values of the scale readings was obviously imperative.

By assuming in the first instance that the curvature of the knife edge (in section) was of the form of an ellipse placed at the extremity of its shorter diameter, it was ascertained (*vide* Appendix 1, Vol. 1879-1882, page 20) that the effect of such a curvature on the balance though accounting roughly for the general features of the defect noticed above, failed to explain the greater steadiness of the balance to oversetting even though a much larger range of movement was conceded than was actually assumed in the theory. The investigation however showed that the effect was of the right order of magnitude and that by reversing the above process of investigation by plotting the actual variations of the scale readings under the action of the known disturbing forces, it was possible to derive the corrections necessary for every particular position of the balance—that is for the particular readings of the scale, and derive therefrom the true curvature of the knife edge.

259. We can only very briefly in this volume recount the theory indicating the nature of the corrections, leaving the reader to refer for full details of the investigation, to the appendix in the volume already referred to. It was found by experiment that the curvature of the knife edge was a minimum at that part of the edge which rests on the agate plate when the scale reading was about 33·2 and the curvature increased continuously thereafter though not symmetrically on both sides of this position, and consequently the evolute to the curve has a cusp on the normal to the point of minimum curvature and has branches on each side that are convex towards that line. Suppose *opn* (*vide* figure below) to be a representation (exaggerated in order that it may be distinctly seen) of one side of the evolute on a plane section perpendicular to the knife-edge, the cusp being at the point *o*, through which passes *qo* the normal to the knife-edge drawn from its point of minimum curvature: let *spw*, touching the evolute at *p*, be the normal to the point of the curve of the knife-edge on which the magnet is supposed to be resting under the influence of a deflector magnet: *spw* will necessarily be vertical, since the agate plane on which the magnet rests, being a tangent plane, is horizontal: let the angle *qrs* which *qo* makes with *spw* be α and—*t* being the centre of gravity of the magnet and its attachments—let the distance $to = c$; and—*xo* being perpendicular to *qo*—let the angle *xot* be called ε.



If α_0 be the north dip of the magnetic axis of the magnet when *qo* is vertical; H is the horizontal magnetic force; V_0 the vertical component; Y the disturbing force produced by the deflecting magnet; *m*, W the moment and weight respectively of the magnetograph magnet; *g* the force of gravity; then as *tv* and *wo* are perpendicular and *vo* parallel to line *spw*, the equation of equilibrium :—

$$m(V_0 + Y)\cos(\alpha_0 + \alpha) - mH\sin(\alpha_0 + \alpha) - Wg(tu) = 0 \qquad (100)$$

As $(\alpha_0+\alpha)$ is a small angle and $tu = tv - wo = - c\cos(\epsilon + \alpha) - wo$, we have

$$(V_0 + Y) - H(\alpha_0 + \alpha) + \frac{Wg}{m} c\cos(\epsilon + \alpha) + \frac{Wg}{m}(wo) = 0 \qquad (101)$$

when $\alpha = 0$ the expression is simplified and becomes

$$V_0 - H\alpha_0 + \frac{Wg}{m} c\cos\epsilon = 0 \qquad (102)$$

Subtracting (102) from (101) we get

$$Y - H\alpha - \frac{Wg}{m} c\sin\epsilon \times \alpha + \frac{Wg}{m}(wo) = 0 \text{ nearly whence,} \qquad (103)$$

$$\frac{Wg}{m}(wo) = \left[H + \frac{Wg}{m} c\sin\epsilon \right]\alpha - Y$$

and

$$wo = \left[\frac{m}{Wg} H + c\sin\epsilon \right]\alpha - \frac{m}{Wg}Y \qquad (104)$$

Differentiating (103) with respect to α we have

$$\frac{dY}{d\alpha} = \left[H + \frac{Wg}{m} c\sin\epsilon \right] - \frac{Wg}{m}\frac{d(wo)}{d\alpha} \qquad (105)$$

260. For practical use the above equations have been conveniently modified thus :—

As it will be quite by accident if the initial position of the balance in any set of experiments, is such as to place qo vertical, let the disturbing force, which in this case will be zero for the actual initial position, be called Y_1, and the force which brings the balance back in the vertical position for qo be Y_2. Then we have to substitute in equation (103) $Y_1 - Y_2$ for Y, and calling the angular value of a division of the scale of the magnetograph as a (= ·00154) ; and s as the scale reading, we may put $a(s - 33{\cdot}2)$ for α, and for $\left[H + \frac{Wg}{m} c\sin\epsilon \right] 33{\cdot}2a$ which may be taken as constant during any single set of experiment we may write C. Thus equation (103) becomes

$$Y \text{ or } Y_1 - Y_2 = \left[H + \frac{Wg}{m} c\sin\epsilon \right] a\,.\,s - \left[C + \frac{Wg}{m}(wo) \right] \qquad (106)$$

we have also

$$\frac{Wg}{m}(wo) = \left[H + \frac{Wg}{m} c\sin\epsilon \right] a\,.\,s - (C - Y_2) - Y_1 \qquad (107)$$

and

$$(wo) = \left[\frac{m}{Wg} H + c\sin\epsilon \right] a\,.\,s - \frac{m}{Wg}(C - Y_2) - \frac{mY_1}{Wg} \qquad (108)$$

Differentiating we have

$$\frac{dY}{ds} = \left[H + \frac{Wg}{m} c\sin\epsilon \right] a - \frac{Wg}{m}\frac{d(wo)}{ds} \qquad (109)$$

It will be seen from the last expression in equation (109) how the scale coefficient is modified from time to time by the use of this formula instead of the equation (97), which does not take into account the change of scale coefficient with the change of scale reading.

261. For the derivation of the coefficients up to January 1882 the following procedure was adopted. For deflection operations referred in paragraph 229 the disturbing force derived from experiment 3 (*vide* equation 83 duly modified for the distribution constant) is

$$Y = H\,\acute{a}\left(1 + \frac{H}{F}\right)\frac{d}{2r^3\left(1 - \frac{p}{r^2}\right)} \qquad (110)$$

From this value of the disturbing force, divided by the value of the single deflection on the magnetograph, the crude first values of the coefficient $\frac{dY}{ds}$ are derived. From a modification of the equation (107), namely,

$$\frac{Wg}{m}(wo) = \left[H + \frac{Wg}{m}(c\sin\epsilon) \right] . a\,(s - 33{\cdot}2) - Y \qquad (111)$$

the values of $\frac{Wg}{m}(wo)$ have been once for all determined by taking the results of a large series of experiments; and then the ratios given by the consecutive differences of these average values divided by the difference of the greatest and the least scale reading during the deflection experiment constitute the correction applicable to the coefficient as shown in equation

$$\frac{dY}{ds} + \frac{\Delta\left[\frac{Wg}{m}(wo)\right]}{\Delta s} = \left(H + \frac{Wg}{m}c\sin\epsilon\right)a. \qquad (111A)$$

which thus furnishes the values of $\left[H + \frac{Wg}{m}c\sin\epsilon\right]a$ which constitute the provisional scale coefficients for the *constant* scale reading 33·2.

262. The question of temperature effect upon the scale coefficient has now incidentally to be examined here. Its derivation from the crude values of the scale coefficients varying with the value of the scale of course would have been obviously impracticable. For this purpose hence was it necessary in the first instance to secure provisional values of the scale coefficients for some constant scale reading (33·2) as referred to in the last paragraph.

263. The series is then utilized for the derivation of the vitiating effects of temperature and time, and is treated by the formula $A + b\,(t^\circ - 80^\circ) + cT$ referred to already in paragraph 235. From a large group of monthly experimental data judiciously selected, the values of the constants were derived; and as a matter of check work, inserting the values in the above equation and recalculating the theoretical coefficients for the temperature and time of the several experiments, it was seen if they were found to agree well with the original values. Subsequent derivations of the constants from the data, which have accumulated from time to time, leave little doubt as to the propriety of the adoption of the method of taking these constants into account in the evaluation of the scale coefficient of the vertical force magnetograph. Thus furnished with the values of A, b and c, A being corrected from the result of the larger annual deflection experiment as referred to in paragraph 237, the final monthly values of the coefficients were computed for the temperature and time for each particular month, that is, the equivalent value of the full expression $A' + b\,(t^\circ - 80^\circ) + c\,T$ or $\left[H + \frac{Wg}{m}c\sin\epsilon\right]a$. As these values of the coefficients (*vide* equation 111A) refer to the constant scale reading 33·2, the correction $\frac{\Delta\left[\frac{Wg}{m}(wo)\right]}{\Delta s}$ dependent upon the departure of the scale division of the corresponding month from 33·2 has to be applied, which constitute the final coefficients for the different scale readings of every month.

264. For the derivation of the coefficients after the year 1882, the method indicated above for the evaluation of the constants of the vitiating effects of change of scale, temperature and time remains the same, while the disturbing force Y was determined as modified from equation referred to in paragraph 230. The experiment No. 2 was added to the deflection experiments which up till then consisted only of operations (1) and (3).

The various details of the process adopted will best be grasped by considering a concrete example shown below for the derivation of the scale coefficients for May 1894. The disturbing force as given by the expression $J \,.\, H \,.\, \sin\mu\frac{1}{r^3}\left[1 + \frac{p}{r^2}\right]$ (see formula 91) was found by deflection experiments at a single distance 2·5 feet N., equal to ·001397 from which $\frac{dY}{ds} = \cdot000919$. The value of $\Delta\left[\frac{Wg}{m}(wo)\right]$ being ·000024 for the scale reading during the experiment, and 3·04 being the difference between the greatest and the least scale reading, we find by formula (111A), the scale coefficient for the month of May (corresponding to the scale reading 33·2) equal to ·000927. Such provisional monthly values of the scale coefficients round about May 1894, were grouped for a convenient period, and the provisional values of the constants A, b, and c in equation referred to in paragraph 263 were derived, namely, $A = +\cdot000574$, $b = +\cdot0000233$, and $c = +\cdot00000241$. The value of the constant A was then corrected as in V. F. No. 2, *vide* paragraph 237, by the results of the large yearly deflection experiments, which included a number of deflection distances, *viz.* 1·8, 2·0, 2·3, 2·5 and 3·0 feet. The final modified value of A so found was +·000528, which with the constants b and c as above, was adopted and the final value of the scale coefficient then derived for the month was

$$\frac{dY}{ds} = A' + b \times (t^\circ - 80^\circ) + c \times T + \frac{Wg}{m}\frac{\Delta(wo)}{\Delta s}.$$

$$\cdot000866 = \cdot000528 + \cdot0000233 \times 13^\circ\!\cdot\!88 + \cdot00000241 \times 7 - \cdot000002.$$

Whence $\frac{dY}{ds} = \cdot000866 \times 5\cdot43 = \cdot00470$ C. G. S. for an ordinate of 1 inch, which appears in table 203, 5·43 being the factor for converting the scale coefficient for an unit of division of the scale into that of an inch of ordinate.

265. The monthly coefficients so derived and used in the reductions have all been collected in table 203 below:—

TABLE 203.—*Scale coefficients of V. F. Magnetograph No. 1 for an inch of ordinate.*

Unity = 1γ = ·00001 C. G. S.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1873 ...	396	402	418	463	490	499	460	446	441	444	447	429
1874 ...	397	391	405	432	476	499	481	462	458	462	454	448
1875 ...	430	420	450	484	517	541	519	502	488	482	481	474
1876 ...	454	448	462	438	524	536	535 (1st—6th) 512 (15th—31st)	507	503	502	499	488
1877 ...	476	466	481	503	533	562	558	550	542	541	531	518
1878 ...	483	475	493	522	549	576	550	533	535	538	530	504
1879 ...	480	475 (1st to 7th) variable. 443 (17th—28th)	496	523	549	557	553	542	534	533	515	485
1880 ...	454 (1st to 13th) variable.	763 (1st—15th) 812 (16th—29th) variable.	767	797	813	825	798	788	777	779	772	758
1881 ...	747 (1st to 7th) variable.	494 (2nd—12th) 489 (13th—23rd) variable.)	493	504	532	538	519	513	524	505	496	471
1882 ...	458	446	456	491	523	526 (1st to 26th)	......	237	226	226	212	182
1883 ...	178	168	175	204 (1st to 15th) 304 (17th to 30th)	341	355	325	296	269	280	263	184
1884 ...	......	228	255	288	329	352	343	327	319	312	298	287
1885 ...	283	273	278 (1st to 6th) 355 (7th—31st)	374	399	411	393	361	340	334 (1st to 16th) 325 (17th—31st)	315	284
1886 ...	251	254 ((2nd—5th) 213 (7th—28th)	225	266	329	333	279 (1st—20th) 266 (21st—31st)	256	256	266	267	252
1887 ...	......	......	248	283	324	325	286	272	261	260	257	237
1888 ...	......	252	280	312	332	339	319	307	304	312	312	306
1889 ...	295	290	305	320	342 (9th to 31st)	348	317	312	308	308	293	274
1890 ...	263	271	292 (1st—19th) 238 (26th—30th)	252 (3rd—22nd) 276 (24th—30th)	280	296 (1st—2nd) 333 (4th—30th)	314	311	317 (1st—16th) 378 (17th—30th)	381	378	378
1891 ...	356	334	345	389	424	449 (1st—19th) 435 (20th—30th)	423	418	427	425 267	274	277
1892 ...	278	294	299 (1st—16th) 327 (17th—31st)	402	453	452	438	400	360	363	355	345
1893 ...	330	317	353	420	477	483	449	443	437	428	431	417
1894 ...	395	396	414	444	470	453	433	415	404	400	388	378
1895 ...	369	369	394	414	441	449	431	407	396	400	398	385
1896 ...	378	371	378 (1st—18th) 415 (19th—31st)	450	483	483	443	413	415	428	431	411
1897 ...	380	369	386	424	467	487	475 (1st—16th) 496 (17th—31st)	478	471	465	445	421
1898 ...	401	413	436	487	531	529	498	479	469	479	483	471

7. Temperature coefficient of the magnet of No. 1 Magnetograph.

266. The temperature coefficient of the instrument was for the first time derived in February 1879. As will be seen from the result in the table below the coefficient being found too high, the balance was dismounted, and the temperature bar altered.

267 Since then the balance had remained undisturbed and from time to time five independent heating experiments have been made—in January 1880, February 1881, January 1886, January 1895 and January 1907.

Results of heating experiment for temperature coefficient, V. F. No. 1 Magnetograph.

February 1879,	Temperature co-efficient	$= \frac{dV}{ds} \frac{\Sigma(\Delta s)}{\Sigma(\Delta t)}$	$= (\cdot001156)\ (-\cdot208)$	$= -\cdot000240$
January 1880	"	"	$= (\cdot001570)\ (-\cdot019)$	$= -\cdot000030$
February 1881	"	"	$= (\cdot001047)\ (-\cdot015)$	$= -\cdot000016$
January 1886	"	"	$= (\cdot000600)\ (-\cdot194)$	$= -\cdot000116$
January 1895	"	"	$= (\cdot000712)\ (-\cdot225)$	$= -\cdot000160$
January 1907	"	"	$= (\cdot000622)\ (-\cdot196)$	$= -\cdot000122$

268. Considering that after 1880 the instrument was not in any way disturbed, the small value of the coefficient derived in the first two experiments giving an average coefficient of about 2·3γ for 1° F., which appears suddenly to change in the last three experiments to an average of about 13·3γ, introduces such a large amount of uncertainty in the value that it is difficult to ascribe it to observational errors. The balance was readjusted in 1879 and the first two experiments were performed within about a year of the readjustment, and it is not improbable that the instrument by then had not acquired a set or settled conditions of molecular change, after the rough handling to which the magnet was subjected when the alteration in the temperature bar and other readjustments of parts were made late in 1879. This is the only plausible reason which can be advanced to explain the discrepancy in the result. Rejecting these two values, the three subsequent independent determinations give fairly consistent values, the average of which is −13·3γ. In the first two* of these three experiments the actual change of force has not been properly allowed for. In the last experiment this has been done, and as it was specially performed with care on a quiet day, the presumption that the value is approximately correct is very strong.

269. Provisionally hence −13·3γ for 1° F. has been accepted as the temperature coefficient of the instrument from 1880 to 1905 and −24γ from 1873 to 1879.

We shall refer to this subject again in connection with the comparison of the records of the No. 1 and No. 2 magnetographs.

8. Use of the V. F. No. 1 Magnetograph.

270. The use of this instrument for supplying corrections to secure the mean monthly values of vertical force has not been made except for the years 1888 to 1892, V. F. No. 2 being employed for this purpose for 1893 to 1905. The dip observations being more or less unreliable before 1888, as will be seen later on, no use of the V. F. No. 1 in this direction has been made prior to that period. The temperature correction used for 1888 to 1892 and applied in these reductions has never exceeded 2γ, as the difference in the mean temperature of the time of the absolute observations of inclination and of the mean of the month in the magnetograph enclosure had rarely exceeded 0°·1 F. Hence as the absolute values are reliable only to 1γ, whether the temperature coefficient be taken as 10γ or 14γ, the correction in either case would be ±1γ. Any small uncertainty in the temperature coefficient hence does not affect the accurracy of the absolute result so far.

Reduction of the Absolute V. F. to the mean of the day.

271. The diurnal inequalities of the vertical force registered by V. F. No. 1 instrument have been derived in the usual way described for the other instruments and the results are given in tables 217 to 238 corrected for temperature and other defects as shown in the next section.

272. The corrections for aperiodic changes have been collected and given in tables 204 and 205 and these have been duly considered for application in the analysis for Fourier coefficients wherever they were found significant.

* The correction applied is for the normal diurnal variation only.

TABLE 204.—*Average progressive increase per day of Vertical Force Magnetograph No. 1 derived from monthly means.*

Unity = ·1γ = ·000001 C. G. S.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
1873 ...	- 1	- 12	- 19	- 23	- 18	- 4	+ 3	- 3	- 6	- 3	+ 1	+ 4	- 7
1874 ...	+ 1	- 4	- 9	- 17	- 18	- 4	+ 1	- 2	- 3	- 1	- 1	- 1	- 5
1875 ...	+ 1	- 3	- 10	- 14	- 19	- 12	- 3	- 3	- 1	0	- 1	- 2	- 6
1876 ...	- 1	- 1	- 5	- 7	- 10	- 5	- 21	+ 9	+ 3	+ 3	+ 4	+ 5	- 2
1877 ...	+ 6	0	- 7	- 9	- 9	- 2	+ 5	+ 3	+ 1	+ 4	+ 6	+ 12	+ 1
1878 ...	+ 11	- 3	- 11	- 11	- 10	- 2	+ 11	+ 3	- 1	+ 4	- 3	- 2	- 1
1879 ...	+ 2	+ 4	- 14	- 12	- 7	+ 2	+ 6	+ 7	+ 4	+ 5	+ 12	+ 23	+ 3
1880 ...	+ 7	0	- 32	- 23	- 14	- 6	- 5	- 5	- 3	- 1	+ 1	+ 5	- 6
1881 ...	+ 4	0	- 20	- 12	- 10	- 7	- 6	- 7	- 7	- 5	- 5	- 8	- 7
1882 ...	- 8	- 5	+ 1	+ 2	- 9	- 3	0	- 15	- 7	- 5	- 9	- 7	- 5
1883 ...	- 2	- 1	- 2	- 9	- 7	+ 6	- 4	- 13	- 1	+ 7	- 9	- 28	- 5
1884 ...	0	- 27	- 13	- 7	- 7	0	+ 8	+ 6	+ 5	+ 4	+ 3	+ 4	- 2
1885 ...	+ 7	- 2	- 19	- 8	- 18	- 9	+ 6	+ 8	+ 4	0	- 3	0	- 3
1886 ...	+ 19	0	- 10	- 4	- 3	+ 1	- 3	- 3	+ 1	+ 2	- 2	- 4	0
1887 ...	- 1	0	- 20	- 9	- 9	2	+ 5	+ 2	+ 3	- 10	+ 3	+ 3	- 3
1888 ...	- 4	+ 1	- 8	- 9	- 7	- 1	+ 5	+ 2	+ 2	- 3	- 4	+ 11	- 1
1889 ...	+ 5	- 2	- 6	- 5	- 4	- 1	+ 5	+ 3	- 3	- 1	+ 4	0	0
1890 ...	- 2	+ 1	- 1	- 15	- 20	- 6	+ 16	- 3	+ 1	- 1	+ 2	+ 4	- 2
1891 ...	+ 10	0	- 14	- 15	- 15	- 1	+ 8	- 1	+ 1	- 14	+ 10	+ 7	- 2
1892 ...	+ 4	- 2	- 21	- 30	- 6	+ 4	+ 5	+ 8	+ 5	+ 2	+ 6	+ 5	- 2
1893 ...	+ 5	- 6	- 21	- 24	- 12	+ 6	+ 5	- 3	- 5	- 1	+ 4	+ 9	- 4
1894 ...	+ 5	- 5	- 11	- 14	- 13	- 2	+ 9	+ 7	+ 4	+ 7	+ 6	+ 4	0

TABLE 205.—*Average progressive increase per day of Vertical Force Magnetograph No. 1 derived from the daily means of the first and the last day of each month.*

Unity = ·1γ = ·000001 C. G. S.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
1873 ...	+ 11	- 14	- 21	- 22	- 28	+ 7	+ 5	- 6	- 6	- 2	+ 4	+ 4	- 6
1874 ...	+ 1	0	- 8	- 17	- 22	+ 2	- 2	- 5	0	- 2	- 3	0	- 5
1875 ...	+ 3	- 1	- 12	- 9	- 21	- 13	- 3	- 5	- 5	+ 4	+ 1	- 2	- 5
1876 ...	+ 3	+ 1	- 2	- 11	- 12	- 5	- 21	+ 9	+ 1	+ 6	+ 2	+ 6	- 2
1877 ...	+ 9	- 5	- 3	- 17	- 7	- 3	+ 7	+ 9	- 3	+ 5	+ 8	+ 7	+ 1
1878 ...	+ 11	- 2	- 14	- 14	- 11	- 1	+ 15	- 2	+ 3	0	+ 7	+ 16	+ 1
1879 ...	+ 2	+ 4	- 14	- 12	- 8	+ 7	0	+ 9	+ 2	+ 8	+ 11	+ 23	+ 3
1880 ...	+ 7	- 76	- 20	- 16	- 8	- 4	- 6	- 6	- 5	0	- 1	+ 5	- 11
1881 ...	+ 4	0	- 22	- 4	- 15	- 7	- 5	- 5	- 7	- 4	- 5	- 9	- 7
1882 ...	- 8	- 9	+ 4	+ 6	- 9	- 3	0	- 15	- 17	- 1	- 8	- 23	- 7
1883 ...	+ 5	+ 8	- 2	- 9	- 7	+ 12	+ 5	- 25	- 2	+ 1	- 20	- 28	- 5
1884 ...	0	- 27	- 9	- 9	- 11	0	+ 10	+ 6	+ 4	+ 5	0	- 2	- 3
1885 ...	+ 1	- 2	- 19	- 8	- 22	- 11	+ 9	+ 7	- 7	+ 1	- 4	- 8	- 5
1886 ...	+ 19	0	- 10	- 5	- 4	+ 8	- 9	- 2	+ 5	+ 12	- 5	- 7	0
1887 ...	- 1	0	- 20	- 8	- 16	+ 3	+ 6	- 2	+ 3	- 10	+ 3	+ 3	- 3
1888 ...	- 4	+ 1	- 8	- 6	- 22	+ 5	+ 5	- 1	+ 9	- 15	- 4	+ 11	- 2
1889 ...	+ 5	- 16	+ 3	- 9	- 2	- 5	+ 7	+ 2	- 7	- 6	+ 10	+ 4	- 1
1890 ...	- 3	+ 1	- 1	- 15	- 20	- 6	+ 16	- 3	+ 1	- 1	- 11	+ 12	- 3
1891 ...	+ 7	+ 1	- 6	- 15	- 15	- 1	+ 8	- 1	+ 1	- 14	+ 10	+ 7	- 1
1892 ...	+ 6	+ 2	- 30	- 30	- 3	+ 14	- 4	+ 15	+ 2	- 3	+ 9	+ 2	- 2
1893 ...	+ 9	- 8	- 25	- 28	- 16	+ 15	+ 3	- 3	- 3	- 2	- 4	+ 16	- 4
1894 ...	+ 5	- 2	- 19	- 17	- 10	- 3	+ 14	+ 6	+ 6	+ 3	+ 9	+ 4	0

273. We have a long series from 1873 to 1905 of inequalities registered by this instrument, and the question of its acceptance or rejection as a reliable series will depend upon the proper reply to the inquiry how far and in what way are the indications of the inequalities contaminated by effects of temperature and other instrumental defects referred to and discussed already; and how far when such effects are determined and eliminated do the corrected inequalities satisfy the requirements as regards accuracy of results expected in variations of these kinds. These points have been taken up for discussion in the next section.

9. *Comparison of the Diurnal Inequalities of Vertical Force as registered simultaneously by V. F. No. 1 and No. 2 Magnetographs.*

274. The comparison results of the records of these two instruments given below extend over a period of five years from 1894 to 1898.

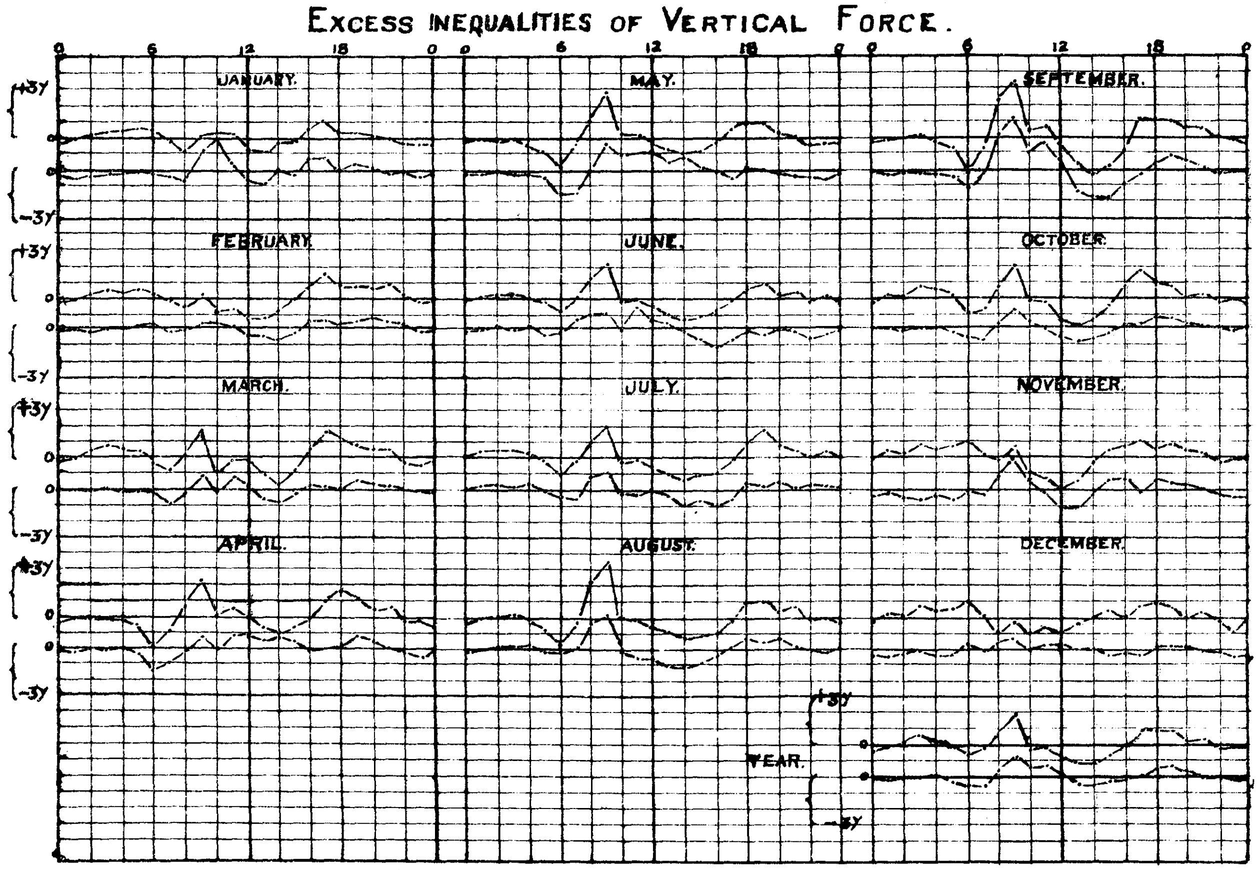
The mean monthly variations (average of the period) registered by each instrument and corrected for the aperiodic change only * appear in tables 206 and 207.

Table 208 gives the differences, and the results of these three tables are all charted for ready reference on plate 5.

275. It will be seen that the differences, figures I*a* to XIII*a*, are not, after all, seriously large; as only twice during the period does the difference become as large as 3·5γ, all the rest lying well within 2·0γ except once when it reaches 2·6γ. It will also be noted that the differences recur with marked regularity, as in the comparison of the irregularities of even individual months when the progressive change is correctly allowed for, the character and magnitude of the differences remain as in the average months remarkably persistent and definite.

Not only is this disclosed in the difference results of the simultaneous record which are charted below in the upper set of curves, but even the differences of the average monthly inequalities of 22 years from 1873 to 1894 and similar inequalities from 1894 to 1904, the former series being recorded by V. F. No. 1 and the latter by V. F. No. 2 magnetograph, tell the same tale. These differences, which are also charted below

EXCESS INEQUALITIES OF VERTICAL FORCE.



Upper curve denotes excess inequalities of V. F. No. 1 over V. F. No. 2 for period 1894 - 1898.
Lower " " " " " for the period 1873 - 1894 over Vertical Force No. 2 for the period 1894 - 1904.

* The inequalities herein discussed are taken without the temperature correction being applied to either instrument.

TABLE 206.—*Diurnal Variations of V. F. No. 2, 1894—1898, corrected for progressive change.*

Unity = ·1γ = ·000001 C. G. S.

Bombay Civil Time.	Months.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
H. m.													
10 16	− 95	− 61	− 110	− 178	− 205	− 178	− 157	− 205	− 251	− 160	− 71	− 38	− 142
11 16	− 120	− 85	− 146	− 190	− 186	− 190	− 155	− 184	− 258	− 156	− 64	− 56	− 148
12 16	− 68	− 45	− 117	− 134	− 136	− 150	− 121	− 134	− 178	− 74	− 8	− 34	− 99
13 16	− 21	+ 4	− 39	− 50	− 47	− 71	− 63	− 62	− 50	+ 5	+ 17	− 25	− 33
14 16	− 9	+ 19	+ 38	+ 17	+ 17	− 7	− 1	+ 2	+ 47	+ 46	+ 5	− 29	+ 13
15 16	+ 8	+ 13	+ 50	+ 49	+ 56	+ 42	+ 31	+ 43	+ 85	+ 38	− 9	− 20	+ 32
16 16	− 1	− 9	+ 13	+ 41	+ 56	+ 56	+ 40	+ 54	+ 63	− 4	− 22	− 9	+ 23
17 16	− 24	− 38	− 29	+ 7	+ 27	+ 40	+ 24	+ 27	+ 6	− 41	− 28	− 17	− 4
18 16	− 2	− 20	− 21	− 12	− 6	+ 4	− 5	− 11	− 2	− 10	− 4	− 2	− 7
19 16	+ 10	+ 6	+ 7	+ 1	− 6	− 7	− 23	− 8	+ 14	+ 5	0	+ 3	0
20 16	+ 12	+ 4	+ 13	+ 17	+ 13	+ 8	− 2	+ 6	+ 24	+ 8	0	+ 3	+ 9
21 16	+ 18	+ 6	+ 18	+ 29	+ 27	+ 21	+ 14	+ 22	+ 32	+ 16	+ 6	+ 8	+ 18
22 16	+ 25	+ 19	+ 28	+ 39	+ 39	+ 34	+ 26	+ 34	+ 45	+ 34	+ 21	+ 17	+ 30
23 16	+ 31	+ 30	+ 38	+ 47	+ 44	+ 40	+ 34	+ 43	+ 55	+ 42	+ 28	+ 23	+ 38
0 16	+ 32	+ 28	+ 38	+ 50	+ 46	+ 43	+ 39	+ 49	+ 60	+ 43	+ 28	+ 23	+ 40
1 16	+ 30	+ 26	+ 35	+ 49	+ 46	+ 43	+ 41	+ 54	+ 67	+ 42	+ 26	+ 21	+ 39
2 16	+ 27	+ 25	+ 31	+ 40	+ 42	+ 39	+ 39	+ 54	+ 61	+ 39	+ 25	+ 19	+ 36
3 16	+ 19	+ 16	+ 24	+ 36	+ 40	+ 39	+ 40	+ 53	+ 60	+ 33	+ 18	+ 13	+ 32
4 16	+ 12	+ 11	+ 22	+ 34	+ 45	+ 46	+ 46	+ 57	+ 61	+ 33	+ 14	+ 12	+ 33
5 16	+ 9	+ 8	+ 26	+ 49	+ 73	+ 77	+ 74	+ 83	+ 80	+ 42	+ 16	+ 12	+ 45
6 16	+ 12	+ 8	+ 42	+ 104	+ 122	+ 113	+ 116	+ 140	+ 143	+ 66	− 3	− 1	+ 71
7 16	+ 29	+ 20	+ 61	+ 73	+ 75	+ 79	+ 73	+ 86	+ 90	+ 62	+ 14	+ 11	+ 55
8 16	+ 59	+ 23	+ 19	− 16	− 34	− 10	− 9	− 45	− 63	− 15	+ 14	+ 44	− 3
9 16	+ 11	− 8	− 47	− 111	− 152	− 110	− 94	− 158	− 188	− 99	− 22	+ 22	− 81

TABLE 207.—*Diurnal Variations of V. F. No. 1, 1894—1898, corrected for progressive change.*

Unity = ·1γ = ·000001 C. G. S.

Bombay Civil Time.	Months.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
H. m.													
10 17	− 91	− 70	− 121	− 176	− 203	− 181	− 161	− 205	− 246	− 162	− 82	− 50	− 146
11 17	− 117	− 92	− 149	− 187	− 183	− 190	− 159	− 185	− 251	− 161	− 77	− 65	− 151
12 17	− 77	− 58	− 120	− 135	− 138	− 155	− 127	− 139	− 184	− 90	− 28	− 46	− 108
13 17	− 31	− 8	− 51	− 56	− 55	− 81	− 73	− 71	− 67	− 13	+ 3	− 31	− 44
14 17	− 13	+ 12	+ 21	+ 7	+ 7	− 21	− 14	− 12	+ 23	+ 31	− 0	− 29	+ 1
15 17	+ 6	+ 12	+ 41	+ 41	+ 47	+ 30	+ 20	+ 30	+ 68	+ 33	− 5	− 16	+ 25
16 17	+ 2	− 3	+ 18	+ 39	+ 52	+ 48	+ 31	+ 44	+ 56	+ 4	− 15	− 7	+ 23
17 17	− 14	− 24	− 12	+ 17	+ 32	+ 38	+ 23	+ 27	+ 16	− 24	− 19	− 11	+ 4
18 17	+ 2	− 12	− 9	+ 3	+ 3	+ 9	+ 3	− 2	+ 9	− 2	0	+ 3	+ 1
19 17	+ 14	+ 13	+ 14	+ 11	+ 4	0	− 7	0	+ 24	+ 11	+ 6	+ 7	+ 8
20 17	+ 13	+ 10	+ 18	+ 22	+ 16	+ 11	+ 4	+ 10	+ 30	+ 9	+ 5	+ 6	+ 13
21 17	+ 18	+ 13	+ 21	+ 31	+ 30	+ 24	+ 18	+ 26	+ 37	+ 18	+ 9	+ 11	+ 21
22 17	+ 21	+ 19	+ 25	+ 36	+ 36	+ 32	+ 27	+ 33	+ 46	+ 31	+ 17	+ 15	+ 28
23 17	+ 27	+ 27	+ 34	+ 45	+ 42	+ 41	+ 37	+ 43	+ 55	+ 40	+ 26	+ 14	+ 36
0 17	+ 29	+ 26	+ 35	+ 46	+ 44	+ 42	+ 40	+ 48	+ 57	+ 41	+ 26	+ 22	+ 38
1 17	+ 28	+ 23	+ 35	+ 46	+ 44	+ 45	+ 44	+ 54	+ 65	+ 43	+ 27	+ 24	+ 40
2 17	+ 26	+ 25	+ 33	+ 38	+ 41	+ 42	+ 43	+ 54	+ 61	+ 40	+ 28	+ 22	+ 37
3 17	+ 23	+ 20	+ 27	+ 34	+ 40	+ 44	+ 46	+ 56	+ 61	+ 38	+ 25	+ 19	+ 36
4 17	+ 17	+ 14	+ 25	+ 33	+ 42	+ 48	+ 49	+ 57	+ 59	+ 37	+ 19	+ 17	+ 35
5 17	+ 14	+ 13	+ 29	+ 45	+ 64	+ 75	+ 71	+ 76	+ 74	+ 44	+ 21	+ 18	+ 45
6 17	+ 16	+ 9	+ 38	+ 84	+ 103	+ 105	+ 104	+ 120	+ 120	+ 58	+ 7	+ 9	+ 64
7 17	+ 27	+ 18	+ 53	+ 65	+ 70	+ 79	+ 72	+ 83	+ 84	+ 57	+ 14	+ 14	+ 53
8 17	+ 50	+ 18	+ 20	− 8	− 21	+ 3	− 2	− 23	− 41	− 1	+ 12	+ 36	+ 4
9 17	+ 12	− 6	− 31	− 90	− 126	− 88	− 78	− 123	− 153	− 78	− 16	+ 20	− 63

TABLE 208.—*Excesses of ordinates of V. F. No. 1 over those of V. F. No. 2.*

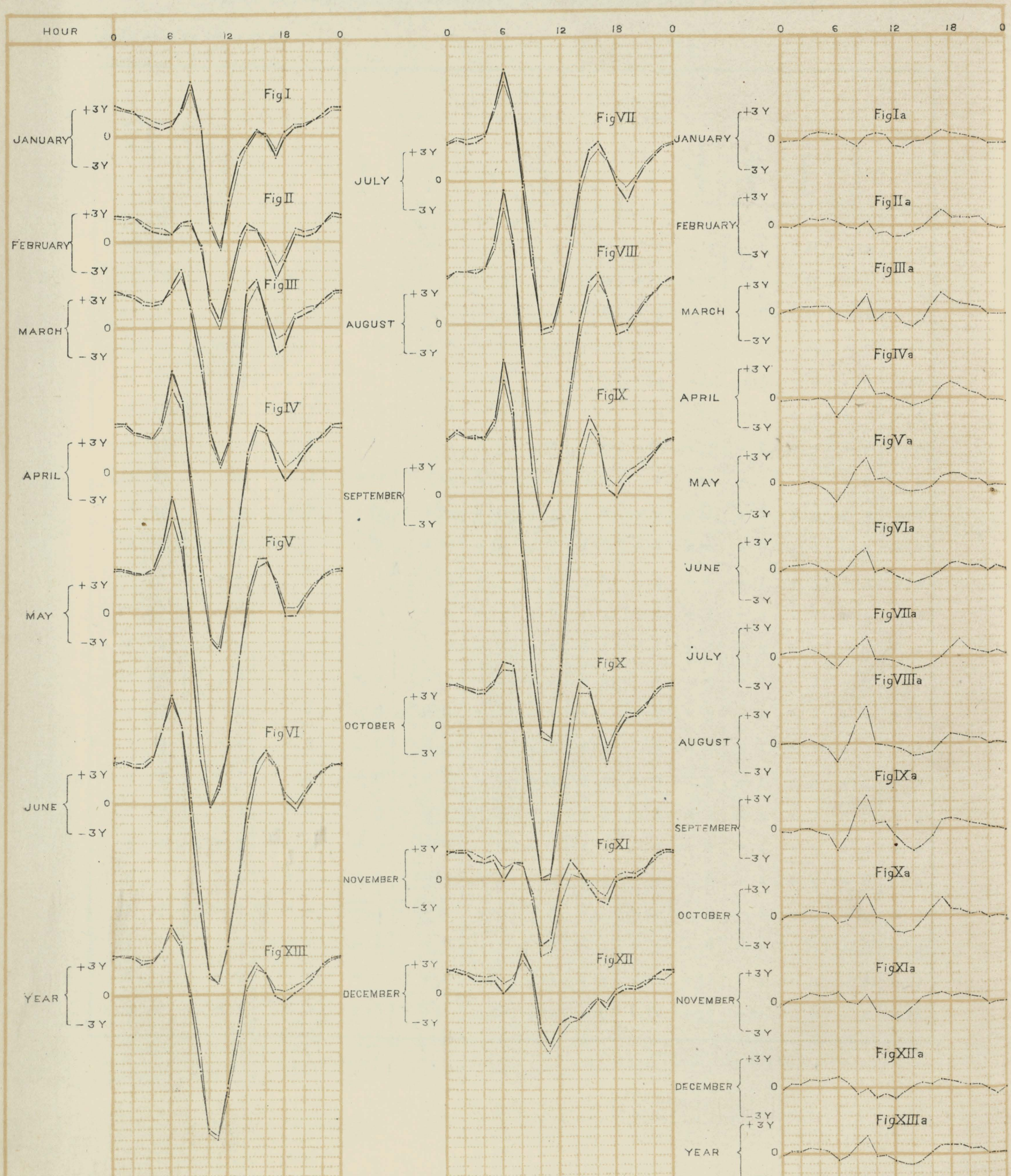
Unity = 0·1γ = ·000001 C. G. S.

Bombay Civil Time.	Month.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
H. m.													
10 17	+ 4	− 9	− 11	+ 2	+ 2	− 3	− 4	0	+ 5	− 2	− 11	− 12	− 4
11 17	+ 3	− 7	− 3	+ 3	+ 3	0	− 4	− 1	+ 7	− 5	− 13	− 9	− 3
12 17	− 9	− 13	− 3	− 1	− 2	− 5	− 6	− 5	− 6	− 16	− 20	− 12	− 9
13 17	− 10	− 12	− 12	− 6	− 8	− 10	− 10	− 9	− 17	− 18	− 14	− 6	− 11
14 17	− 4	− 7	− 17	− 10	− 10	− 14	− 13	− 14	− 24	− 15	− 5	0	− 12
15 17	− 2	− 1	− 9	− 8	− 9	− 12	− 11	− 13	− 17	− 5	+ 4	+ 4	− 7
16 17	+ 3	+ 6	+ 5	− 2	− 4	− 8	− 9	− 10	− 7	+ 8	+ 7	+ 2	0
17 17	+ 10	+ 14	+ 17	+ 10	+ 5	− 2	− 1	0	+ 10	+ 17	+ 9	+ 6	+ 8
18 17	+ 4	+ 8	+ 12	+ 15	+ 9	+ 5	+ 8	+ 9	+ 11	+ 8	+ 4	+ 5	+ 8
19 17	+ 4	+ 7	+ 7	+ 10	+ 10	+ 7	+ 16	+ 8	+ 10	+ 6	+ 6	+ 4	+ 8
20 17	+ 1	+ 6	+ 5	+ 5	+ 3	+ 3	+ 6	+ 4	+ 6	+ 1	+ 5	+ 3	+ 4
21 17	0	+ 7	+ 3	+ 2	+ 3	+ 3	+ 4	+ 4	+ 5	+ 2	+ 3	+ 3	+ 3
22 17	− 4	0	− 3	− 3	− 3	− 2	+ 1	− 1	+ 1	− 3	− 4	− 2	− 2
23 17	− 4	− 3	− 4	− 2	− 2	+ 1	+ 3	0	0	− 2	− 2	− 9	− 2
0 17	− 3	− 2	− 3	− 4	− 2	− 1	+ 1	− 1	− 3	− 2	− 2	− 1	− 2
1 17	− 2	− 3	0	− 3	− 2	+ 2	+ 3	0	− 2	+ 1	+ 1	+ 3	+ 1
2 17	− 1	0	+ 2	− 2	− 1	+ 3	+ 4	0	0	+ 1	+ 3	+ 3	+ 1
3 17	+ 4	+ 4	+ 3	− 2	0	+ 5	+ 6	+ 3	+ 1	+ 5	+ 7	+ 6	+ 4
4 17	+ 5	+ 3	+ 3	− 1	− 3	+ 2	+ 3	0	− 2	+ 4	+ 5	+ 5	+ 2
5 17	+ 5	+ 5	+ 3	− 4	− 9	− 2	− 3	− 7	− 6	+ 2	+ 5	+ 6	0
6 17	+ 4	+ 1	− 4	− 20	− 19	− 8	− 12	− 20	− 23	− 8	+ 10	+ 10	− 7
7 17	− 2	− 2	− 8	− 8	− 5	0	− 1	− 3	− 6	− 5	0	+ 3	− 2
8 17	− 9	− 5	+ 1	+ 8	+ 13	+ 13	+ 11	+ 22	+ 22	+ 9	− 2	− 8	+ 7
9 17	+ 1	+ 2	+ 16	+ 21	+ 26	+ 22	+ 20	+ 35	+ 35	+ 21	+ 6	− 2	+ 18

Colaba Observatory

Comparison of the Diurnal Inequalities of Vertical Force as registered by the Vertical Force Magnetographs No. I. and No. 2.

Plate 5.



Figs: I to XIII { Thick Curves Diurnal Inequality by V. F. Magnetograph No 2. / Thin Curves " " " " " No 1.

Figs: Ia to XIIIa. Difference Curves (Thin *minus* Thick in Figs I to XIII.)

Govt. Photozinco. Office, Poona, 1909

in the lower set of curves, show that the character of the errors from hour to hour remain almost the same. As Colaba is almost an equatorial station the vertical force and declination inequalities are, unlike those cf the horizontal force, little disturbed and the average inequalities of the three 11-year periods do not differ much from each other, and are comparable if the minute *natural* changes due to this cause are allowed for (*vide* Chapter VII, Part II). It will be seen that notwithstanding these natural differences, the curves even here unmistakably exhibit instrumental errors of precisely the same character which is clearly indicated by the parallelism in the two sets of differences charted above.

The persistent recurrence of these well defined difference curves throughout, hence leaves little doubt that they are due to the operation of some definite and regular instead of some irregular or fortuitous cause or causes which differentiate the movements of the two instruments. If so the elimination of these corrections is apparently possible.

276. A glance at the inequality curves, figures I to XIII, plate 5, shows that the movements of the V. F. No. 1 instrument invariably indicate a contracted range suggestive of some defect in the knife edge of the instrument obstructing the free motion of the balance. Such a large diminution in range can scarcely be the result of the use of wrong scale coefficients and it will be seen later that the sluggishness of the balance on its knife edge is clearly indicated as one of the principal causes of this discrepancy ; and to this we shall presently return.

277. Referring first to another apparently more definite cause, it is to be remembered that the inequalities of V. F. No. 2 instrument are accepted to be almost free from temperature errors. As the march of temperature in the enclosures of the two instruments which are more or less under identically similar c nditions, cannot be much unlike, it is clear that the uncompensated temperature effects due to the difference in the temperature coefficients of the two instruments about $-13{\cdot}3\gamma$ in No. 1 and $-3{\cdot}4\gamma$ in No. 2 must undoubtedly constitute a contributory cause of the disturbance to which the difference curves under examination are due.

278. The indications of a thermograph (*vide* table 55) which was specially placed in the underground chamber in a central position near the magnetographs with a view to secure a continuous diurnal record of temperature supplementing the record of the temperature of the thermometers in the enclosure (read five times a day), were utilized for the purpose, as was anticipated then, of correctly deriving the necessary temperature corrections for the 24 hours. It will be seen that while the amplitude on the average as registered by the thermograph was about $0^{\circ}{\cdot}4$ F. the range of movement of the thermometer in the enclosure was about $0^{\circ}{\cdot}2$ F. only (*vide* tables 55 and 187).

279. The really important fluctuation however which was disclosed by the thermograph record was the sudden rise and as sudden a fall of temperature invariably occurring between 9 and 10 a.m. and 10 and 11 a.m. respectively in the underground chamber. These effects, it was ascertained from experiments, were caused by the two additional lamps used in the room between 9 and 10 a.m. daily, during the shifting time ; for, when for one month the shifting time was specially transferred to the evening hours between 8 and 9 p.m., the abrupt movements between 9 and 11 a.m. ceased, and similar movements appeared in the evening hours.

280. Whether this sudden rise and fall of temperature in the magnetograph room indicated by the thermograph also affected the conditions in the magnetograph enclosure influencing the actual temperature of the magnet was doubtful; but this sudden rise of temperature coinciding with the abnormal fall of force between 9 and 10 a.m. as shown by the difference curves apparently at any rate strengthened the suspicion that these temperature effects may after all be the principal if not the only cause of the irregular movements in the magnetic curve observed about this time every day. It was this supposition that the thermograph so placed in the underground chamber would correctly measure the temperature variation of the magnet in the enclosure, which unfortunately led the investigation on to a wrong trail until the experiments referred to in paragraph 117 gave the necessary clue.

281. The inquiry hence into this question has been given at some length to show how step by step the final result has been attained. Accepting the operation of two vitiating causes, *viz.* (1) the diminution of range and (2) the temperature effects above referred to, it was assumed as an hypothesis that if the ordinates of the inequalities of V. F. No. 1, which are contracted in range, be increased by a coefficient and then further modified by temperature corrections derived from some temperature coefficient (the difference of the temperature coefficients of the two instruments) and the temperature variations as shown by the thermograph, reduced in range in due proportion to that indicated by the thermometer in the enclosure, the resulting ordinates ought to be equal to those of the V. F. No. 2 instrument.

282. Equations de ived rom the hypothesis were worked out by least squares but the results showed that the errors were nearly as large as the original departures which were to be explained and eliminated ;

and though several other modifications of the formula were tried with an additional unknown constant—that of the differential aperiodic change—the result remained persistently unsatisfactory.

283. The special temperature experiments subsequently carried out in the magnetograph enclosures (*vide* experiment, paragraph 117) disclosed the real character of the temperature changes of the magnet and furnished the proper temperature series which, when substituted in the above process, at once showed results indicating a step in the right direction. But it appeared equally clear also that without some further assumption in addition to that of the uniform diminution of range, in regard to some effects of lag, it was not possible to secure any result which may be accepted as satisfactory.

284. It was always noticed during deflection experiments on this magnetograph at Colaba, that whenever the deflector was used, the balance took some time to respond fully to the action of this disturbing force, and hence it had always been the practice to wait for five minutes before the reading corresponding to any deflection was made and noted. Plate 6, a copy of one of the magnetograms, illustrates such sluggish behaviour of the balance when disturbed in different ways. And curiously the negative movements from *any position of rest* were found to be sensibly smaller than the positive deflections. But this special peculiarity on account of the effects being very small, and therefore easily masked by natural changes, was not suspected and taken into account until it was disclosed at a much later stage of the inquiry as will be seen presently.

285. Hence to provide for the supposed factors—lag, diminution of the range and temperature—the conditions were best expressed by the equation—

$$aV''_{0^h} + b\left(V''_{1^h} - V''_{0^h}\right) + ct^{0}_{1^h} = V'_{1^h} \qquad (112)$$

where a is some constant for diminution of range; b some fraction of an hour determining the lag; c the differential temperature coeffcient; $t^{0}_{1^h}$ the ordinate of temperature variation at 1 hour; V''_{0^h}, V''_{1^h}, V''_{2^h}, etc., etc, the ordinates of the inequality by V. F. No. 2 instrument at different hours, V'_{0^h}, V'_{1^h}, V'_{2^h}, etc., etc., being likewise the ordinates of V. F. No. 1.

The actual temperature variation in the enclosure experimentally derived being available for the month of January only, the solution for that month attempted first, gave by the method of least squares the constants $a = \cdot 890$, $b = \cdot 847$, $c = 10\cdot 6$.

The residual errors are small and what is of interest, the value of the constant c appears to be significant so far: for the temperature coefficient of V. F. No. 2 is we know $-3\cdot 47\gamma$ and the temperature coefficient of the V. F. No. 1 hence indicated by the above *differential* coefficient works out at about -14γ. This value is nearly the same as that derived experimentally. On the further assumption that the temperature variations were practically the same throughout the year—and such a supposition is not unjustifiable from the indications of the thermometer in the enclosure given in tables 187—the variations for the year and that of the summer months for which the movements are large, were solved, and the constants derived were :—

For the year ... $a = \cdot 947$; $b = \cdot 853$; $c = 10\cdot 2$

For the summer months—March to October ... $a = \cdot 917$; $b = \cdot 834$; $c = 13\cdot 0$

The above coefficients appear to be fairly consistent for the year, but for the summer months, the inequalities of which show larger movements, the coefficient c is somewhat larger.

286. The result, however, so far as it *concerned the temperature conditions*, was provisionally accepted as satisfactory and the inequalities of the V. F. No. 1 were all corrected for the supposed

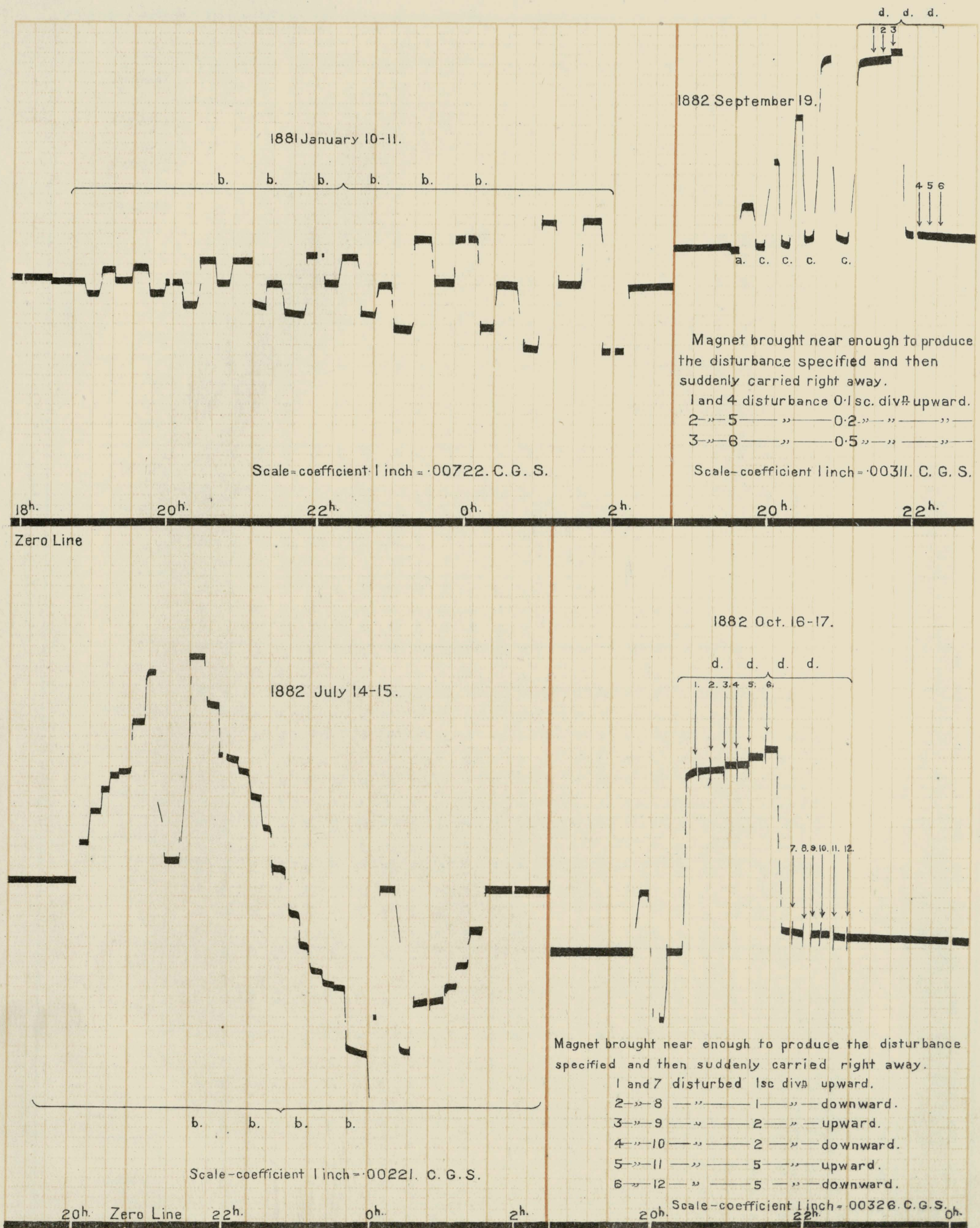
TABLE 209.

Value of	Months											
	January.	February.	March.	April.	May.	June.	July.	August.	September	October.	November.	December.
a	·890	·939	·941	·912	·917	·871	·941	·921	·927	·946	1·002	·901
b	·847	·900	·859	·849	·843	·801	·965	·793	·812	·826	·885	·953

Colaba Observatory

Traces of Vertical Force No. 1 magnetograms showing different features in its behaviour.

Plate 6.



a = Dislocation of the curve due to slight jerks.
b = Showing the sluggishness to respond to change of force.
c = Shows that the sluggishness to return to original position varies with the incident force & is slightly different for positive & negative directions.
d = „ „ „ is overcome by free oscillation in proportion to the amplitudes.

Govt. Photozinco. Office, Poona, 1909.

TABLE 210.—*Consecutive Differences of V. F. No. 2 Variations.*

Unity = ·1γ = ·000001 C. G. S.

Bombay Civil Time. Hourly Intervals.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
10 & 11	− 25	− 24	− 36	− 12	+ 19	− 12	+ 2	+ 21	− 7	+ 4	+ 7	− 18	− 6
11 & 12	+ 52	+ 40	+ 29	+ 56	+ 50	+ 40	+ 34	+ 50	+ 80	+ 82	+ 56	+ 22	+ 49
12 & 13	+ 47	+ 49	+ 78	+ 84	+ 89	+ 79	+ 58	+ 72	+ 128	+ 79	+ 25	+ 9	+ 66
13 & 14	+ 12	+ 15	+ 77	+ 67	+ 64	+ 64	+ 62	+ 64	+ 97	+ 41	− 12	− 4	+ 46
14 & 15	+ 17	− 6	+ 12	+ 32	+ 39	+ 49	+ 32	+ 41	+ 38	− 8	− 14	+ 9	+ 19
15 & 16	− 9	− 22	− 37	− 8	0	+ 14	+ 9	+ 11	− 22	− 42	− 13	+ 11	− 9
16 & 17	− 23	− 29	− 42	− 34	− 29	− 16	− 16	− 27	− 57	− 37	− 6	− 8	− 27
17 & 18	+ 22	+ 18	+ 8	− 19	− 33	− 36	− 29	− 38	− 8	+ 31	+ 24	+ 15	− 3
18 & 19	+ 12	+ 26	+ 28	+ 13	0	− 11	− 18	+ 3	+ 16	+ 15	+ 4	+ 5	+ 7
19 & 20	+ 2	− 2	+ 6	+ 16	+ 19	+ 15	+ 21	+ 14	+ 10	+ 3	0	0	+ 9
20 & 21	+ 6	+ 2	+ 5	+ 12	+ 14	+ 13	+ 16	+ 16	+ 8	+ 8	+ 6	+ 5	+ 9
21 & 22	+ 7	+ 13	+ 10	+ 10	+ 12	+ 13	+ 12	+ 12	+ 13	+ 18	+ 15	+ 9	+ 12
22 & 23	+ 6	+ 11	+ 10	+ 8	+ 5	+ 6	+ 8	+ 9	+ 10	+ 8	+ 7	+ 6	+ 8
23 & 0	+ 1	− 2	0	+ 3	− 2	+ 3	+ 5	+ 6	+ 5	+ 1	0	0	+ 2
0 & 1	− 2	− 2	− 3	− 1	0	0	+ 2	+ 5	+ 7	− 1	− 2	− 2	− 1
1 & 2	− 3	− 1	− 4	− 9	− 4	− 4	− 2	0	− 6	− 3	− 1	− 2	− 3
2 & 3	− 8	− 9	− 7	− 4	− 2	0	+ 1	− 1	− 1	− 6	− 7	− 6	− 4
3 & 4	− 7	− 5	− 2	− 2	+ 5	+ 7	+ 6	+ 4	+ 1	0	− 4	− 1	+ 1
4 & 5	− 3	− 3	+ 4	+ 15	+ 28	+ 31	+ 28	+ 26	+ 19	+ 9	+ 2	0	+ 12
5 & 6	+ 3	0	+ 16	+ 55	+ 49	+ 36	+ 42	+ 57	+ 63	+ 24	− 19	− 13	+ 26
6 & 7	+ 17	+ 12	+ 19	− 31	− 47	− 34	− 43	− 54	− 53	− 4	+ 17	+ 12	− 16
7 & 8	+ 30	+ 3	− 42	− 89	− 109	− 89	− 86	− 131	− 153	− 72	0	+ 33	− 58
8 & 9	− 48	− 31	− 66	− 95	− 118	− 100	− 85	− 113	− 125	− 89	− 36	− 22	− 78
9 & 10	− 106	− 54	− 63	− 67	− 53	− 67	− 59	− 47	− 63	− 61	− 48	− 61	− 61
Factors for positive movements ...	·868	·894	·877	·868	·909	·935	·899	·903	·881	·882	·871	·904	·917
Factors for negative movements ...	·781	·772	·732	·776	·825	·838	·792	·794	·794	·767	·667	·697	·785

TABLE 211.—*Consecutive Differences of V. F. No 1 Variations.*

Unity = ·1γ = ·000001 C. G. S.

Bombay Civil Time. Hourly Intervals.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
10 & 11	− 26	− 22	− 28	− 11	+ 20	− 9	+ 2	+ 20	− 5	+ 1	+ 5	− 15	− 5
11 & 12	+ 40	+ 34	+ 29	+ 52	+ 45	+ 35	+ 32	+ 46	+ 67	+ 71	+ 49	+ 19	+ 43
12 & 13	+ 46	+ 50	+ 69	+ 79	+ 83	+ 74	+ 54	+ 68	+ 117	+ 77	+ 31	+ 15	+ 64
13 & 14	+ 18	+ 20	+ 72	+ 63	+ 62	+ 60	+ 59	+ 29	+ 90	+ 44	− 3	+ 2	+ 45
14 & 15	+ 19	0	+ 20	+ 34	+ 40	+ 51	+ 34	+ 42	+ 45	+ 2	− 5	+ 13	+ 24
15 & 16	− 4	− 15	− 23	− 2	+ 5	+ 18	+ 11	+ 14	− 12	− 29	− 10	+ 9	− 2
16 & 17	− 16	− 21	− 30	− 22	− 20	− 10	− 8	− 17	− 40	− 28	− 4	− 4	− 19
17 & 18	+ 16	+ 12	+ 3	− 14	− 29	− 29	− 20	− 29	− 7	+ 22	+ 19	+ 14	− 3
18 & 19	+ 12	+ 25	+ 23	+ 8	+ 1	− 9	− 10	+ 2	+ 15	+ 13	+ 6	+ 4	+ 7
19 & 20	− 1	− 3	+ 4	+ 11	+ 12	+ 11	+ 11	+ 10	+ 6	− 2	− 1	− 1	+ 5
20 & 21	+ 5	+ 3	+ 3	+ 9	+ 14	+ 13	+ 14	+ 16	+ 7	+ 9	+ 4	+ 5	+ 8
21 & 22	+ 3	+ 6	+ 4	+ 5	+ 6	+ 8	+ 9	+ 7	+ 9	+ 13	+ 8	+ 4	+ 7
22 & 23	+ 6	+ 8	+ 9	+ 9	+ 6	+ 9	+ 10	+ 10	+ 9	+ 9	+ 9	− 1	+ 8
23 & 0	+ 2	− 1	+ 1	+ 1	+ 2	+ 1	+ 3	+ 5	+ 2	+ 1	0	+ 8	+ 2
0 & 1	− 1	− 3	0	0	0	+ 3	+ 4	+ 6	+ 8	+ 2	+ 1	+ 2	+ 2
1 & 2	− 2	+ 2	− 2	− 8	− 3	− 3	− 1	0	− 4	− 3	+ 1	− 2	− 3
2 & 3	− 3	− 5	− 6	− 4	− 1	+ 2	+ 3	+ 2	0	− 2	− 3	− 3	− 1
3 & 4	− 6	− 6	− 2	− 1	+ 2	+ 4	+ 3	+ 1	− 2	− 1	− 6	− 2	− 1
4 & 5	− 3	− 1	+ 4	+ 12	+ 22	+ 27	+ 22	+ 19	+ 15	+ 7	+ 2	+ 1	+ 10
5 & 6	+ 2	− 4	+ 9	+ 39	+ 39	+ 30	+ 33	+ 44	+ 46	+ 14	− 14	− 9	+ 19
6 & 7	+ 11	+ 9	+ 15	− 19	− 33	− 26	− 32	− 37	− 36	− 1	+ 7	+ 5	− 11
7 & 8	+ 23	0	− 33	− 73	− 91	− 76	− 74	− 106	− 125	− 58	− 2	+ 22	− 49
8 & 9	− 38	− 24	− 51	− 82	− 105	− 91	− 76	− 100	− 112	− 77	− 28	− 16	− 67
9 & 10	− 103	− 64	− 90	− 86	− 77	− 93	− 83	− 82	− 93	− 84	− 66	− 70	− 83
...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE 212.—*Consecutive Differences of V. F. No. 2 Variations multiplied by Factors.*

Unity = ·1γ = ·000001 C. G. S.

Bombay Civil Time. Hourly Intervals.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
10 & 11	− 20	− 19	− 26	− 9	+ 17	− 10	+ 2	+ 19	− 6	+ 4	+ 6	− 13	− 5
11 & 12	+ 45	+ 36	+ 25	+ 49	+ 45	+ 37	+ 31	+ 45	+ 70	+ 72	+ 49	+ 20	+ 45
12 & 13	+ 41	+ 44	+ 68	+ 73	+ 81	+ 74	+ 52	+ 65	+ 113	+ 70	+ 22	+ 8	+ 61
13 & 14	+ 10	+ 13	+ 68	+ 58	+ 58	+ 60	+ 56	+ 58	+ 85	+ 36	− 8	− 3	+ 42
14 & 15	+ 15	− 5	+ 11	+ 28	+ 35	+ 46	+ 29	+ 37	+ 33	− 6	− 9	+ 8	+ 17
15 & 16	− 7	− 17	− 27	− 6	0	+ 13	+ 8	+ 10	− 17	− 32	− 9	+ 10	− 7
16 & 17	− 18	− 22	− 31	− 26	− 24	− 13	− 13	− 21	− 45	− 28	− 4	− 6	− 21
17 & 18	+ 19	+ 16	+ 7	− 15	− 27	− 30	− 23	− 30	− 6	+ 27	+ 21	+ 14	− 2
18 & 19	+ 10	+ 23	+ 25	+ 11	0	− 9	− 14	+ 3	+ 14	+ 13	+ 3	+ 5	+ 6
19 & 20	+ 2	− 2	+ 5	+ 14	+ 17	+ 14	+ 19	+ 13	+ 9	+ 3	0	0	+ 8
20 & 21	+ 5	+ 2	+ 4	+ 10	+ 13	+ 12	+ 14	+ 14	+ 7	+ 7	+ 5	+ 5	+ 8
21 & 22	+ 6	+ 12	+ 9	+ 9	+ 11	+ 12	+ 11	+ 11	+ 11	+ 16	+ 13	+ 8	+ 11
22 & 23	+ 5	+ 10	+ 9	+ 7	+ 5	+ 6	+ 7	+ 8	+ 9	+ 7	+ 6	+ 5	+ 7
23 & 0	+ 1	− 2	0	+ 3	+ 2	+ 3	+ 4	+ 5	+ 4	+ 1	0	0	+ 2
0 & 1	− 2	− 2	− 2	− 1	0	0	+ 2	+ 5	+ 6	− 1	− 1	− 1	− 1
1 & 2	− 2	− 1	− 3	− 7	− 3	− 3	− 2	0	− 5	− 2	− 1	− 1	− 2
2 & 3	− 6	− 7	− 5	− 3	− 2	0	+ 1	− 1	− 1	− 5	− 5	− 4	− 3
3 & 4	− 5	− 4	− 1	− 2	+ 5	+ 6	+ 5	+ 4	+ 1	0	− 3	− 1	+ 1
4 & 5	− 2	− 2	+ 4	+ 13	+ 25	+ 29	+ 25	+ 23	+ 17	+ 8	+ 2	0	+ 11
5 & 6	+ 3	0	+ 14	+ 48	+ 45	+ 34	+ 38	+ 51	+ 56	+ 21	− 13	− 9	+ 24
6 & 7	+ 15	+ 11	+ 17	− 24	− 39	− 28	− 34	− 43	− 42	− 3	+ 15	+ 11	− 13
7 & 8	+ 26	+ 3	− 31	− 69	− 90	− 75	− 68	− 104	− 121	− 55	0	+ 30	− 46
8 & 9	− 37	− 24	− 48	− 74	− 97	− 84	− 67	− 90	− 99	− 68	− 24	− 15	− 61
9 & 10	− 83	− 42	− 46	− 52	− 44	− 56	− 47	− 37	− 50	− 47	− 32	− 43	− 48
Mean ...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE 213.—*V. F. No. 2 Variations calculated from 23 hour by applying differences in the table 212.*

Unity = ·1γ = ·000001 C. G. S.

Bombay Civil Time. Hourly Intervals.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
10 17	− 82	− 61	− 109	− 156	− 187	− 172	− 145	− 189	− 222	− 147	− 67	− 38	− 132
11 17	− 102	− 80	− 135	− 165	− 170	− 182	− 143	− 170	− 228	− 143	− 61	− 51	− 137
12 17	− 57	− 44	− 110	− 116	− 125	− 145	− 112	− 125	− 158	− 71	− 12	− 31	− 92
13 17	− 16	0	− 42	− 43	− 44	− 71	− 60	− 60	− 45	− 1	+ 10	− 23	− 31
14 17	− 6	+ 13	+ 26	+ 15	+ 14	− 11	− 4	− 2	+ 40	+ 35	+ 2	− 26	+ 11
15 17	+ 9	+ 8	+ 37	+ 43	+ 49	+ 35	+ 25	+ 35	+ 73	+ 29	− 7	− 18	+ 28
16 17	+ 2	− 9	+ 10	+ 37	+ 49	+ 48	+ 33	+ 45	+ 56	− 3	− 16	− 8	+ 21
17 17	− 16	− 31	− 21	+ 11	+ 25	+ 35	+ 20	+ 24	+ 11	− 31	− 20	− 14	0
18 17	+ 3	− 15	− 14	− 4	− 2	+ 5	− 3	− 6	+ 5	− 4	+ 1	0	− 2
19 17	+ 13	+ 8	+ 11	+ 7	− 2	− 4	− 17	− 3	+ 19	+ 9	+ 4	+ 5	+ 4
20 17	+ 15	+ 6	+ 16	+ 21	+ 15	+ 10	+ 2	+ 10	+ 28	+ 12	+ 4	+ 5	+ 12
21 17	+ 20	+ 8	+ 20	+ 31	+ 28	+ 22	+ 16	+ 24	+ 35	+ 19	+ 9	+ 10	+ 20
22 17	+ 26	+ 20	+ 29	+ 40	+ 39	+ 34	+ 27	+ 35	+ 46	+ 35	+ 22	+ 18	+ 31
23 17	+ 31	+ 30	+ 38	+ 47	+ 44	+ 40	+ 34	+ 43	+ 55	+ 42	+ 28	+ 23	+ 38
0 17	+ 32	+ 28	+ 38	+ 50	+ 46	+ 43	+ 38	+ 48	+ 59	+ 43	+ 28	+ 23	+ 40
1 17	+ 30	+ 26	+ 36	+ 49	+ 46	+ 43	+ 40	+ 53	+ 65	+ 42	+ 27	+ 22	+ 39
2 17	+ 28	+ 25	+ 33	+ 42	+ 43	+ 40	+ 38	+ 53	+ 60	+ 40	+ 26	+ 21	+ 37
3 17	+ 22	+ 18	+ 28	+ 39	+ 41	+ 40	+ 39	+ 52	+ 59	+ 35	+ 21	+ 17	+ 34
4 17	+ 17	+ 14	+ 27	+ 37	+ 46	+ 46	+ 44	+ 56	+ 60	+ 35	+ 18	+ 16	+ 35
5 17	+ 15	+ 12	+ 31	+ 50	+ 71	+ 75	+ 69	+ 79	+ 77	+ 43	+ 20	+ 16	+ 46
6 17	+ 18	+ 12	+ 45	+ 98	+ 116	+ 109	+ 107	+ 130	+ 133	+ 64	+ 7	+ 7	+ 70
7 17	+ 33	+ 23	+ 62	+ 74	+ 77	+ 81	+ 73	+ 87	+ 91	+ 61	+ 22	+ 18	+ 57
8 17	+ 59	+ 26	+ 31	+ 5	− 13	+ 6	+ 5	− 17	− 30	+ 6	+ 22	+ 48	+ 11
9 17	+ 22	+ 2	− 17	− 69	− 110	− 78	− 62	− 107	− 129	− 62	− 2	+ 33	− 50
Mean ...	+ 5	+ 2	+ 3	+ 6	+ 4	+ 2	+ 3	+ 4	+ 7	+ 4	+ 4	+ 3	+ 4

TABLE 214.—*Calculated Variations of V. F. No. 2 in table 213 corrected for the constant excess shown in the last row of table 213.*

Unity = ·1γ = ·000001 C. G. S.

Bombay Civil Time.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
H. m.													
10 17	− 87	− 6[illegible]	− 112	− 162	− 191	− 174	− 148	− 193	− 229	− 151	− 71	− 41	− 136
11 17	− 107	− 82	− 138	− 171	− 174	− 184	− 146	− 174	− 235	− 147	− 65	− 54	− 141
12 17	− 62	− 4[illegible]	− 113	− 122	− 129	− 147	− 115	− 129	− 165	− 75	− 16	− 34	− 96
13 17	− 21	− [illegible]	− 45	− 49	− 48	− 73	− 63	− 64	− 52	− 5	+ 6	− 26	− 35
14 17	− 11	+ 11	+ 23	+ 9	+ 10	− 13	− 7	− 6	+ 33	+ 31	− 2	− 29	+ 7
15 17	+ 4	+ 6	+ 34	+ 37	+ 45	+ 33	+ 22	+ 31	+ 66	+ 25	− 11	− 21	+ 24
16 17	− 3	− 11	+ 7	+ 31	+ 45	+ 46	+ 30	+ 41	+ 49	− 7	− 20	− 11	+ 17
17 17	− 21	− 3[illegible]	− 24	+ 5	+ 21	+ 33	+ 17	+ 20	+ 4	− 35	− 24	− 17	− 4
18 17	− 2	− 17	− 17	− 10	− 6	+ 3	− 6	− 10	− 2	− 8	− 3	− 3	− 6
19 17	+ 8	+ [illegible]	+ 8	+ 1	− 6	− 6	− 20	− 7	+ 12	+ 5	0	+ 2	0
20 17	+ 10	+ [illegible]	+ 13	+ 15	+ 11	+ 8	− 1	+ 6	+ 21	+ 8	0	+ 2	+ 8
21 17	+ 15	+ [illegible]	+ 17	+ 25	+ 24	+ 20	+ 13	+ 20	+ 28	+ 15	+ 5	+ 7	+ 16
22 17	+ 21	+ 1[illegible]	+ 26	+ 34	+ 35	+ 32	+ 24	+ 31	+ 39	+ 31	+ 18	+ 15	+ 27
23 17	+ 26	+ 2[illegible]	+ 35	+ 41	+ 40	+ 38	+ 31	+ 39	+ 48	+ 38	+ 24	+ 20	+ 34
0 17	+ 27	+ 2[illegible]	+ 35	+ 44	+ 42	+ 41	+ 35	+ 44	+ 52	+ 39	+ 24	+ 20	+ 36
1 17	+ 25	+ 2[illegible]	+ 33	+ 43	+ 42	+ 41	+ 37	+ 49	+ 58	+ 38	+ 23	+ 19	+ 35
2 17	+ 23	+ 2[illegible]	+ 30	+ 36	+ 39	+ 38	+ 35	+ 49	+ 53	+ 36	+ 22	+ 18	+ 33
3 17	+ 17	+ 1[illegible]	+ 25	+ 33	+ 37	+ 38	+ 36	+ 48	+ 52	+ 31	+ 17	+ 14	+ 30
4 17	+ 12	+ 12	+ 24	+ 31	+ 42	+ 44	+ 41	+ 52	+ 53	+ 31	+ 14	+ 13	+ 31
5 17	+ 10	+ 1[illegible]	+ 28	+ 44	+ 67	+ 73	+ 66	+ 75	+ 70	+ 39	+ 16	+ 13	+ 42
6 17	+ 13	+ 1[illegible]	+ 42	+ 92	+ 112	+ 107	+ 104	+ 126	+ 126	+ 60	+ 3	+ 4	+ 66
7 17	+ 28	+ 21	+ 59	+ 68	+ 73	+ 79	+ 70	+ 83	+ 84	+ 57	+ 18	+ 15	+ 53
8 17	+ 54	+ 2[illegible]	+ 28	− 1	− 17	+ 4	+ 2	− 21	− 37	+ 2	+ 18	+ 45	+ 7
9 17	+ 17	[illegible]	− 20	− 75	− 114	− 80	− 65	− 111	− 136	− 66	− 6	+ 30	− 54

TABLE 215.—*Excesses of the modified inequality of V. F. Magnetograph No. 2 in table 214 over the inequality of the same instrument in table 206.*

Unity = ·1γ = ·000001 C. G. S.

Bombay Civil Time.	MONTH.												Year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
H. m.													
10 17	+ 8	− 2	− 2	+ 16	+ 14	+ 4	+ 9	+ 12	+ 22	+ 9	0	− 3	+ 6
11 17	+ 13	+ 3	+ 8	+ 19	+ 12	+ 6	+ 9	+ 10	+ 23	+ 9	− 1	+ 2	+ 7
12 17	+ 6	− 1	+ 4	+ 12	+ 7	+ 3	+ 6	+ 5	+ 13	− 1	− 8	0	+ 3
13 17	0	− 6	− 6	+ 1	− 1	− 2	0	− 2	− 2	− 10	− 11	− 1	− 2
14 17	− 2	− 8	− 15	− 8	− 7	− 6	− 6	− 8	− 14	− 15	− 7	0	− 6
15 17	− 4	− 7	− 16	− 12	− 11	− 9	− 9	− 12	− 19	− 13	− 2	− 1	− 8
16 17	− 2	− 2	− 6	− 10	− 11	− 10	− 10	− 13	− 14	− 3	+ 2	− 2	− 6
17 17	+ 3	+ 5	+ 5	− 2	− 6	− 7	− 7	− 7	− 2	+ 6	+ 4	0	0
18 17	0	+ 3	+ 4	+ 2	0	− 1	− 1	+ 1	0	+ 2	+ 1	− 1	+ 1
19 17	− 2	0	+ 1	0	0	+ 1	+ 3	+ 1	− 2	0	0	− 1	0
20 17	− 2	0	0	− 2	− 2	0	+ 1	0	− 3	0	0	− 1	− 1
21 17	− 3	0	− 1	− 4	− 3	− 1	− 1	− 2	− 4	− 1	− 1	− 1	− 2
22 17	− 4	− 1	− 2	− 5	− 4	− 2	− 2	− 3	− 6	− 3	− 3	− 2	− 3
23 17	− 5	− 2	− 3	− 6	− 4	− 2	− 3	− 4	− 7	− 4	− 4	− 3	− 4
0 17	− 5	− 2	− 3	− 6	− 4	− 2	− 4	− 5	− 8	− 4	− 4	− 3	− 4
1 17	− 5	− 2	− 2	− 6	− 4	− 2	− 4	− 5	− 9	− 4	− 3	− 2	− 4
2 17	− 4	− 2	− 1	− 4	− 3	− 1	− 4	− 5	− 8	− 3	− 3	− 1	− 3
3 17	− 2	0	+ 1	− 3	− 3	− 1	− 4	− 5	− 8	− 2	− 1	+ 1	− 2
4 17	0	+ 1	+ 2	− 3	− 3	− 2	− 5	− 5	− 8	− 2	0	+ 1	− 2
5 17	+ 1	+ 2	+ 2	− 5	− 6	− 4	− 8	− 8	− 10	− 3	0	+ 1	− 3
6 17	+ 1	+ 2	0	− 12	− 10	− 6	− 12	− 14	− 17	− 6	+ 6	+ 5	− 5
7 17	− 1	+ 1	− 2	− 5	− 2	0	− 3	− 3	− 6	− 5	+ 4	+ 4	− 2
8 17	− 5	+ 1	+ 9	+ 15	+ 17	+ 14	+ 15	+ 24	+ 26	+ 12	+ 4	+ 1	+ 10
9 17	+ 6	+ 8	+ 27	+ 36	+ 38	+ 30	+ 33	+ 47	+ 52	+ 33	+ 16	+ 8	+ 27

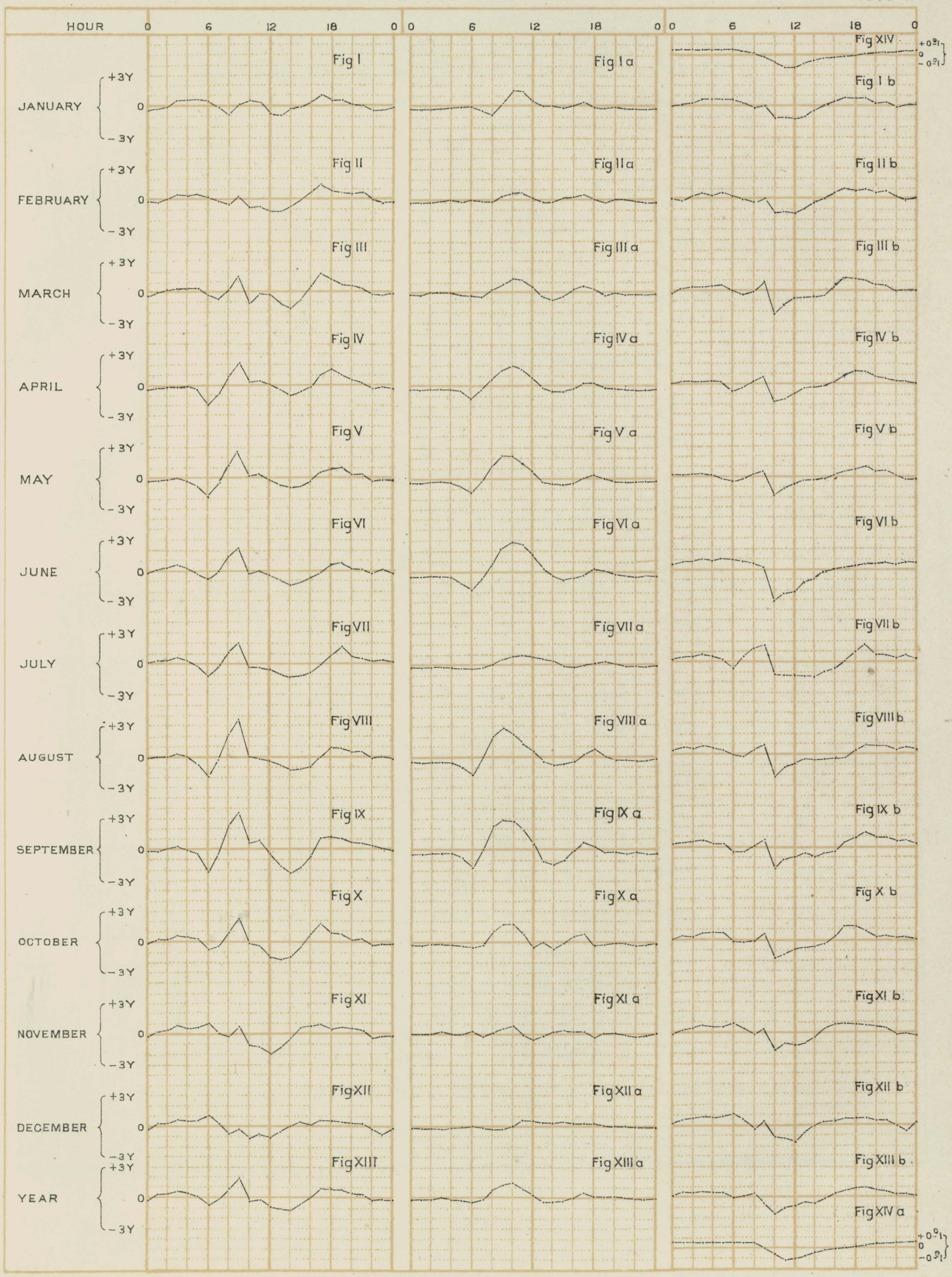
TABLE 216.—*Excesses of the modified inequality of V. F. Magnetograph No. 2 in table 214 over the inequality of V. F. Magnetograph No. 1 in table 207 showing residual temperature effects in the latter instrument.*

Bombay Civil Time.		Month.												Year.
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
H.	m.													
10	17	+ 4	+ 7	+ 9	+ 14	+ 12	+ 7	+ 13	+ 12	+ 17	+ 11	+ 11	+ 9	+ 10
11	17	+ 10	+ 10	+ 11	+ 16	+ 9	+ 6	+ 13	+ 11	+ 16	+ 14	+ 12	+ 11	+ 10
12	17	+ 15	+ 12	+ 7	+ 13	+ 9	+ 8	+ 12	+ 10	+ 19	+ 15	+ 12	+ 12	+ 12
13	17	+ 10	+ 6	+ 6	+ 7	+ 7	+ 8	+ 10	+ 7	+ 15	+ 8	+ 3	+ 5	+ 9
14	17	+ 2	− 1	+ 2	+ 2	+ 3	+ 8	+ 7	+ 6	+ 10	0	− 2	0	+ 6
15	17	− 2	− 6	− 7	− 4	− 2	+ 3	+ 2	+ 1	− 2	− 8	− 6	− 5	− 1
16	17	− 5	− 8	− 11	− 8	− 7	− 2	− 1	− 3	− 7	− 11	− 5	− 4	− 6
17	17	− 7	− 9	− 12	− 12	− 11	− 5	− 6	− 7	− 12	− 11	− 5	− 6	− 8
18	17	− 4	− 5	− 8	− 13	− 9	− 6	− 9	− 8	− 11	− 6	− 3	− 6	− 7
19	17	− 6	− 7	− 6	− 10	− 10	− 6	− 13	− 7	− 12	− 6	− 6	− 5	− 8
20	17	− 3	− 6	− 5	− 7	− 5	− 3	− 5	− 4	− 9	− 1	− 5	− 4	− 5
21	17	− 3	− 7	− 4	− 6	− 6	− 4	− 5	− 6	− 9	− 3	− 4	− 4	− 5
22	17	0	− 1	+ 1	− 2	− 1	0	− 3	− 2	− 7	0	+ 1	0	− 1
23	17	− 1	+ 1	+ 1	− 4	− 2	− 3	− 6	− 4	− 7	− 2	− 2	+ 6	− 2
0	17	− 2	0	0	− 2	− 2	− 1	− 5	− 4	− 5	− 2	− 2	− 2	− 2
1	17	− 3	+ 1	− 2	− 3	− 2	− 4	− 7	− 5	− 7	− 5	− 4	− 5	− 5
2	17	− 3	− 2	− 3	− 2	− 2	− 4	− 8	− 5	− 8	− 4	− 6	− 4	− 4
3	17	− 6	− 4	− 2	− 1	− 3	− 6	− 10	− 8	− 9	− 7	− 8	− 5	− 6
4	17	− 5	− 2	− 1	− 2	0	− 4	− 8	− 5	− 6	− 6	− 5	− 4	− 4
6	17	− 4	− 3	− 1	− 1	+ 3	− 2	− 5	− 1	− 4	− 5	− 5	− 5	− 3
6	17	− 3	+ 1	+ 4	+ 8	+ 9	+ 2	0	+ 6	+ 6	+ 2	− 4	− 5	+ 2
7	17	+ 1	+ 3	+ 6	+ 3	+ 3	0	− 2	0	0	0	+ 4	+ 1	0
8	17	+ 4	+ 6	+ 8	+ 7	+ 4	+ 1	+ 4	+ 2	+ 4	+ 3	+ 6	+ 9	+ 3
9	17	+ 5	+ 6	+ 11	+ 15	+ 12	+ 8	+ 13	+ 12	+ 17	+ 12	+ 10	+ 10	+ 9

Colaba Observatory

Excesses of the Diurnal Inequalities of Vertical Force as registered by the Vertical Force Magnetograph No. 1 over those by No. 2.

Plate 7.



Figs I to XIII Excess Diurnal Inequalities V.F. Magnetograph No. 1 *minus* V.F. Magnetograph No. 2.

Figs Ia to XIIIa Excess Diurnal Inequalities Theoretically Computed (Method I)

Figs Ib to XIIIb Residual Difference Curves Figs I to XIII *minus* Figs Ia to XIIIa.

Fig XIV and XIVa Diurnal Inequality of Temperature of V.F. Magnetograph No. 1 Magnet Derived from Experiments Referred to in the Text.

Govt. Photozinco. Office, Poona, 1909.

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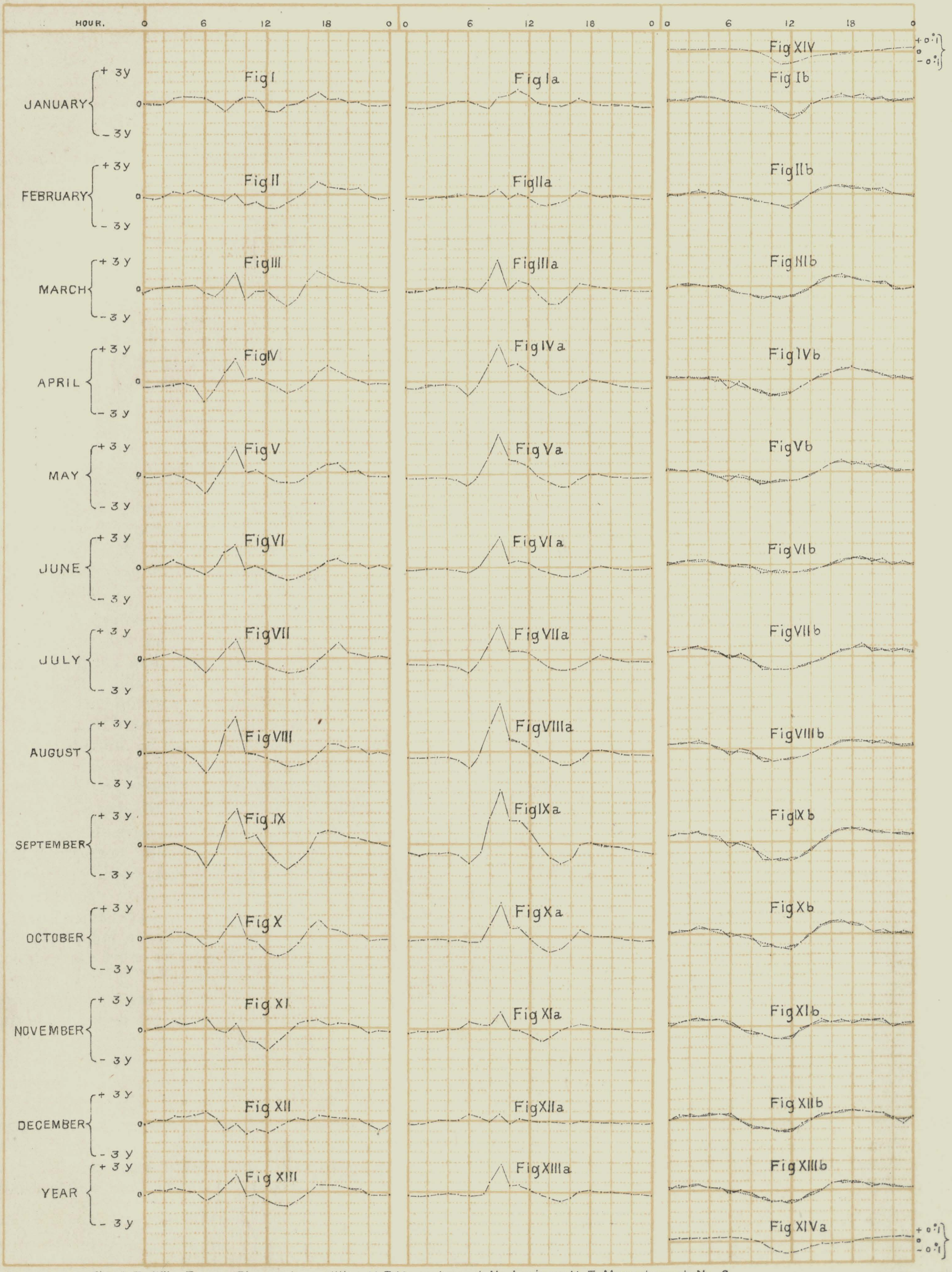
Excesses of the Diurnal Inequalities of Vertical Force as registered by the Vertical Force Magnetograph No. I over those by No. 2

Plate 8.



Figs I To XIII Excess Diurnal Inequalities V. F Magnetograph No. I *minus* V. F. Magnetograph No. 2

Figs Ia To XIIIa Excess Diurnal Inequalities. Theoretically Computed. (Method 2)

Figs Ib To XIIIb Residual Difference Curves Figs I To XIII *minus* Figs Ia To XIIIa: Dotted Curves Show Smoothed Difference Curves.

Figs XIV and XIVa Diurnal Inequality of Temperature of V. F. Magnetograph No. I Magnet Derived from Experiments Referred in the Text.

Govt. Photozinco: Office Poona. 1909.

variation due to temperature and equated by the same formula (112) omitting the coefficient *c*. The calculations thus simplified enabled the coefficients *a* and *b* to be rederived by least squares. The coefficients are given above in table 209 and the results are charted in plate 7.

Figures I to XIII show the original excesses (to be investigated) of the inequalities of V. F. No. 1 over those of No. 2. Figures I*a* to XIII*a* denote the excesses which modify the inequalities of V. F. No. 2, and figures I*b* to XIII*b* the excesses of the modified No. 2 inequalities over those of No. 1 or the residual errors which, if correct, ought to give us the temperature curve we wish to seek.

287. It will be seen from the above that the results are unsatisfactory for the average months, and when the calculations are extended to several months individually, specially for the months of August and September when the movements are large, the results were found to be still more divergent. It appeared hence that the hypothesis though simulating the average phenomenon fairly approximately, failed to elucidate the real defect in the working of the balance.

288. After this the examination of the differences of the ordinates of two consecutive hours was taken in hand. As the record begins at 10 hour every day and the continuity of the curve as already referred to elsewhere can only be depended upon from 10 a.m. to 9 a.m. of the following day, twenty-three differences only in this connection hence become appropriate for consideration—the 24th difference from 9 to 10 hour being admittedly the result of the mathematical treatment adopted in making the inequalities truly cyclic. The 23 differences (tables 210, 211) showed that apart from the aperiodic change the action of the balance of the old instrument when compared with that of the new, was suspiciously faulty in that its motion was sensibly unequal in respect of positive and negative movements. The suspicion was strengthened as referred to in paragraph 284 by the examination of all the deflection experiments performed upon this instrument for the previous 20 years which when carefully analysed revealed the fact that the sluggishness of the balance *was not uniform* but was sensibly less so in respect of movements indicating increase of force from any initial position of rest than in the case of movements in the opposite direction. That is, the response to change of force was somewhat nearer to the truth in case of the downward movement of the north end of the magnet indicating increase of force corresponding to the upward movement of the centre of gravity of the balance, but less so in the opposite direction.

289. A glance at the average differences when charted side by side shows that a fairly close parallelism is indicated by the records of the two instruments, but the small growing error is not indicated apparently till the 24th difference is reached which exhibits a sudden dislocation of conditions not wholly accounted for by the aperiodic change. Omitting the last difference it will be seen that the ratio of the negative to the positive movements is respectively in No. 2 and No. 1 magnetograph ·771 and ·660, and this defect from unity in each instrument is in the usual course made up in the mathematical treatment adopted, by the 24th difference which completes the periodic cycle. On the other hand the ratio of the average positive movement of No. 1 to that of No. 2 is ·917, and that of the negative movement is ·785 which figures are also suggestive. Hence to ascertain if the balance does behave in the manner suspected, the following method was adopted :—

The 23 differences of the ordinates of the inequalities of V. F. No. 2 were reduced by the two
table 210 factors mentioned above, one each for the positive and negative differences derived from the ratio of corresponding differences of the two instruments : these reduced differences are shown in table 212 ; and starting in both directions with the ordinate of any convenient hour, *viz.* 23^h, a modified inequality series containing all the 24 ordinates was built up by integration. These appear in table 213. In the operation as the factors are unequal the series is affected by a constant which is corrected for and the resulting inequalities are given in table 214, which when compared with the original inequalities of V. F. No. 2 and with those of V. F. No. 1 give two sets of excess inequalities shown in tables 215 and 216 respectively. The resulting excesses shown in table 216 give fairly smooth residual curves and it at once becomes apparent that they are strikingly parallel to the temperature curve referred to in paragraphs 117 and 283 with which we know the inequality would be residually affected by the removal of the other instrumental defect. The results of the average inequalities of the 12 months and the year shown in tables 215 and 216 are charted in plate 8. Figures I to XIII show the original differences collected in table 208 which have to be explained. Figures I*a* to XIII*a* represent the differences given in table 215 between the correct inequality of the V. F. No. 2 instrument and the modified inequality by the same instrument on the supposition that its correct working is affected by a defect referred to above. Figures I*b* to XIII*b* give the final residual errors, that is the excesses of figures I to XIII over figures I*a* to XIII*a*, or the excesses shown in table 216 reversed.

290. Figures XIV and XIV*a* in the plate indicate the temperature curve referred to in paragraph 117, drawn reversed; and the close parallelism of all the residual curves, figures I*b* to XIII*b*, to this curve leaves little room for doubt as to the appropriateness of the above hypothesis adopted in regard to the defective working of the balance of instrument No. 1.

291. This may be expressed by the formula $a\Delta V'' + b|\Delta V''| = \Delta V'$, where a and b are some constants, $\Delta V'$ and $\Delta V''$ representing differences of ordinates of V. F. Nos 1 and 2 respectively and $|\Delta V''|$ represents the differences of V. F. No. 2 considered *irrespective* of the algebraic sign.

The solution of these equations gives results which are practically identical with those referred to in the previous paragraph as will be seen from the corrected inequalities of No. 1 magnetograph for the year 1894 in table 238, which have been especially derived by the application of this formula, and subsequently corrected for the temperature errors shown in the last column of table 216. These are comparable with those of No. 2 instrument in table 191.

292. We have thus available at least a workable method, by which the corrections to the ordinates of the V. F. No. 1 for every month due to effects of a defective knife edge can be independently derived.

293. Errors so computed for individual months selected at random were found to be almost always the same as the average corrections for the corresponding month. Hence the differences of each month, indicated in table 208 whether the explanation given above as to their cause be correct or not, have been accepted once for all as average corrections and made applicable throughout to the old series from month to month. The inequalities so corrected for the years 1873 to 1894 (the V. F. No. 1 series) have been given in tables 217 to 238.

294. In passing it may be noted that while the application of the corrections can be relied upon to be fully effective for the average months, and for the year and group of years, there may remain some amount of uncertainty in the case of individual months, especially in the winter when the range is small and when even the smallest error would make the percentage error large. This however though hardly capable of affecting the general character or run of the inequality, must in the computations for the Fourier coefficients introduce significant errors, and hence the analysis of each monthly inequality has been advisedly excluded, restricting the calculations to average months and groups of months, to half years, years and groups of years.

TABLES 217 & 218.—*Vertical Force Magnetograph No. 1—showing the mean diurnal inequalities for each month of the years 1873 and 1874 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1873. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 15	+ 21	+ 32	+ 38	+ 37	+ 58	+ 50	+ 39	+ 57	+ 34	+ 20	+ 13	+ 34
1 17	+ 2	+ 18	+ 17	+ 33	+ 37	+ 50	+ 48	+ 42	+ 56	+ 31	+ 21	+ 9	+ 29
2 17	+ 1	+ 7	+ 11	+ 18	+ 22	+ 44	+ 47	+ 47	+ 54	+ 31	+ 15	+ 9	+ 25
3 17	− 16	− 5	+ 18	+ 9	+ 16	+ 22	+ 45	+ 48	+ 53	+ 18	+ 2	+ 2	+ 17
4 17	− 29	− 12	+ 5	− 2	+ 9	+ 45	+ 52	+ 56	+ 60	+ 15	− 1	+ 3	+ 16
5 17	− 29	− 18	+ 10	+ 11	+ 39	+ 79	+ 81	+ 89	+ 78	+ 21	− 5	+ 2	+ 29
6 17	− 28	− 14	+ 42	+ **82**	+ 79	+**115**	+**127**	+**147**	+**143**	+ 49	− 19	− 7	+ **59**
7 17	+ 22	+ 9	+ 54	+ 75	+ 16	+ 67	+ 93	+ 85	+ 86	+ 42	+ 9	+ 9	+ 46
8 17	+ **68**	− 4	+ 3	+ 3	− 95	+ 4	+ 3	− 42	− 74	− 39	+ 15	+ **58**	− 10
9 17	+ 50	− 67	− 87	− 84	−**196**	− 110	− 126	− 144	− 157	− 118	− 10	+ 40	− 86
10 17	− 44	−**101**	− 102	− 148	− 168	−**150**	− 152	−**163**	−**235**	−**139**	− **38**	− 19	−**121**
11 17	−**106**	− 78	−**122**	−**163**	− 129	− 138	−**157**	− 135	− 226	− 123	− 23	− **48**	− 120
12 17	− 74	− 8	− 81	− 94	− 95	− 133	− 127	− 100	− 156	− 41	+ 29	− 23	− 75
13 17	− 22	+ 47	+ 16	− 15	− 20	− 63	− 73	− 51	− 39	+ 32	+ **41**	− 16	− 14
14 17	− 4	+ **70**	+ **92**	+ 54	+ 55	− 24	− 24	+ 3	+ 65	+ **69**	+ 5	− 22	+ 29
15 17	+ 22	+ 64	+ 80	+ 66	+ **83**	− 1	+ 16	+ 46	+ 93	+ 59	− 26	− 18	+ 40
16 17	+ 48	+ 33	+ 12	+ 46	+ 78	+ 5	+ 37	+ 52	+ 61	− 7	− 34	− 7	+ 26
17 17	+ 14	− 19	− 46	− 3	+ 50	+ 4	+ 19	+ 11	− 13	− 52	− 27	− 20	− 8
18 17	+ 24	− 5	− 37	− 27	+ 12	− 13	− 13	− 34	− 23	+ 6	− 4	− 2	− 10
19 17	+ 28	+ 16	+ 14	+ 1	+ 15	− 10	− 34	− 28	0	+ 8	− 2	+ 4	0
20 17	+ 15	+ 9	+ 20	+ 16	+ 27	+ 9	− 6	− 11	+ 13	+ 13	− 5	+ 5	+ 8
21 17	+ 12	+ 4	+ 5	+ 19	+ 32	+ 29	+ 14	0	+ 18	+ 17	+ 1	+ 5	+ 13
22 17	+ 24	+ 15	+ 20	+ 37	+ 43	+ 54	+ 36	+ 16	+ 35	+ 31	+ 13	+ 14	+ 28
23 17	+ 20	+ 22	+ 33	+ 36	+ 42	+ 51	+ 38	+ 29	+ 45	+ 34	+ 20	+ 26	+ 32
Range ...	174	171	214	245	279	265	284	310	378	208	79	106	180
Average progressive increase per day.	− 1	− 12	− 19	− 23	− 18	4	+ 3	− 3	− 6	− 3	+ 1	+ 4	− 7

Unity = ·1γ = ·000001 C. G. S.

1874. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 31	+ 22	+ 39	+ 35	+ 41	+ 39	+ 47	+ 45	+ 56	+ 39	+ 20	+ 8	+ 3[illegible]
1 17	+ 22	+ 19	+ 28	+ 34	+ 41	+ 36	+ 45	+ 49	+ 60	+ 41	+ 17	+ 8	+ 3[illegible]
2 17	+ 13	+ 12	+ 26	+ 29	+ 40	+ 30	+ 44	+ 49	+ 53	+ 36	+ 11	+ 4	+ 2[illegible]
3 17	0	+ 4	+ 13	+ 25	+ 34	+ 23	+ 42	+ 41	+ 52	+ 27	+ 7	+ 1	+ 2[illegible]
4 17	− 1	− 3	+ 9	+ 24	+ 37	+ 31	+ 45	+ 49	+ 60	+ 24	+ 9	− [illegible]	+ 2[illegible]
5 17	− 5	− 9	+ 13	+ 31	+ 67	+ 55	+ 75	+ 74	+ 73	+ 35	+ 4	− 4	+ 3[illegible]
6 17	− 8	− 5	+ 32	+ **86**	+**120**	+**106**	+**118**	+**138**	+**149**	+ **63**	− 5	− 1[illegible]	+ **6**[illegible]
7 17	+ 2	+ 10	+ **53**	+ 57	+ 77	+ 88	+ 73	+ 93	+ 96	+ 56	+ 23	− 1	+ 5[illegible]
8 17	+ **49**	+ **40**	+ 19	− 29	− 7	+ 25	+ 3	− 29	− 65	− 18	+ 25	+ **42**	+ 4
9 17	+ 43	+ 25	− 44	− 115	− 134	− 59	− 97	− 143	− 206	− 100	− 24	+ 22	− 7[illegible]
10 17	− 12	+ 9	− 74	−**161**	− 177	− 104	− 169	−**182**	−**231**	− 141	− **71**	− 17	− 11[illegible]
11 17	− **70**	− 28	−**123**	− 136	−**183**	−**142**	−**179**	− 167	− 220	−**143**	− 55	− **42**	−**12**[illegible]
12 17	− 55	− 22	− 102	− 97	− 145	− 127	− 129	− 108	− 165	− 67	− 3	+ 1	− 84
13 17	− 42	− 11	− 33	− 23	− **72**	− 82	− 81	− 53	− 58	+ 18	+ 14	+ 13	− 34
14 17	− 36	− 24	+ 29	+ 28	+ 1	− 33	− 11	+ 3	+ 40	+ 47	+ 5	0	+ 5
15 17	− 26	− 38	+ 33	+ 61	+ 43	+ 5	+ 35	+ 34	+ 79	+ 33	− 4	− 6	+ 2[illegible]
16 17	− 11	− 37	+ 3	+ 51	+ 48	+ 26	+ 52	+ 45	+ 65	− 3	− 16	0	+ 1[illegible]
17 17	− 10	− **41**	− 25	+ 8	+ 25	+ 20	+ 30	+ 12	+ 6	− 45	− 32	− 2[illegible]	− [illegible]
18 17	+ 4	− 16	− 16	− 14	+ 2	+ 3	− 3	− 16	+ 1	− 8	− 4	− 11	− [illegible]
19 17	+ 20	+ 9	+ 9	− 5	− 4	− 19	− 35	− 19	+ 11	+ 8	− 1	0	− [illegible]
20 17	+ 23	+ 14	+ 19	+ 9	+ 22	+ 5	− 1	− 1	+ 24	+ 17	+ 4	− 5	+ 11
21 17	+ 20	+ 9	+ 21	+ 25	+ 31	+ 15	+ 15	+ 12	+ 30	+ 16	+ 11	− 1	+ 1[illegible]
22 17	+ 28	+ 20	+ 31	+ 34	+ 42	+ 30	+ 33	+ 31	+ 43	+ 31	+ **27**	+ 9	+ 3[illegible]
23 17	+ 32	+ 26	+ 40	+ 38	+ 46	+ 32	+ 40	+ 35	+ 53	+ 44	+ 25	+ 2[illegible]	+ 3[illegible]
Range ...	119	81	176	247	303	248	297	320	380	206	98	8	18[illegible]
Average progressive increase per day.	+ 1	− 4	− 9	− 17	− 18	− 4	+ 1	− 2	− 3	− 1	− 1	− 1	[illegible]

TABLES 219 & 220.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1875 and 1876 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1875. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 29	+ 20	+ 27	+ 35	+ 34	+ 39	+ 28	+ 31	+ 52	+ 36	+ 24	+ 16	+ 31
1 17	+ 19	+ 17	+ 20	+ 29	+ 29	+ 36	+ 37	+ 30	+ 56	+ 28	+ 16	+ 3	+ 25
2 17	+ 18	+ 14	+ 13	+ 22	+ 28	+ 35	+ 36	+ 35	+ 49	+ 28	+ 14	+ 3	+ 24
3 17	+ 13	+ 10	+ 8	+ 19	+ 22	+ 33	+ 34	+ 32	+ 53	+ 24	+ 5	− 5	+ 20
4 17	+ 8	+ 6	+ 12	+ 18	+ 30	+ 36	+ 31	+ 35	+ 56	+ 25	+ 12	− 4	+ 22
5 17	+ 4	− 4	+ 12	+ 21	+ 57	+ 56	+ 58	+ 57	+ 74	+ 22	+ 7	− 10	+ 29
6 17	+ 5	+ 8	+ 24	+ **75**	+ **108**	+ **95**	+ **98**	+ **115**	+ **130**	+ 56	0	− 23	+ **57**
7 17	+ 15	+ 3	+ 46	+ 54	+ 58	+ 76	+ 77	+ 68	+ 79	+ 39	+ 17	− 11	+ 42
8 17	+ 18	− 19	+ 19	− 40	− 48	− 3	+ 18	− 42	− 76	− 48	+ 10	+ 18	− 17
9 17	− 48	− 56	− 36	− 121	− 144	− 98	− 64	− 145	− 196	− 108	− 37	+ 8	− 88
10 17	− 146	− 70	− 41	− 121	− **161**	− 138	− 117	− **166**	− **239**	− **138**	− **78**	− 11	− 118
11 17	− **153**	− **84**	− **76**	− **122**	− 157	− **162**	− **133**	− 150	− 236	− 120	− 76	− **33**	− **125**
12 17	− 55	− 15	− 76	− 84	− 100	− 125	− 100	− 90	− 155	− 47	− 16	− 6	− 72
13 17	+ 23	+ 51	− 22	− 21	− 43	− 66	− 65	− 31	− 32	+ 32	+ 26	− 2	− 13
14 17	+ 60	+ **71**	+ 41	+ 46	+ 21	− 8	− 25	+ 19	+ 63	+ **68**	+ **27**	0	+ 33
15 17	+ **71**	+ 52	+ **51**	+ 63	+ 57	+ 34	+ 14	+ 58	+ 90	+ 53	+ 13	− 8	+ 46
16 17	+ 27	+ 8	+ 6	+ 52	+ 72	+ 40	+ 28	+ 65	+ 70	+ 6	+ 1	+ 8	+ 31
17 17	− 27	− 42	− 42	+ 16	+ 37	+ 24	+ 15	+ 30	+ 14	− 36	− 16	+ 4	− 2
18 17	+ 5	− 15	− 46	− 23	+ 2	0	− 5	− 9	− 6	− 13	− 1	+ 5	− 9
19 17	+ 17	− 2	− 5	− 13	− 4	− 2	− 18	− 8	+ 10	− 1	+ 2	+ 6	− 2
20 17	+ 20	+ 3	+ 6	+ 7	+ 14	+ 8	− 3	+ 1	+ 18	+ 13	+ 7	+ 7	+ 8
21 17	+ 26	+ 2	+ 8	+ 19	+ 24	+ 19	+ 10	+ 11	+ 29	+ 12	+ 5	+ 3	+ 14
22 17	+ 30	+ 18	+ 18	+ 29	+ 35	+ 29	+ 23	+ 21	+ 43	+ 32	+ 21	+ 12	+ 26
23 17	+ 25	+ 17	+ 28	+ 33	+ 29	+ 37	+ 26	+ 25	+ 54	+ 31	+ 24	+ **19**	+ 29
Range ...	224	155	127	197	269	257	231	281	369	206	105	52	182
Average progressive increase per day.	+ 1	− 3	− 10	− 14	− 19	− 12	− 3	− 3	− 1	0	− 1	− 2	− 6

Unity = ·1γ = ·000001 C. G. S.

1876. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 26	+ 7	+ 36	+ 33	+ 39	+ 34	+ 35	+ 47	+ 60	+ 41	+ 32	+ 19	+ 34
1 17	+ 25	+ 17	+ 24	+ 36	+ 39	+ 31	+ 30	+ 51	+ 59	+ 38	+ 24	+ 5	+ 30
2 17	+ 19	+ 10	+ 22	+ 31	+ 38	+ 36	+ 33	+ 56	+ 62	+ 38	+ 17	+ 5	+ 31
3 17	+ 14	+ 6	+ 16	+ 26	+ 31	+ 28	+ 32	+ 53	+ 61	+ 29	+ 8	− 3	+ 25
4 17	+ 9	+ 2	+ 16	+ 25	+ 34	+ 31	+ 38	+ 61	+ 69	+ 35	+ 10	0	+ 27
5 17	+ 4	− 4	+ 16	+ 28	+ 61	+ 62	+ 66	+ 88	+ 78	+ 32	+ 5	− 3	+ 36
6 17	+ 5	+ 4	+ 33	+ **75**	+ **92**	+ **105**	+ **107**	+ **142**	+ **146**	+ 62	− 10	− 17	+ **62**
7 17	+ 20	+ 7	+ 46	+ 45	+ 47	+ 76	+ 59	+ 89	+ 104	+ 49	+ 15	− 10	+ 44
8 17	+ **68**	+ 6	+ 5	− 28	− 60	− 7	− 40	− 37	− 45	− 35	+ 22	+ **30**	− 11
9 17	+ 22	− 41	− 52	− 102	− 173	− 101	− **148**	− 172	− 209	− 137	− 36	+ 15	− 96
10 17	− 58	− 71	− 76	− 131	− **185**	− 168	− 145	− **213**	− **270**	− 205	− **124**	− 34	− 139
11 17	− **107**	− **86**	− **111**	− **132**	− 155	− **181**	− 123	− 187	− 262	− **207**	− 122	− **56**	− **143**
12 17	− 77	− 35	− 93	− 84	− 82	− 139	− 70	− 142	− 168	− 105	− 50	− 24	− 88
13 17	− 49	+ 17	− 24	− 18	− 2	− 59	− 22	− 77	− 56	+ 7	− 6	− 16	− 25
14 17	− 32	+ **53**	+ 46	+ 34	+ 57	− 1	+ 27	− 6	+ 41	+ 74	+ 5	− 17	+ 24
15 17	+ 2	+ 51	+ **52**	+ 50	+ 77	+ 51	+ 49	+ 38	+ 79	+ **74**	+ 16	− 6	+ 45
16 17	+ 15	+ 26	+ 14	+ 35	+ 62	+ 63	+ 49	+ 66	+ 64	+ 31	+ 18	+ 16	+ 37
17 17	− 10	− 17	− 25	+ 1	+ 16	+ 41	+ 19	+ 35	+ 7	− 8	+ 6	− 3	+ 5
18 17	+ 5	− 11	− 20	− 17	− 14	0	− 16	− 9	+ 6	+ 16	+ 26	+ 8	− 2
19 17	+ 10	− 2	− 6	− 3	− 5	− 6	− 31	− 8	+ 7	+ 23	+ 24	+ 14	+ 1
20 17	+ 17	+ 4	+ 5	+ 11	+ 13	+ 9	− 9	+ 11	+ 26	+ 38	+ 35	+ 19	+ 15
21 17	+ 18	+ 7	+ 7	+ 18	+ 18	+ 19	+ 3	+ 21	+ 32	+ 32	+ 32	+ 15	+ 19
22 17	+ 22	+ 19	+ 22	+ 27	+ 34	+ 30	+ 19	+ 31	+ 46	+ 42	+ **39**	+ 20	+ 29
23 17	+ 27	+ 22	+ 33	+ 31	+ 33	+ 32	+ 23	+ 41	+ 52	+ 41	+ 32	+ 22	+ 32
Range ...	175	139	163	207	277	286	255	355	416	281	163	86	205
Average progressive increase per day.	− 1	− 1	− 5	− 7	− 10	− 5	− 21	+ 9	+ 3	+ 3	+ 4	+ 5	− 2

TABLES 221 & 222.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1877 and 1878 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1877. Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 17	+ 27	+ 35	+ 28	+ 45	+ 44	+ 37	+ 28	+ 33	+ 43	+ 34	+ 13	+ 18	+ 32
1 17	+ 21	+ 26	+ 20	+ 44	+ 44	+ 34	+ 26	+ 37	+ 42	+ 31	+ 10	+ 14	+ 27
2 17	+ 15	+ 23	+ 18	+ 43	+ 43	+ 38	+ 30	+ 37	+ 45	+ 31	+ 2	+ 14	+ 28
3 17	+ 6	+ 5	+ 12	+ 33	+ 36	+ 25	+ 28	45	+ 44	27	− 2	+ 5	+ 21
4 17	+ 5	+ 6	+ 8	+ 27	+ 45	+ 34	+ 37	+ 48	53	34	0	+ 12	25
5 17	0	0	+ 8	+ 30	+ 72	60	+ 65	+ 77	68	36	0	+ 5	+ 34
6 17	+ 1	+ 4	+ 24	+ **86**	+**109**	+ **94**	+**119**	+**140**	+**133**	+ 51	− 15	7	**62**
7 17	+ 21	+ 16	+ 33	+ 54	+ 57	+ 64	+ 86	+ 84	+ 89	+ 37	− 5	+ 19	+ 45
8 17	+ **66**	+ 5	− 14	− 47	− 41	− 11	− 4	− 45	− 58	− 20	− 3	+ 25	− 13
9 17	+ 13	− 53	− 78	−136	−160	−121	− 80	−179	−206	−102	− 22	− 54	−100
10 17	−123	− 98	−113	−182	−**190**	−176	−174	−**237**	−**279**	−**155**	− **53**	−**132**	−159
11 17	−**146**	−**123**	−**140**	−**215**	−185	−**195**	−**179**	−220	−265	−141	− 40	−114	−**163**
12 17	− 58	− 66	−111	−154	−127	−128	−116	−133	−144	− 44	+ 15	− 34	− 91
13 17	− 19	− 11	− 21	− 43	− 46	− 33	− 50	− 52	− 19	+ 34	+ **25**	+ 7	− 19
14 17	− 6	30	+ 71	+ 36	+ 36	+ 33	+ 8	+ 29	+ 80	+ **64**	+ 5	+ 17	+ 34
15 17	+ 26	+ 34	+ **87**	79	+ 67	+ 53	+ 45	+ 83	+111	+ 54	− 4	+ 23	+ 55
16 17	+ 30	+ 31	+ 54	+ 73	+ 67	+ 55	+ 49	+102	+ 96	+ 8	− 7	+ 25	+ 47
17 17	− 5	− 9	+ 8	+ 21	+ 26	+ 26	+ 24	+ 54	+ 19	− 28	− 4	+ 5	+ 11
18 17	+ 15	+ 6	+ 3	+ 11	− 5	+ 3	− 13	− 5	− 4	− 13	+ 7	+ 17	+ 1
19 17	+ 20	+ 21	+ 8	+ 16	0	+ 1	− 15	+ 2	+ 14	− 11	+ 5	+ 23	+ 6
20 17	+ 23	+ 31	+ 25	+ 36	+ 17	+ 16	+ 6	+ 17	+ 23	+ 10	+ 11	+ 24	+ 19
21 17	+ 24	+ 30	+ 22	+ 39	+ 23	+ 16	+ 14	+ 22	+ 35	+ 14	13	+ 19	+ 22
22 17	+ 28	+ **37**	+ 23	+ 49	+ 34	+ 32	28	+ 33	+ 39	+ 25	+ 20	+ 24	+ 31
23 17	+ 23	+ 36	+ 24	+ 43	+ 38	+ 29	+ 26	+ 26	+ 40	+ 29	+ 18	+ **26**	+ 29
Range ...	212	160	227	301	299	289	298	377	412	219	78	158	225
Average progressive increase per day.	+ 6	0	− 7	− 9	− 9	− 2	+ 5	+ 3	+ 1	+ 4	+ 6	+ 12	+ 1

Unity = ·1γ = ·000001 C. G. S.

1878. Bombay Civil Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
H. m.													
0 17	+ 23	+ 7	+ 18	+ 48	+ 35	+ 38	+ 43	+ 37	+ 51	+ 35	+ 15	− 4	+ 28
1 17	+ 8	+ 8	+ 15	+ 47	+ 29	+ 40	+ 35	+ 36	+ 50	+ 27	+ 12	− 8	+ 23
2 17	+ 7	− 5	+ 13	+ 41	+ 23	34	+ 34	+ 42	+ 48	+ 27	15	− 3	+ 22
3 17	− 3	− 13	+ 7	+ 30	+ 22	32	+ 32	+ 39	+ 52	+ 23	+ 6	− 6	+ 17
4 17	− 4	− 12	+ 2	+ 24	19	+ 40	+ 41	47	+ 55	+ 24	+ 13	+ 5	+ 21
5 17	− 9	− 10	+ 2	+ 32	+ 42	+ 67	+ 69	+ 70	+ 70	+ 31	+ 13	+ 4	+ 31
6 17	− 3	− 6	19	+ **79**	+ **90**	+**102**	+**116**	**120**	+**135**	+ 57	− 3	+ 5	+ **58**
7 17	+ 17	+ 2	+ 33	+ 47	+ 65	+ 71	+ 83	+ 66	+ 86	+ 58	+ 23	+ 22	+ 44
8 17	+ 39	0	− 16	− 43	− 18	− 5	+ 5	− 39	− 33	− 51	+ 25	+ 38	− 9
9 17	− 29	− 45	− 85	−144	−130	− 95	− 86	−148	−158	−128	− 9	− 18	− 91
10 17	−143	− 72	−122	−209	−**172**	−151	−166	−**172**	−**246**	−**148**	− **35**	− **64**	−**141**
11 17	−**161**	− **83**	−**140**	−**210**	−162	−**154**	−**172**	−149	−237	−128	− 33	− 41	−139
12 17	− 82	− 39	−101	−133	−113	−114	−126	−103	−160	− 37	+ **33**	+ 17	− 80
13 17	− 18	+ 21	− 3	− 29	− 30	− 46	− 72	− 45	− 53	+ 35	+ 32	+ **41**	− 14
14 17	+ 15	+ **54**	+ 81	+ 43	+ 32	+ 4	+ 2	+ 13	+ 51	+ **75**	+ 7	+ 40	+ 35
15 17	42	+ 53	+ **93**	+ 78	+ 47	+ 26	+ 44	+ 49	+ 87	+ 65	− 13	+ 21	+ 49
16 17	+ **46**	27	+ 54	+ 77	+ 48	+ 27	+ 53	+ 62	+ 66	+ 4	− 21	+ 3	+ 36
17 17	+ 25	+ 10	+ 3	+ 34	+ 22	+ 4	+ 23	+ 20	+ 6	− 38	− 28	− 11	+ 5
18 17	+ 36	+ 11	+ 8	+ 13	+ 7	− 9	− 3	− 10	− 6	− 7	− 18	− 5	+ 1
19 17	+ 36	+ 17	+ 13	+ 18	+ 12	− 5	− 21	− 9	+ 11	0	− 20	− 9	+ 3
20 17	+ 43	+ 18	+ 20	+ 28	+ 19	+ 16	+ 5	+ 11	+ 26	+ 11	− 19	− 13	+ 13
21 17	+ 35	+ 17	+ 17	+ 37	+ 24	+ 16	+ 18	+ 16	+ 32	+ 15	− 12	− 18	+ 16
22 17	+ 34	+ 19	+ 23	+ 47	+ 36	+ 33	+ 32	+ 27	+ 36	+ 26	+ 1	− 8	+ 25
23 17	+ 29	+ 12	+ 24	+ 41	+ 35	+ 36	+ 30	+ 31	+ 43	+ 30	+ 9	− 1	+ 26
Range ...	207	137	233	289	262	256	288	292	381	223	68	105	199
Average progressive increase per day.	+ 11	− 3	− 11	− 11	− 10	− 2	+ 11	+ 3	− 1	+ 4	− 3	− 2	− 1

TABLES 223 & 224.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1879 and 1880 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1879. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	Sept.mber.	October.	November.	December.	Year.
0 17	+ 17	+ 21	+ 23	+ 41	+ 39	+ 36	+ 23	+ 29	+ 48	+ 30	+ 15	− 2	+ 27
1 17	+ 12	+ 18	+ 20	+ 40	+ 34	+ 29	+ 17	+ 24	+ 46	+ 22	+ 10	− 11	+ 21
2 17	+ 15	+ 17	+ 8	+ 28	+ 36	+ 30	+ 21	+ 30	+ 42	+ 21	+ 5	− 15	+ 20
3 17	+ 10	+ 12	+ 2	+ 23	+ 25	+ 22	+ 15	+ 25	+ 42	+ 7	− 2	− 21	+ 13
4 17	+ 9	+ 14	− 3	+ 17	+ 33	+ 29	+ 24	+ 31	+ 53	+ 12	+ 3	− 18	+ 17
5 17	+ 9	+ 7	− 3	+ 30	+ 56	+ 58	+ 50	+ 55	+ 69	+ 18	+ 7	− 14	+ 28
6 17	+ 15	+ 2	+ 4	+ **78**	+ **98**	+ **107**	+ **100**	+ **120**	+ **132**	+ 60	0	− **22**	+ **57**
7 17	+ 31	+ 20	+ 28	+ 45	+ 43	+ 82	+ 68	+ 75	+ 89	+ **61**	+ 16	− 20	+ 44
8 17	+ **57**	+ 24	− 1	− 39	− 57	− 15	− 2	− 45	− 59	− 10	+ 6	+ 23	− 11
9 17	+ 18	− 33	− 46	− 115	− **161**	− 118	− 113	− 167	− 172	− 110	− 48	+ 31	− 87
10 17	− 90	− 48	− 44	− **143**	− 159	− 167	− 151	− **195**	− 205	− 153	− **98**	− 9	− 121
11 17	− **142**	− **73**	− **86**	− 139	− 156	− **181**	− **171**	− 184	− **217**	− **156**	− 78	− 21	− **133**
12 17	− 77	− 28	− 81	− 93	− 104	− 121	− 125	− 116	− 157	− 76	− 6	+ 18	− 80
13 17	− 19	+ 13	− 28	− 10	− 24	− 50	− 51	− 25	− 55	− 5	+ 24	+ **34**	− 16
14 17	+ 4	+ **31**	+ 57	+ 41	+ 35	+ 13	+ 16	+ 39	+ 44	+ 47	+ **25**	+ 20	+ 32
15 17	+ 21	+ 25	+ **69**	+ 55	+ 66	+ 55	+ 63	+ 79	+ 72	+ 47	+ 17	+ 2	+ 48
16 17	+ 31	− 1	+ 40	+ 44	+ 68	+ 62	+ 73	+ 79	+ 49	+ 11	+ 1	+ 7	+ 38
17 17	+ 4	− 34	− 2	+ 6	+ 23	+ 32	+ 54	+ 44	+ 4	− 14	− 3	+ 2	+ 10
18 17	+ 20	− 20	− 2	− 10	− 3	+ 1	+ 13	+ 4	+ 11	+ 18	+ 16	+ 7	+ 5
19 17	+ 20	− 8	+ 13	− 10	− 1	− 4	− 6	+ 11	+ 14	+ 27	+ 20	+ 5	+ 7
20 17	+ 23	+ 4	+ 25	+ 11	+ 20	+ 15	+ 11	+ 17	+ 32	+ 37	+ 17	+ 4	+ 18
21 17	+ 19	+ 6	+ 22	+ 19	+ 23	+ 22	+ 16	+ 23	+ 34	+ 31	+ 13	0	+ 19
22 17	+ 18	+ 13	+ 23	+ 29	+ 39	+ 38	+ 29	+ 26	+ 41	+ 41	+ 19	− 1	+ 26
23 17	+ 18	+ 19	+ 24	+ 39	+ 34	+ 32	+ 19	+ 24	+ 43	+ 34	+ 15	+ 6	+ 26
Range ...	199	104	155	221	259	288	271	315	349	217	123	56	190
Average progressive increase per day.	+ 2	+ 4	− 14	− 12	− 7	+ 2	+ 6	+ 7	+ 4	+ 5	+ 12	+ 23	+ 3

Unity = ·1γ = ·000001 C. G. S.

1880. Bombay Civil Time. H. m.	January.	F.bruary.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 2	+ 21	+ 18	+ 33	+ 30	+ 27	+ 38	+ 59	+ 57	+ 48	+ 27	+ 13	+ 31
1 17	+ 3	+ 22	+ 12	+ 25	+ 27	+ 24	+ 35	+ 61	+ 63	+ 40	+ 21	+ 7	+ 27
2 17	+ 1	+ 18	+ 6	+ 22	+ 25	+ 18	+ 34	+ 54	+ 55	+ 38	+ 18	+ 1	+ 24
3 17	+ 2	+ 11	+ 3	+ 20	+ 21	+ 16	+ 32	+ 53	+ 49	+ 28	+ 6	− 6	+ 19
4 17	+ 3	+ 14	+ 2	+ 16	+ 26	+ 24	+ 32	+ 58	+ 53	+ 31	+ 7	− 7	+ 22
5 17	+ 5	+ 8	− 2	+ 22	+ 54	+ 44	+ 66	+ 82	+ 69	+ 42	+ 7	− 10	+ 32
6 17	+ 1	+ 6	+ 12	+ **73**	+ **94**	+ **87**	+ **108**	+ **152**	+ **145**	+ 80	− 8	− 18	+ **61**
7 17	− 1	+ 21	+ 49	+ 69	+ 61	+ 72	+ 67	+ 90	+ 107	+ **81**	+ **30**	− 7	+ 52
8 17	+ 34	+ 26	+ 27	+ 1	− 35	− 1	− 22	− 43	− 50	+ 2	+ 27	+ **28**	− 1
9 17	+ **43**	− 16	− 24	− 82	− **138**	− 91	− 105	− 169	− 191	− 104	− 30	+ 18	− 75
10 17	+ 21	− 51	− 16	− 106	− 135	− 110	− **145**	− **224**	− **255**	− 158	− **63**	− 17	− 104
11 17	− **33**	− **92**	− **75**	− **141**	− 131	− **148**	− 140	− 207	− 251	− **161**	− 60	− **31**	− **122**
12 17	− 22	− 48	− 73	− 107	− 99	− 117	− 112	− 154	− 156	− 85	− 2	+ 5	− 80
13 17	+ 14	0	− 7	− 35	− 21	− 51	− 48	− 78	− 30	+ 6	+ 12	+ 8	− 19
14 17	− 6	+ 22	+ 46	+ 28	+ 31	+ 13	+ 1	− 1	+ 61	+ 42	− 7	− 4	+ 20
15 17	− 14	+ **29**	+ **54**	+ 55	+ 60	+ 59	+ 40	+ 41	+ 97	+ 38	− 12	− 9	+ 37
16 17	− 4	+ 21	+ 12	+ 51	+ 54	+ 58	+ 47	+ 53	+ 68	− 9	− 21	0	+ 27
17 17	− 20	− 17	− 32	+ 13	+ 19	+ 33	+ 30	+ 20	− 8	− 50	− 31	− 14	− 5
18 17	− 10	− 11	− 28	− 21	− 8	− 1	− 4	+ 2	− 10	− 19	− 5	− 9	− 10
19 17	− 8	− 3	− 10	− 14	− 14	− 10	− 26	0	+ 6	+ 4	+ 2	0	− 6
20 17	− 1	− 3	− 3	+ 5	+ 5	+ 2	− 3	+ 16	+ 20	+ 8	+ 8	− 1	+ 4
21 17	− 5	− 3	+ 8	+ 20	+ 19	+ 9	+ 13	+ 35	+ 24	+ 17	+ 16	+ 5	+ 13
22 17	− 1	+ 11	+ 15	+ 25	+ 31	+ 24	+ 29	+ 49	+ 37	+ 40	+ 26	+ 16	+ 25
23 17	− 7	+ 18	+ 20	+ 30	+ 29	+ 27	+ 30	+ 54	+ 47	+ 46	+ 29	+ 24	+ 29
Range ...	76	121	129	214	232	235	253	376	400	242	93	59	183
Average progressive increase per day.	+ 7	0	− 32	− 23	− 14	− 6	− 5	− 5	− 3	− 1	+ 1	+ 5	− 6

TABLES 225 & 226.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1881 and 1882 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1881. Bombay Civil Time. H. m.	January.	February.	March	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 33	+ 35	+ 33	+ 42	+ 29	+ 40	+ 33	+ 52	+ 68	+ 50	+ 19	+ 16	+ 38
1 17	+ 35	+ 33	+ 26	+ 43	+ 30	+ 34	+ 34	+ 52	+ 65	+ 43	+ 13	+ 5	+ 33
2 17	+ 23	+ 26	+ 22	+ 37	+ 29	+ 28	+ 30	+ 51	+ 62	+ 38	+ 7	+ 3	+ 30
3 17	+ 15	+ 16	+ 18	+ 31	+ 26	+ 27	+ 29	+ 45	+ 52	+ 29	+ 1	− 7	+ 23
4 17	+ 9	+ 12	+ 17	+ 30	+ 42	+ 39	+ 37	+ 53	+ 57	+ 32	+ 3	− 6	+ 27
5 17	+ 14	+ 8	+ 16	+ 42	+ 77	+ 80	+ 78	+ 88	+ 73	+ 45	0	− 8	+ 42
6 17	+ 9	+ 11	+ 46	+ 108	+ 129	+ 135	+ 131	+ 170	+ 161	+ 95	− 14	− 18	+ 80
7 17	+ 33	+ 25	+ 77	+ 75	+ 64	+ 97	+ 61	+ 108	+ 119	+ 85	+ 27	− 1	+ 64
8 17	+ 55	+ 50	+ 36	− 25	− 56	− 12	− 41	− 48	− 63	− 23	+ 33	+ 44	− 5
9 17	− 5	+ 13	− 49	− 136	− 186	− 127	− 150	− 185	− 200	− 149	− 21	+ 40	− 97
10 17	− 97	− 39	− 85	− 162	− 199	− 173	− 156	− 215	− 271	− 179	− 57	+ 15	− 134
11 17	− 142	− 89	− 125	− 162	− 184	− 199	− 143	− 197	− 278	− 173	− 48	− 9	− 145
12 17	− 87	− 77	− 86	− 105	− 113	− 154	− 102	− 139	− 187	− 76	+ 7	+ 10	− 92
13 17	− 23	− 38	− 4	− 24	− 6	− 71	− 38	− 67	− 60	+ 20	+ 33	+ 13	− 22
14 17	− 1	− 6	+ 43	+ 43	+ 65	+ 11	+ 24	+ 8	+ 49	+ 64	+ 21	− 17	+ 26
15 17	+ 22	0	+ 42	+ 68	+ 99	+ 66	+ 75	+ 52	+ 88	+ 48	+ 5	− 33	+ 45
16 17	+ 16	− 10	− 3	+ 49	+ 84	+ 83	+ 80	+ 75	+ 65	− 12	− 9	− 21	+ 32
17 17	− 16	− 33	− 51	− 4	+ 25	+ 45	+ 47	+ 33	+ 9	− 60	− 40	− 30	− 6
18 17	0	− 17	− 33	− 26	− 20	− 6	− 20	− 16	+ 8	− 13	− 10	− 16	− 14
19 17	+ 14	+ 6	+ 3	− 14	− 17	− 23	− 53	− 18	+ 13	+ 5	− 9	− 8	− 8
20 17	+ 16	+ 9	+ 6	+ 5	+ 5	+ 7	− 16	− 1	+ 22	+ 16	− 8	− 7	+ 4
21 17	+ 18	+ 8	+ 5	+ 19	+ 16	+ 21	− 2	+ 17	+ 34	+ 16	+ 3	− 4	+ 13
22 17	+ 27	+ 25	+ 18	+ 27	+ 30	+ 31	+ 18	+ 37	+ 51	+ 41	+ 23	+ 9	+ 28
23 17	+ 34	+ 34	+ 30	+ 34	+ 30	+ 30	+ 20	+ 46	+ 59	+ 48	+ 20	+ 25	+ 34
Range ...	197	139	202	270	328	334	287	385	439	274	90	77	225
Average progressive increase per day.	+ 4	0	− 20	− 12	− 10	− 7	− 6	− 7	− 7	− 5	− 5	− 8	− 7

Unity = ·1γ = ·000001 C. G. S.

1882. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 21	+ 30	+ 34	+ 52	+ 52	+ 54	+ 52	+ 54	+ 58	+ 40	+ 23	+ 22	+ 41
1 17	+ 22	+ 32	+ 27	+ 53	+ 48	+ 41	+ 49	+ 50	+ 53	+ 36	+ 24	+ 15	+ 36
2 17	+ 21	+ 31	+ 26	+ 44	+ 50	+ 41	+ 44	+ 44	+ 49	+ 32	+ 18	+ 15	+ 35
3 17	+ 11	+ 22	+ 19	+ 41	+ 46	+ 34	+ 43	+ 40	+ 40	+ 24	+ 5	+ 9	+ 27
4 17	+ 9	+ 25	+ 22	+ 38	+ 44	+ 36	+ 50	+ 45	+ 44	+ 28	+ 5	+ 6	+ 29
5 17	+ 3	+ 24	+ 24	+ 53	+ 78	+ 70	+ 73	+ 69	+ 57	+ 37	+ 5	+ 5	+ 41
6 17	+ 13	+ 45	+ 44	+ 116	+ 143	+ 116	+ 118	+ 133	+ 123	+ 71	− 12	− 4	+ 75
7 17	+ 29	+ 59	+ 83	+ 90	+ 89	+ 76	+ 71	+ 91	+ 88	+ 49	+ 29	+ 8	+ 62
8 17	+ 73	+ 65	+ 49	+ 7	− 20	− 21	− 9	− 31	− 28	− 30	+ 36	+ 43	+ 10
9 17	+ 26	+ 12	− 25	− 106	− 131	− 112	− 102	− 151	− 143	− 106	− 8	+ 35	− 69
10 17	− 68	− 53	− 74	− 175	− 178	− 156	− 168	− 205	− 205	− 150	− 53	− 9	− 124
11 17	− 87	− 120	− 129	− 194	− 206	− 187	− 181	− 190	− 209	− 141	− 57	− 47	− 145
12 17	− 28	− 86	− 128	− 150	− 156	− 129	− 144	− 142	− 147	− 59	+ 2	− 29	− 99
13 17	− 2	− 33	− 34	− 36	− 69	− 55	− 64	− 72	− 47	+ 22	+ 15	− 16	− 33
14 17	− 9	− 11	+ 46	+ 31	− 2	+ 9	+ 3	− 20	+ 34	+ 58	− 1	− 18	+ 11
15 17	− 5	+ 5	+ 59	+ 54	+ 49	+ 35	+ 24	+ 24	+ 56	+ 43	− 14	− 19	+ 26
16 17	− 11	− 10	+ 12	+ 30	+ 53	+ 34	+ 27	+ 52	+ 38	− 8	− 29	− 14	+ 14
17 17	− 34	− 43	− 53	− 24	+ 26	+ 23	+ 5	+ 41	− 12	− 57	− 42	− 9	− 15
18 17	− 13	− 29	− 46	− 32	− 11	+ 1	+ 8	+ 19	− 9	− 10	− 10	− 12	− 12
19 17	− 5	+ 1	− 12	− 7	− 19	− 24	− 24	+ 6	+ 8	+ 5	− 10	− 4	− 7
20 17	− 3	− 2	− 5	+ 8	+ 5	+ 7	+ 7	+ 18	+ 24	+ 10	− 8	− 5	+ 5
21 17	+ 2	− 3	+ 4	+ 24	+ 26	+ 21	+ 21	+ 29	+ 31	+ 18	+ 12	+ 3	+ 16
22 17	+ 15	+ 13	+ 22	+ 37	+ 43	+ 43	+ 40	+ 47	+ 45	+ 40	+ 34	+ 17	+ 33
23 17	+ 19	+ 28	+ 35	+ 45	+ 49	+ 46	+ 48	+ 51	+ 54	+ 43	+ 35	+ 30	+ 40
Range ...	160	185	212	310	349	303	299	338	332	208	93	90	220
Average progressive increase per day.	− 8	− 5	+ 1	+ 2	− 9	− 3	0	− 15	− 7	− 5	− 9	− 7	− 5

TABLES 227 & 228.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1883 and 1884 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1883. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
	MONTH.												
0 17	+ 36	+ 24	+ 27	+ 54	+ 51	+ 37	+ 45	+ 41	+ 64	+ 5[illegible]	+ 38	+ 32	+ 42
1 17	+ 33	+ 26	+ 24	+ 57	+ 53	+ 31	+ 39	+ 38	+ 60	+ 4[illegible]	+ 31	+ 28	+ 37
2 17	+ 31	+ 23	+ 20	+ 53	+ 55	+ 28	+ 31	+ 35	+ 55	+ 3[illegible]	+ 22	+ 28	+ 35
3 17	+ 22	+ 12	+ 13	+ 50	+ 51	+ 26	+ 26	+ 29	+ 51	+ 2[illegible]	+ 7	+ 21	+ 27
4 17	+ 19	+ 5	+ 13	+ 52	+ 61	+ 35	+ 36	+ 35	+ 56	+ 2[illegible]	+ 9	+ 20	+ 30
5 17	+ 22	+ 2	+ 14	+ 66	+ 91	+ 69	+ 66	+ 61	+ 73	+ 3[illegible]	+ 8	+ 18	+ 43
6 17	+ 27	+ 6	+ 28	**+123**	**+140**	**+114**	**+115**	**+128**	**+151**	+ 6[illegible]	− 3	+ 21	**+ 76**
7 17	+ 40	+ 27	**+ 56**	+ 87	+ 93	+ 73	+ 76	+ 85	+ 98	**+ 7[illegible]**	+ 20	+ 34	+ 63
8 17	**+ 62**	**+ 59**	+ 42	− 4	− 17	− 18	− 16	− 10	− 61	+ 1[illegible]	+ 13	**+ 58**	+ 9
9 17	+ 24	+ 41	− 8	−110	−144	−120	−115	−120	−195	− 8[illegible]	− 42	− 1	− 74
10 17	−101	− 6	− 48	−201	**−203**	−163	−162	−160	**−249**	−14[illegible]	**− 87**	**− 93**	−134
11 17	**−146**	**− 46**	**−102**	**−212**	−200	**−172**	**−165**	**−161**	−234	**−16[illegible]**	− 65	− 87	**−146**
12 17	− 97	− 31	+ 82	−144	−150	−136	−132	−130	−150	− 8[illegible]	+ 8	− 35	− 96
13 17	− 35	− 14	− 17	− 41	− 60	− 62	− 80	− 80	− 43	− [illegible]	**+ 47**	− 12	− 34
14 17	− 11	− 23	+ 46	+ 34	+ 6	+ 5	− 14	− 6	+ 45	+ 3[illegible]	+ 15	− 4	+ 11
15 17	+ 7	− 23	+ 39	+ 57	+ 43	+ 59	+ 37	+ 49	+ 75	+ 3[illegible]	− 21	− 3	+ 29
16 17	+ 1	− 35	− 5	+ 31	+ 35	+ 69	+ 59	+ 69	+ 56	− 1[illegible]	− 36	− 21	+ 17
17 17	− 30	− 43	− 54	− 14	+ 4	+ 45	+ 49	+ 22	− 4	− 5[illegible]	− 58	− 49	− 16
18 17	0	− 27	− 37	− 44	− 19	+ 5	+ 11	− 10	− 17	− 1[illegible]	− 9	− 8	− 14
19 17	+ 9	− 8	− 15	− 14	− 15	− 13	− 24	− 15	+ 6	+ 1[illegible]	− 1	+ 1	− 7
20 17	+ 11	− 3	− 3	+ 10	+ 9	+ 6	+ 4	+ 7	+ 22	+ 1[illegible]	− 1	− 8	+ 6
21 17	+ 16	+ 1	+ 4	+ 26	+ 28	+ 19	+ 22	+ 20	+ 32	+ 1[illegible]	+ 15	+ 2	+ 17
22 17	+ 30	+ 13	+ 16	+ 39	+ 41	+ 34	+ 40	+ 34	+ 49	+ 4[illegible]	+ 39	+ 20	+ 34
23 17	+ 35	+ 22	+ 27	+ 48	+ 47	+ 35	+ 43	+ 36	+ 61	+ 5[illegible]	+ 46	+ 34	+ 41
Range ...	208	105	158	335	343	286	280	289	400	24[illegible]	134	151	222
Average progressive increase per day.	− 2	− 1	− 2	− 9	− 7	+ 6	− [illegible]	− 13	− 1	+ 7	− 9	− 28	− 5

Unity = ·1γ = ·000001 C. G. S.

1884. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
	MONTH.												
0 17	+ 33	+ 46	+ 47	+ 64	+ 43	+ 31	+ 39	+ 47	+ 60	+ 46	+ 34	+ 26	+ 43
1 17	+ 33	+ 44	+ 43	+ 59	+ 43	+ 30	+ 41	+ 49	+ 56	+ 43	+ 31	+ 18	+ 40
2 17	+ 32	+ 38	+ 34	+ 48	+ 40	+ 32	+ 43	+ 53	+ 57	+ 42	+ 24	+ 14	+ 38
3 17	+ 19	+ 25	+ 23	+ 42	+ 39	+ 31	+ 42	+ 53	+ 51	+ 34	+ 14	+ 10	+ 31
4 17	+ 17	+ 19	+ 24	+ 45	+ 46	+ 46	+ 54	+ 65	+ 56	+ 34	+ 12	+ 6	+ 35
5 17	+ 19	+ 10	+ 29	+ 64	+ 72	+ 82	+ 84	+ 97	+ 75	+ 38	+ 7	+ 3	+ 48
6 17	+ 31	+ 22	+ 69	**+138**	**+132**	**+128**	**+121**	**+166**	**+149**	+ 73	− 9	− 1	**+ 84**
7 17	+ 57	+ 36	**+ 87**	+ 88	+ 80	+ 77	+ 73	+ 99	+115	**+ 79**	+ 38	+ 24	+ 70
8 17	**+ 94**	**+ 72**	+ 26	− 33	− 32	− 32	− 28	− 71	− 19	+ 20	**+ 72**	**+ 79**	+ 12
9 17	+ 43	+ 46	− 74	−156	−147	−132	−124	−208	−157	− 71	+ 33	+ 61	− 75
10 17	− 69	− 12	−125	−223	**−196**	**−182**	−168	**−259**	−244	−144	− 26	− 20	−138
11 17	**−120**	**−106**	**−160**	**−238**	−180	−179	**−174**	−231	**−277**	**−151**	**− 67**	− 53	**−160**
12 17	− 97	− 81	−125	−171	−113	−120	−122	−141	−202	− 85	− 40	− 35	−110
13 17	− 58	− 70	− 29	− 52	− 22	− 36	− 50	− 59	− 77	− 23	− 29	− 45	− 46
14 17	− 44	− 78	+ 59	+ 41	+ 45	+ 36	+ 22	+ 32	+ 48	+ 22	− 52	**− 64**	+ 7
15 17	− 20	− 49	+ 51	+ 80	+ 65	+ 71	+ 53	+ 84	+ 90	+ 16	− 48	− 53	+ 29
16 17	− 11	− 32	+ 2	+ 63	+ 51	+ 70	+ 46	+ 85	+ 72	− 17	− 32	− 27	+ 21
17 17	− 37	− 39	− 56	+ 6	+ 4	+ 34	+ 25	+ 38	+ 9	− 61	− 37	− 27	− 12
18 17	− 9	− 18	− 43	− 21	− 22	− 16	− 10	− 8	− 11	− 19	− 11	− 8	− 16
19 17	+ 12	+ 23	+ 8	+ 2	− 23	− 29	− 36	− 2	+ 9	+ 1	0	+ 5	− 3
20 17	+ 13	+ 27	+ 19	+ 19	+ 1	− 2	− 10	+ 11	+ 21	+ 10	+ 10	+ 12	+ 11
21 17	+ 15	+ 11	+ 14	+ 32	+ 14	+ 1[illegible]	+ 7	+ 22	+ 28	+ 19	+ 12	+ 15	+ 17
22 17	+ 25	+ 26	+ 33	+ 50	+ 28	+ 26	+ 25	+ 36	+ 45	+ 41	+ 30	+ 24	+ 32
23 17	+ 29	+ 41	+ 47	+ 56	+ 35	+ 25	+ 30	+ 42	+ 50	+ 44	+ 31	+ 34	+ 39
Range ...	214	178	247	376	328	310	295	425	426	230	139	143	244
Average progressive increase per day.	0	− 27	− 13	− 7	− 7	0	+ 8	+ 6	+ 5	+ 4	+ 3	+ 4	− 2

TABLES 229 & 230.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1885 and 1886 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1885. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 20	+ 32	+ 31	+ 44	+ 39	+ 30	+ 26	+ 31	+ 50	+ 41	+ 27	+ 22	+ 33
1 17	+ 12	+ 37	+ 25	+ 42	+ 38	+ 30	+ 28	+ 36	+ 55	+ 35	+ 16	+ 19	+ 30
2 17	+ 8	+ 29	+ 22	+ 40	+ 32	+ 28	+ 31	+ 41	+ 48	+ 34	+ 9	+ 14	+ 28
3 17	- 5	+ 18	+ 14	+ 30	+ 30	+ 23	+ 31	+ 40	+ 43	+ 23	- 2	+ 5	+ 20
4 17	- 5	+ 13	+ 11	+ 27	+ 39	+ 37	+ 37	+ 49	+ 53	+ 24	- 7	+ 4	+ 23
5 17	- 6	+ 9	+ 10	+ 31	+ 69	+ 65	+ 73	+ 85	+ 66	+ 28	- 10	+ 1	+ 35
6 17	- 4	+ 12	+ 21	+ 89	+119	+110	+116	+144	+134	+ 51	- 31	- 17	+ 62
7 17	+ 12	+ 13	+ 42	+ 55	+ 55	+ 68	+ 70	+ 75	+ 83	+ 58	- 2	+ 1	+ 43
8 17	+ 66	0	+ 1	- 27	- 51	— 21	- 7	- 65	- 57	+ 5	+ 13	+ 46	- 9
9 17	+ 52	- 57	- 60	- 118	- 159	- 126	- 97	- 187	- 192	- 72	- 18	+ 31	- 85
10 17	- 64	- 103	- 74	- 159	- 181	- 148	- 147	- 208	- 235	- 93	- 53	- 46	- 125
11 17	- 119	- 124	- 118	- 184	- 174	- 152	- 147	- 172	- 228	- 119	- 63	- 53	- 137
12 17	- 68	- 52	- 123	- 132	- 122	- 114	- 115	- 105	- 136	- 70	- 6	- 24	- 88
13 17	- 17	+ 24	- 55	- 40	- 27	- 37	- 58	- 21	- 44	- 6	+ 27	- 24	- 23
14 17	- 2	+ 43	+ 53	+ 37	+ 37	+ 23	+ 14	+ 51	+ 55	+ 25	+ 20	- 38	+ 27
15 17	+ 13	+ 34	+ 93	+ 68	+ 70	+ 55	+ 64	+ 87	+ 80	+ 16	- 2	- 30	+ 46
16 17	+ 15	+ 8	+ 50	+ 49	+ 66	+ 66	+ 80	+ 88	+ 60	- 18	- 8	- 11	+ 36
17 17	- 13	- 34	- 19	- 1	+ 34	+ 36	+ 38	+ 30	- 8	- 44	- 20	- 13	- 1
18 17	+ 1	- 9	- 22	- 11	- 4	- 2	- 22	- 31	- 1	- 17	+ 3	+ 6	- 9
19 17	+ 14	+ 15	+ 10	+ 8	- 5	- 21	- 44	- 17	+ 17	0	+ 12	+ 16	0
20 17	+ 18	+ 19	+ 19	+ 29	+ 12	- 4	- 13	- 3	+ 30	+ 10	+ 14	+ 18	+ 12
21 17	+ 20	+ 15	+ 19	+ 37	+ 20	+ 6	- 4	+ 8	+ 33	+ 15	+ 21	+ 21	+ 18
22 17	+ 29	+ 28	+ 25	+ 47	+ 34	+ 22	+ 14	+ 23	+ 47	+ 36	+ 31	+ 26	+ 30
23 17	+ 24	+ 33	+ 32	+ 43	+ 34	+ 24	+ 16	+ 21	+ 52	+ 37	+ 27	+ 33	+ 31
Range ...	185	167	219	273	300	262	263	352	369	177	94	104	199
Average progressive increase per day.	+ 7	- 2	- 19	- 8	- 18	- 9	+ 6	+ 8	+ 4	0	- 3	0	- 3

Unity = ·1γ = ·000001 C. G. S.

1886. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 24	+ 19	+ 28	+ 50	+ 39	+ 33	+ 37	+ 39	+ 53	+ 35	+ 11	0	+ 31
1 17	+ 19	+ 17	+ 27	+ 48	+ 43	+ 25	+ 39	+ 41	+ 52	+ 35	+ 6	- 3	+ 28
2 17	+ 21	+ 8	+ 18	+ 42	+ 40	+ 21	+ 36	+ 41	+ 49	+ 26	+ 3	- 9	+ 25
3 17	+ 14	- 5	+ 11	+ 37	+ 34	+ 14	+ 32	+ 34	+ 47	+ 23	- 10	- 15	+ 17
4 17	+ 10	- 3	+ 10	+ 33	+ 41	+ 20	+ 35	+ 40	+ 48	+ 17	- 13	- 16	+ 18
5 17	+ 5	- 10	+ 7	+ 44	+ 74	+ 44	+ 58	+ 65	+ 58	+ 22	- 12	- 22	+ 27
6 17	+ 4	- 11	+ 29	+101	+110	+ 96	+110	+118	+115	+ 52	- 25	- 29	+ 55
7 17	+ 21	+ 12	+ 42	+ 62	+ 54	+ 78	+ 71	+ 67	+ 75	+ 61	- 12	- 21	+ 41
8 17	+ 64	+ 53	+ 12	- 34	- 52	+ 9	- 18	- 46	- 50	- 4	- 7	+ 25	- 5
9 17	+ 61	+ 61	- 46	- 114	- 159	- 79	- 98	- 150	- 163	- 87	- 26	+ 30	- 65
10 17	- 16	+ 24	- 61	- 157	- 177	- 115	- 131	- 175	- 198	- 131	- 32	+ 30	- 94
11 17	- 79	- 3	- 88	- 164	- 157	- 1.4	- 125	- 161	- 213	- 152	- 10	+ 17	- 105
12 17	- 63	- 3	- 62	- 115	- 104	- 109	- 101	- 117	- 157	- 92	+ 41	+ 18	- 71
13 17	- 47	- 26	- 14	- 51	- 28	45	- 54	- 45	- 48	- 9	+ 54	+ 17	- 25
14 17	- 45	- 43	+ 37	+ 6	+ 35	+ 6	- 8	+ 19	+ 47	+ 41	+ 29	+ 6	+ 12
15 17	- 43	- 52	+ 46	+ 45	+ 59	+ 35	+ 15	+ 58	+ 75	+ 50	+ 1	- 4	+ 24
16 17	- 22	- 34	+ 4	+ 42	+ 53	+ 32	+ 25	+ 67	+ 58	+ 16	- 6	+ 7	+ 19
17 17	- 22	- 28	- 34	+ 1	+ 21	+ 25	+ 20	+ 36	+ 6	- 22	- 15	- 7	- 2
18 17	- 4	- 14	- 27	- 14	- 10	+ 3	- 3	- 11	- 3	- 5	- 1	- 9	- 8
19 17	+ 13	- 2	- 5	+ 4	- 10	- 16	- 23	- 5	+ 10	+ 8	- 5	- 6	- 3
20 17	+ 14	+ 2	+ 2	+ 16	+ 11	- 1	- 3	+ 5	+ 22	+ 18	- 2	- 9	+ 6
21 17	+ 17	+ 3	+ 9	+ 30	+ 18	+ 8	+ 13	+ 18	+ 33	+ 23	+ 4	- 9	+ 14
22 17	+ 26	+ 12	+ 23	+ 42	+ 34	+ 22	+ 26	+ 29	+ 40	+ 33	+ 11	- 1	+ 25
23 17	+ 25	+ 18	+ 30	+ 48	+ 38	+ 24	+ 34	+ 34	+ 43	+ 36	+ 12	+ 8	+ 29
Range ...	143	113	134	265	287	230	241	293	328	213	86	59	160
Average progressive increase per day.	+ 19	0	- 10	- 4	- 3	+ 1	- 3	- 3	+ 1	+ 2	- 2	- 4	0

TABLES 231 & 232.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1887 and 1888 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1887. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 24	+ 16	+ 33	+ 50	+ 41	+ 45	+ 40	+ 31	+ 43	+ 33	+ 23	+ 16	+ 33
1 17	+ 22	+ 15	+ 24	+ 41	+ 40	+ 44	+ 39	+ 31	+ 44	+ 28	+ 13	+ 9	+ 28
2 17	+ 17	+ 6	+ 14	+ 37	+ 39	+ 39	+ 39	+ 36	+ 44	+ 23	+ 5	+ 2	+ 25
3 17	+ 9	− 2	+ 8	+ 27	+ 35	+ 37	+ 32	+ 34	+ 43	+ 17	− 4	− 5	+ 19
4 17	+ 8	− 7	0	+ 21	+ 40	+ 39	+ 40	+ 44	+ 51	+ 14	− 6	− 7	+ 20
5 17	+ 3	− 13	− 1	+ 27	+ 66	+ 70	+ 71	+ 78	+ 71	+ 17	− 9	− 11	+ 30
6 17	+ 7	− 12	+ 21	+ 75	+ 100	+ 107	+ 118	+ 132	+ 133	+ 39	− 31	− 25	+ 55
7 17	+ 30	− 12	+ 46	+ 47	+ 31	+ 74	+ 82	+ 72	+ 77	+ 50	− 4	− 14	+ 39
8 17	+ 73	+ 10	+ 12	− 43	− 92	− 18	− 7	− 60	− 99	− 11	+ 4	+ 33	− 17
9 17	+ 38	− 12	− 67	− 142	− 210	− 122	− 120	− 179	− 229	− 96	− 20	+ 42	− 94
10 17	− 73	− 25	− 110	− 181	− 211	− 183	− 179	− 203	− 250	− 142	− 46	+ 17	− 131
11 17	− 121	− 54	− 139	− 187	− 162	− 203	− 202	− 188	− 235	− 147	− 33	− 5	− 139
12 17	− 85	− 24	− 89	− 126	− 107	− 155	− 154	− 114	− 136	− 62	+ 33	+ 5	− 84
13 17	− 41	+ 11	− 2	− 27	− 10	− 71	− 70	− 29	− 10	+ 11	+ 45	− 19	− 18
14 17	− 26	+ 27	+ 70	+ 43	+ 62	+ 4	+ 6	+ 40	+ 88	+ 52	+ 13	− 46	+ 29
15 17	− 7	+ 26	+ 72	+ 75	+ 84	+ 42	+ 58	+ 86	+ 119	+ 61	− 10	− 42	+ 47
16 17	+ 13	+ 5	+ 20	+ 63	+ 85	+ 57	+ 70	+ 92	+ 87	+ 23	− 15	− 3	+ 41
17 17	+ 4	− 23	− 27	+ 21	+ 42	+ 43	+ 37	+ 47	+ 14	− 24	− 20	− 6	+ 9
18 17	+ 10	− 2	− 12	0	− 6	+ 14	− 3	− 25	− 4	− 4	− 3	+ 1	− 3
19 17	+ 13	+ 7	+ 12	+ 19	+ 9	+ 7	− 15	− 9	+ 17	+ 4	− 1	+ 2	+ 5
20 17	+ 14	+ 11	+ 22	+ 34	+ 23	+ 19	+ 15	+ 10	+ 24	+ 16	+ 1	+ 9	+ 16
21 17	+ 16	+ 10	+ 25	+ 40	+ 29	+ 30	+ 24	+ 16	+ 30	+ 25	+ 12	+ 9	+ 22
22 17	+ 24	+ 20	+ 34	+ 45	+ 40	+ 41	+ 31	+ 25	+ 37	+ 34	+ 26	+ 14	+ 31
23 17	+ 27	+ 24	+ 33	+ 46	+ 39	+ 43	+ 33	+ 31	+ 39	+ 37	+ 24	+ 23	+ 33
Range ...	194	81	211	262	311	310	320	335	383	208	91	88	194
Average progressive increase per day.	− 1	0	− 20	− 9	− 9	+ 2	+ 5	+ 2	+ 3	− 10	+ 3	+ 3	− 3

Unity = ·1γ = ·000001 C. G. S.

1888. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 28	+ 29	+ 33	+ 54	+ 37	+ 45	+ 42	+ 41	+ 52	+ 33	+ 13	+ 12	+ 35
1 17	+ 21	+ 27	+ 24	+ 45	+ 39	+ 43	+ 39	+ 37	+ 47	+ 27	+ 10	+ 6	+ 29
2 17	+ 10	+ 22	+ 22	+ 42	+ 35	+ 44	+ 37	+ 39	+ 44	+ 22	+ 4	+ 4	+ 27
3 17	+ 7	+ 10	+ 13	+ 35	+ 29	+ 30	+ 35	+ 33	+ 38	+ 12	− 4	− 4	+ 19
4 17	+ 5	+ 11	+ 13	+ 28	+ 36	+ 39	+ 39	+ 41	+ 40	+ 11	− 10	− 6	+ 21
5 17	− 2	+ 6	+ 8	+ 35	+ 56	+ 67	+ 65	+ 66	+ 54	+ 16	− 11	− 12	+ 29
6 17	0	+ 12	+ 19	+ 95	+ 85	+ 99	+ 102	+ 121	+ 126	+ 37	− 28	− 24	+ 53
7 17	+ 11	+ 10	+ 52	+ 59	+ 38	+ 67	+ 72	+ 69	+ 101	+ 56	− 12	− 19	+ 41
8 17	+ 60	− 6	+ 23	− 48	− 59	− 22	− 3	− 54	− 35	− 10	− 6	+ 23	− 12
9 17	+ 9	− 52	− 33	− 164	− 170	− 121	− 106	− 176	− 180	− 105	− 33	+ 13	− 94
10 17	− 108	− 87	− 58	− 204	− 179	− 152	− 170	− 208	− 249	− 141	− 48	− 8	− 134
11 17	− 116	− 97	− 113	− 193	− 152	− 175	− 194	− 195	− 250	− 149	− 34	− 31	− 141
12 17	− 44	− 33	− 127	− 134	− 100	− 150	− 146	− 131	− 145	− 72	+ 25	− 16	− 89
13 17	− 9	+ 24	− 63	− 45	− 11	− 63	− 66	− 43	− 25	+ 14	+ 56	+ 5	− 19
14 17	+ 3	+ 46	+ 39	+ 52	+ 52	− 8	− 6	+ 38	+ 63	+ 61	+ 49	+ 12	+ 34
15 17	+ 28	+ 47	+ 68	+ 89	+ 62	+ 29	+ 44	+ 80	+ 93	+ 66	+ 23	0	+ 53
16 17	+ 26	+ 19	+ 31	+ 72	+ 59	+ 42	+ 60	+ 89	+ 73	+ 27	− 5	− 3	+ 40
17 17	− 15	− 24	− 17	+ 26	+ 27	+ 29	+ 43	+ 51	+ 11	− 18	− 14	− 9	+ 7
18 17	+ 4	− 12	− 13	+ 3	+ 2	+ 10	0	− 7	+ 3	+ 1	− 2	− 2	− 1
19 17	+ 8	− 5	− 5	+ 6	− 2	+ 13	− 9	+ 3	+ 12	+ 7	− 4	+ 6	+ 2
20 17	+ 11	+ 1	+ 8	+ 19	+ 18	+ 23	+ 13	+ 16	+ 22	+ 14	− 2	+ 3	+ 12
21 17	+ 14	+ 6	+ 17	+ 31	+ 24	+ 30	+ 23	+ 23	+ 26	+ 20	+ 2	+ 5	+ 19
22 17	+ 24	+ 21	+ 25	+ 47	+ 38	+ 42	+ 35	+ 33	+ 36	+ 35	+ 14	+ 15	+ 30
23 17	+ 26	+ 28	+ 33	+ 51	+ 42	+ 39	+ 38	+ 37	+ 43	+ 35	+ 15	+ 23	+ 34
Range ...	176	144	195	299	264	274	296	329	376	215	104	54	194
Average progressive increase per day.	− 4	+ 1	− 8	− 9	− 7	− 1	+ 5	+ 2	+ 2	− 3	− 4	+ 11	− 1

TABLES 233 & 234.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1889 and 1890 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1889. Bombay Civil Time. H. m.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 20	+ 16	+ 33	+ 51	+ 34	+ 28	+ 37	+ 26	+ 47	+ 46	+ 23	+ 25	+ 32
1 17	+ 17	+ 18	+ 27	+ 46	+ 32	+ 28	+ 32	+ 29	+ 49	+ 39	+ 18	+ 18	+ 28
2 17	+ 13	+ 10	+ 16	+ 43	+ 25	+ 27	+ 31	+ 28	+ 43	+ 41	+ 13	+ 13	+ 25
3 17	+ 1	+ 6	+ 12	+ 36	+ 23	+ 20	+ 31	+ 24	+ 41	+ 31	+ 2	+ 10	+ 19
4 17	− 1	4	+ 12	+ 30	+ 27	+ 26	+ 33	+ 32	+ 43	+ 30	0	+ 8	+ 20
5 17	− 3	− 8	+ 12	+ 40	+ 56	+ 53	+ 56	+ 59	+ 60	+ 33	+ 4	+ 9	+ 30
6 17	6	− 7	+ 23	+ 93	+ **95**	+ **78**	+ **95**	+**114**	+**121**	+ 63	− 17	0	+ **54**
7 17	+ 10	+ 2	+ 31	+ 65	+ 53	+ 43	+ 74	+ 73	+ 89	+ **70**	+ 8	+ 15	+ 43
8 17	+ **50**	+ 9	− 10	− 43	− 60	− 27	+ 2	− 39	− 54	− 4	+ 20	+ **50**	− 10
9 17	+ 17	− 35	− 75	− 163	− 164	− 103	− 73	− 152	− 184	− 108	− 21	+ 2	− 89
10 17	− 73	− 69	− 94	− 222	−**175**	− 121	− 128	−**160**	−**212**	− 165	− **56**	− 66	− 128
11 17	−**105**	− **91**	− **127**	−**231**	− 162	−**140**	−**153**	− 153	− 208	−**175**	− 44	− **80**	−**138**
12 17	− 59	− 42	− 108	− 163	110	− 110	− 116	− 100	− 146	− 97	+ 12	− 31	− 88
13 17	− 17	+ 15	− 37	− 58	− 30	− 39	− 53	− 31	− 41	− 6	+ 22	− 13	− 24
14 17	+ 10	+ 46	+ 48	+ 36	+ 49	+ 28	0	+ 26	+ 53	+ 47	+ 9	− 17	+ 29
15 17	+ 27	+ **53**	+ **80**	+ 93	+ 80	+ 56	+ 28	+ 63	+ 84	+ 38	− 4	− 3	+ 50
16 17	+ 17	+ 35	+ 45	+ **94**	+ 75	+ 50	+ 31	+ 76	+ 67	+ 7	− 6	+ 9	+ 41
17 17	− 11	− 10	− 4	+ 45	+ 33	+ 23	+ 13	+ 45	+ 8	− 22	− 23	− 7	+ 7
18 17	+ 5	− 2	− 6	+ 9	+ 2	− 1	− 5	− 9	+ 2	− 10	− 13	− 3	− 2
19 17	+ 9	+ 7	+ 10	+ 21	+ 7	0	− 17	− 10	+ 9	+ 1	− 2	0	+ 3
20 17	+ 16	+ 7	+ 17	+ 33	+ 20	+ 6	+ 1	+ 1	+ 23	+ 21	+ 1	+ 5	+ 13
21 17	+ 15	+ 7	+ 27	+ 45	+ 25	+ 17	+ 13	+ 10	+ 29	+ 28	+ 4	+ 7	+ 19
22 17	+ 24	+ 16	+ 34	+ 52	+ 38	+ 29	+ 28	+ 23	+ 37	+ 42	+ 21	+ 18	+ 30
23 17	+ 23	+ 19	+ 32	+ 51	+ 35	+ 28	+ 30	+ 22	+ 42	+ 46	+ **26**	+ 28	+ 32
Range ...	155	144	207	325	270	218	248	274	333	245	82	130	192
Average progressive increase per day.	+ 5	− 2	− 6	− 5	− 4	− 1	+ 5	+ 3	− 3	− 1	+ 4	0	0

Unity = ·1γ = ·000001 C. G. S.

1890. Bombay Civil Time. H. m.	MONTH. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 23	+ 25	+ 37	+ 35	+ 33	+ 36	+ 25	+ 38	+ 61	+ 40	+ 14	+ 16	+ 32
1 17	+ 21	+ 23	+ 34	+ 33	+ 33	+ 30	+ 28	+ 39	+ 60	+ 37	+ 12	+ 10	+ 29
2 17	+ 17	+ 19	+ 26	+ 28	+ 29	+ 28	+ 29	+ 47	+ 60	+ 38	+ 10	+ 8	+ 28
3 17	+ 7	+ 9	+ 24	+ 24	+ 29	+ 25	+ 29	+ 47	+ 56	+ 29	+ 2	+ 5	+ 23
4 17	+ **4**	+ 2	+ 16	+ 22	+ 34	+ 34	+ 38	+ 54	+ 61	+ 29	+ 5	+ 5	+ 25
5 17	− 2	− 4	+ 20	+ 34	+ 66	+ 60	+ 67	+ 84	+ 80	+ 32	+ 3	+ 4	+ 37
6 17	− 5	− 6	+ 27	+ **80**	+ **99**	+ **85**	+**100**	+**133**	+**140**	+ 51	− 15	− 7	+ **56**
7 17	+ 5	+ 7	+ **42**	+ 47	+ 44	+ 55	+ 59	+ 79	+ 88	+ 54	+ 17	+ 6	+ 41
8 17	+ **53**	+ **39**	+ 9	− 50	− 55	− 20	− 20	− 48	− 55	− 14	+ 32	+ **51**	− 7
9 17	+ 39	+ 23	− 48	− 127	− 147	− 100	− 99	− 165	− 179	− 107	− 3	+ 39	− 74
10 17	− 65	− 24	− 89	−**175**	−**157**	− 127	−**151**	−**217**	−**254**	−**166**	− **45**	− 25	− 123
11 17	− **91**	− **78**	−**114**	− 159	− 133	−**153**	− 140	− 182	− 251	− 163	− 42	− **64**	−**130**
12 17	− 33	− 73	− 93	− 93	− 88	− 105	− 95	− 117	− 171	− 70	+ 14	− 30	− 79
13 17	− 17	− 27	− 32	− 3	− 16	− 42	− 36	− 32	− 53	+ 13	+ **40**	− 11	− 18
14 17	− 26	− 12	+ 27	+ 55	+ 38	+ 11	+ 19	+ 35	+ 56	+ **65**	+ 13	− 17	+ 23
15 17	− 12	− 5	+ 36	+ 76	+ 62	+ 44	+ 57	+ 71	+ 91	+ 61	− 3	− 15	+ 39
16 17	+ 8	+ 10	+ 8	+ 64	+ 52	+ 44	+ 60	+ 68	+ 65	+ 14	− 15	− 5	+ 30
17 17	− 4	− 1	− 20	+ 21	+ 12	+ 20	+ 22	+ 24	− 7	− 33	− 28	− 12	− 1
18 17	+ 1	+ 1	− 6	− 7	− 17	− 13	− 10	− 24	− 11	− 11	− 15	− 6	− 10
19 17	+ 4	+ 6	0	− 3	− 7	− 7	− 28	− 14	+ 4	− 1	− 13	− 1	− 5
20 17	+ 12	+ 9	+ 11	+ 12	+ 7	+ 8	− 8	− 1	+ 21	+ 10	− 10	+ 2	+ 6
21 17	+ 15	+ 8	+ 18	+ 21	+ 19	+ 19	− 3	+ 11	+ 36	+ 19	− 1	+ 7	+ 14
22 17	+ 22	+ 22	+ 32	+ 31	+ 33	+ 37	+ 19	+ 27	+ 48	+ 35	+ 15	+ 17	+ 28
23 17	+ 23	+ 26	+ 38	+ 34	+ 33	+ 34	+ 21	+ 33	+ 53	+ 36	+ 14	+ 22	+ 31
Range ...	144	117	156	255	256	238	251	350	394	231	85	115	186
Average progressive increase per day.	− 2	+ 1	− 1	− 15	− 20	− 6	+ 16	− 3	+ 1	− 1	+ 2	+ 4	− 2

TABLES 235 & 236.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1891 and 1892 and for the whole years.*

Unity = 1γ = ·000001 C. G. S.

1891. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 26	+ 17	+ 43	+ 53	+ 51	+ 32	+ 28	+ 37	+ 53	+ 44	+ 26	+ 27	+ 36
1 17	+ 26	+ 21	+ 42	+ 49	+ 49	+ 31	+ 30	+ 41	+ 54	+ 44	+ 23	+ 25	+ 35
2 17	+ 22	+ 15	+ 34	+ 46	+ 45	+ 32	+ 32	+ 43	+ 53	+ 43	+ 19	+ 27	+ 34
3 17	+ 15	+ 11	+ 27	+ 37	+ 38	+ 27	+ 31	+ 43	+ 57	+ 36	+ 13	+ 24	+ 29
4 17	+ 15	+ 14	+ 26	+ 35	+ 45	+ 38	+ 39	+ 53	+ 66	+ 34	+ 12	+ 22	+ 33
5 17	+ 15	+ 11	+ 34	+ 42	+ 80	+ 79	+ 74	+ 82	+ 87	+ 43	+ 11	+ 21	+ 48
6 17	+ 17	+ 13	+ 60	+ **99**	+ **111**	+ **116**	+ **121**	+ **139**	+ **154**	+ **75**	− 6	+ 9	+ **75**
7 17	+ 43	+ 12	+ **71**	+ 66	+ 62	+ 75	+ 90	+ 89	+ 88	+ 75	+ 33	+ 24	+ 60
8 17	+ **98**	+ 22	+ 22	− 32	− 41	− 26	+ 14	− 38	− 61	− 5	+ **45**	+ **64**	+ 4
9 17	+ 50	− 9	− 61	− 133	− 166	− 125	− 76	− 152	− 192	− 115	+ 10	+ 31	− 79
10 17	− 126	− 60	− 139	180	− **220**	− 165	− 141	− **196**	− **258**	− 182	− **59**	− 41	− 146
11 17	− **151**	− 8[illegible]	− **172**	− **184**	− 198	− **172**	− **167**	− 188	− 250	− **196**	− 54	− 49	− **154**
12 17	− 97	− 20	− 152	− 131	− 131	− 122	− 134	− 129	− 142	− 109	− 10	− 25	− 99
13 17	− 51	+ 32	− 50	− 48	− 44	− 44	− 63	− 50	− 16	− 10	+ 8	− 11	− 29
14 17	− 27	+ **37**	+ 42	+ 22	+ 26	+ 13	− 5	+ 12	+ 74	+ 46	− 3	− 32	+ 18
15 17	+ 2	+ 15	+ 55	+ 50	+ 58	+ 53	+ 37	+ 44	+ 95	+ 48	− 16	− **52**	+ 33
16 17	+ 16	− 17	+ 17	+ 49	+ 66	+ 60	+ 44	+ 57	+ 66	+ 9	− 37	− 42	+ 23
17 17	− 5	− 42	− 23	+ 10	+ 29	+ 31	+ 24	+ 35	− 10	− 33	43	− 41	− 6
18 17	+ 7	− 21	− 15	− 12	+ 2	− 6	− 7	− 11	− 25	+ 4	− 13	− 18	− 9
19 17	+ 15	− 7	+ 2	+ 4	+ 1	− 13	− 28	− 3	− 1	+ 16	− 6	− 9	3
20 17	+ 18	+ 1	+ 17	+ 23	+ 17	+ 6	− 4	+ 11	+ 14	+ 15	− 7	− 6	+ 9
21 17	+ 24	+ 3	+ 29	+ 35	+ 30	+ 19	+ 9	+ 18	+ 23	+ 24	− 1	+ 2	+ 18
22 17	+ 27	+ 15	+ 49	+ 50	+ 49	+ 33	+ 22	+ 26	+ 34	+ 45	+ 25	+ 15	+ 33
23 17	+ 26	+ 20	+ 46	+ 49	+ 47	+ 29	+ 21	+ 31	+ 37	+ 46	+ 28	+ 29	+ 34
Range ...	249	117	243	283	331	288	288	335	412	271	104	116	229
Average progressive increase per day.	+ 10	0	− 14	− 15	− 15	− 1	+ 8	− 1	+ 1	− 14	+ 10	+ 7	− 2

Unity = 1γ = ·000001 C. G. S.

1892. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 34	+ 38	+ 41	+ 44	+ 37	+ 43	+ 39	+ 52	+ 61	+ 54	+ 2[illegible]	+ 17	+ 41
1 17	+ 32	+ 40	+ 32	+ 45	+ 39	+ 44	+ 47	+ 55	+ 65	+ 51	+ 2[illegible]	+ 17	+ 40
2 17	+ 29	+ 32	+ 24	+ 34	+ 40	+ 40	+ 45	+ 61	+ 64	+ 55	+ 3[illegible]	+ 16	+ 39
3 17	+ 20	+ 27	+ 20	+ 33	+ 40	+ 40	+ 38	+ 59	+ 63	+ 49	+ 2[illegible]	+ 12	+ 35
4 17	+ 17	+ 27	+ 21	+ 31	+ 48	+ 52	+ 54	+ 72	+ 75	+ 52	+ 3[illegible]	+ 6	+ 40
5 17	+ 21	+ 31	+ 29	+ 47	+ 68	+ 84	+ 85	+ 112	+ 103	+ 64	+ 3[illegible]	+ 11	+ 57
6 17	+ 30	+ 31	+ 47	+ **100**	+ **107**	+ **119**	+ **143**	+ **178**	+ **175**	+ **109**	+ 18	+ 1	+ **88**
7 17	+ 54	+ 57	+ **70**	+ 75	+ 35	+ 72	+ 91	+ 91	+ 113	+ 98	+ 5[illegible]	+ 14	+ 67
8 17	+ **88**	+ **60**	+ 38	− 31	− 72	− 19	− 17	− 74	− 45	+ 3	+ **5[illegible]**	+ **50**	+ 3
9 17	+ 32	− 7	− 53	− 143	− **174**	− 112	− 108	− 191	− 169	− 104	+ 1[illegible]	+ 19	− 84
10 17	− 104	− 108	− 119	− 177	− 171	− 153	− 175	− **246**	− 237	− 185	− 6[illegible]	− 10	− 145
11 17	− **159**	− **136**	− **146**	− **183**	− 166	− **181**	− **187**	− 215	− **251**	− **211**	− **7[illegible]**	− 10	− **159**
12 17	− 75	− 69	− 108	− 118	− 101	− 143	− 148	− 147	− 172	− 124	− 2[illegible]	+ 13	− 100
13 17	− 15	− 3	− 26	− 16	− 6	− 75	− 72	− 55	− 49	− 33	− [illegible]	− 2	− 30
14 17	− 7	+ 17	+ 50	+ 54	+ 58	− 10	− 11	+ 28	+ 52	+ 24	− 2[illegible]	− 23	+ 18
15 17	+ 6	+ 15	+ 49	+ 71	+ 74	+ 27	+ 32	+ 73	+ 70	+ 24	− 3[illegible]	− 33	+ 32
16 17	− 3	− 23	− 1	+ 46	+ 64	+ 47	+ 50	+ 72	+ 41	− 5	− 3[illegible]	− 29	+ 18
17 17	− 46	− 60	− 41	+ 5	+ 24	+ 37	+ 42	+ 27	− 34	− 56	− 5[illegible]	− **44**	− 17
18 17	− 15	− 33	− 34	− 21	− 9	+ 4	+ 5	− 30	− 34	− 8	− 18	− 19	− 17
19 17	+ 1	− 1	+ 2	− 6	− 27	− 15	− 27	− 15	− 5	+ 12	− 8	− 15	− 9
20 17	+ 3	0	+ 13	+ 11	+ 1	+ 8	− 8	+ 2	+ 10	+ 14	− 1[illegible]	− 17	+ 2
21 17	+ 9	+ 7	+ 18	+ 24	+ 21	+ 22	+ 13	+ 17	+ 14	+ 18	− 9	− 10	+ 12
22 17	+ 26	+ 28	+ 36	+ 35	+ 32	+ 36	+ 24	+ 35	+ 39	+ 45	+ 1[illegible]	+ 8	+ 30
23 17	+ 26	+ 34	+ 41	+ 38	+ 35	+ 35	+ 32	+ 40	+ 48	+ 52	+ 2[illegible]	+ 23	+ 36
Range ...	247	106	216	283	281	300	330	424	426	320	13[illegible]	94	247
Average progressive increase per day.	+ 4	− 2	− 21	− 30	− 6	+ 4	+ 5	+ 8	+ 5	+ 2	+ 6	+ 5	− 2

TABLES 237 & 238.—*Vertical Force Magnetograph No. 1—showing the mean Diurnal Inequalities for each month of the years 1893 and 1894 and for the whole years.*

Unity = ·1γ = ·000001 C. G. S.

1893. Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 29	+ 26	+ 46	+ 46	+ 44	+ 38	+ 35	+ 51	+ 66	+ 54	+ 38	+ 36	+ 42
1 17	+ 32	+ 31	+ 41	+ 43	+ 43	+ 39	+ 38	+ 57	+ 70	+ 52	+ 34	+ 30	+ 41
2 17	+ 27	+ 28	+ 35	+ 37	+ 39	+ 36	+ 36	+ 60	+ 68	+ 48	+ 29	+ 25	+ 39
3 17	+ 27	+ 20	+ 30	+ 30	+ 40	+ 38	+ 41	+ 53	+ 65	+ 40	+ 19	+ 13	+ 34
4 17	+ 24	+ 22	+ 33	+ 32	+ 46	+ 50	+ 53	+ 62	+ 73	+ 41	+ 21	+ 6	+ 38
5 17	+ 25	+ 24	+ 43	+ 49	+ 80	+ 92	+ 85	+ 100	+ 95	+ 51	+ 16	− 2	+ 54
6 17	+ 30	+ 39	+ 70	+ 114	+ 133	+ 149	+ 142	+ 179	+ 168	+ 94	0	− 21	+ 91
7 17	+ 41	+ 51	+ 84	+ 85	+ 78	+ 104	+ 83	+ 115	+ 112	+ 78	+ 31	− 23	+ 69
8 17	+ 67	+ 39	+ 34	− 3	− 36	0	− 13	− 40	− 46	− 3	+ 37	+ 32	+ 5
9 17	− 4	− 15	− 55	− 91	− 155	− 116	− 115	− 163	− 184	− 102	+ 7	+ 39	− 81
10 17	− 141	− 74	− 113	− 141	− 209	− 196	− 172	− 206	− 257	− 184	− 51	+ 5	− 144
11 17	− 156	− 104	− 165	− 167	− 214	− 20	− 16	− 216	− 282	− 190	− 52	− 16	− 16
12 17	− 55	− 49	− 146	− 120	− 156	− 142	− 122	− 170	− 181	− 107	− 6	− 11	− 10
13 17	+ 16	+ 27	− 54	− 43	− 50	− 64	− 68	− 92	− 53	− 13	− 4	− 9	− 3
14 17	+ 36	+ 46	+ 29	+ 17	+ 38	+ 3	− 7	− 11	+ 52	+ 37	− 25	− 36	+ 10
15 17	+ 38	+ 30	+ 36	+ 42	+ 84	+ 50	+ 36	+ 44	+ 87	+ 37	− 42	− 57	+ 32
16 17	− 3	− 11	1	+ 27	+ 78	+ 63	+ 57	+ 73	+ 56	− 15	− 47	− 32	+ 20
17 17	− 51	− 71	− 37	− 19	+ 36	+ 30	+ 40	+ 47	− 17	− 63	− 59	− 34	− 10
18 17	− 47	− 54	− 25	− 34	− 7	− 14	+ 1	− 14	− 21	− 4	− 4	− 13	− 20
19 17	+ 2	− 13	+ 12	− 5	− 17	− 30	− 35	− 15	+ 3	+ 16	+ 3	− 1	− 7
20 17	0	− 12	+ 15	+ 13	+ 8	− 1	− 6	+ 2	+ 9	+ 11	− 4	+ 2	+ [illegible]
21 17	+ 5	− 11	+ 13	+ 16	+ 22	+ 15	+ 6	+ 14	+ 22	+ 20	+ 1	+ 5	+ 11
22 17	+ 20	+ 10	+ 33	+ 34	+ 35	+ 26	+ 20	+ 31	+ 39	+ 45	+ 26	+ 20	+ 28
23 17	+ 26	+ 22	+ 44	+ 39	+ 40	+ 37	+ 25	+ 39	+ 55	+ 53	+ 34	+ 42	+ 38
Range ...	225	155	249	281	347	351	314	395	450	284	97	99	251
Average progressive increase per day.	+ 5	− 6	− 21	− 24	− 12	+ 6	+ 5	− 3	− 5	− 1	+ 4	+ 9	− 4

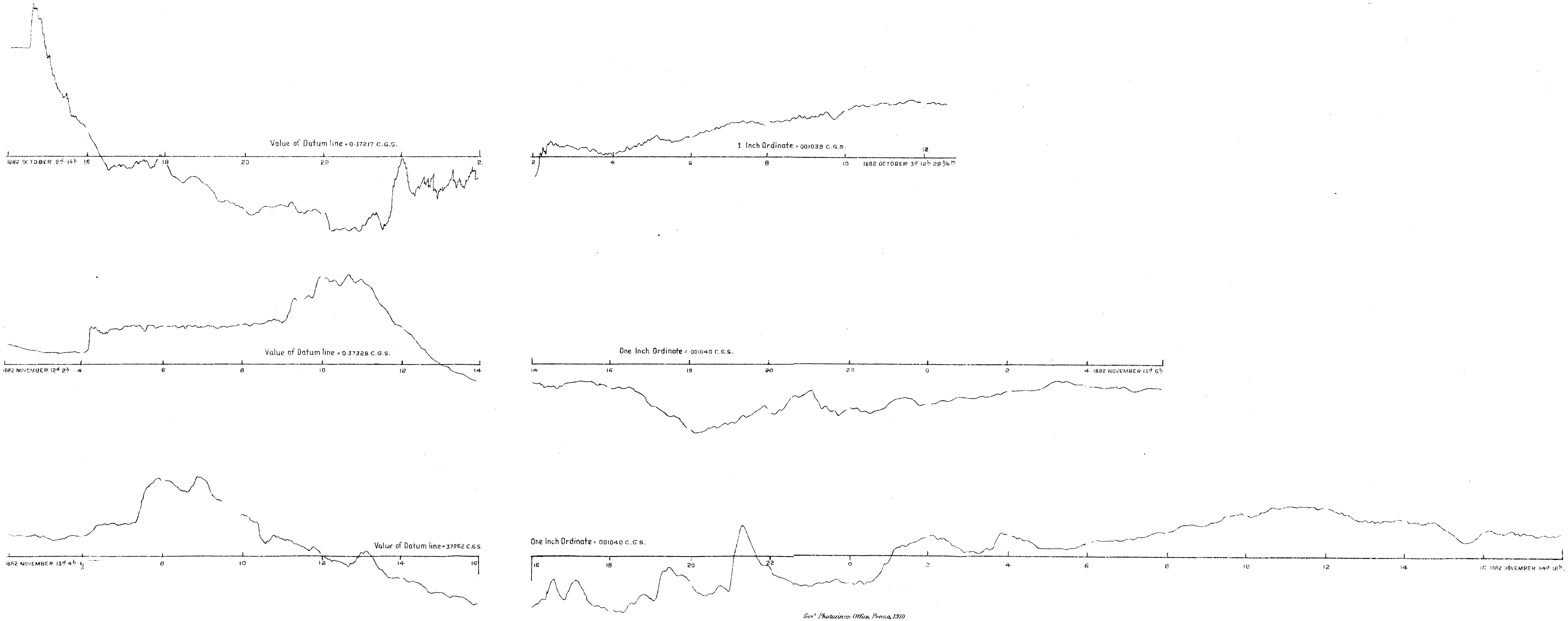
Unity = ·1γ = ·000001 C. G. S.

1894.* Bombay Civil Time. H. m.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
0 17	+ 33	+ 27	+ 45	+ 40	+ 34	+ 34	+ 41	+ 45	+ 71	+ 52	+ 29	+ 26	+ 38
1 17	+ 34	+ 5	+ 43	+ 40	+ 31	+ 33	+ 40	+ 47	+ 74	+ 50	+ 24	+ 27	+ 36
2 17	+ 33	+ 19	+ 43	+ 28	+ 28	+ 37	+ 46	+ 49	+ 70	+ 53	+ 31	+ 26	+ 38
3 17	+ 18	+ 2	+ 29	+ 20	+ 24	+ 39	+ 47	+ 54	+ 69	+ 40	+ 16	+ 20	+ 32
4 17	+ 5	− 7	+ 26	+ 20	+ 33	+ 54	+ 64	+ 62	+ 72	+ 42	+ 17	+ 29	+ 35
5 17	+ 3	− 5	+ 28	+ 33	+ 58	+ 83	+ 93	+ 90	+ 94	+ 50	+ 21	+ 27	+ 48
6 17	+ 9	− 4	+ 52	+ 94	+ 124	+ 127	+ 138	+ 155	+ 159	+ 82	+ 13	+ 25	+ 81
7 17	+ 21	+ 5	+ 68	+ 77	+ 86	+ 98	+ 74	+ 100	+ 92	+ 74	+ 25	+ 28	+ 62
8 17	+ 80	+ 18	+ 28	− 10	− 8	+ 24	− 36	− 27	− 79	− 6	+ 15	+ 69	+ 5
9 17	+ 96	+ 23	− 45	− 102	− 126	− 80	− 127	− 149	− 210	− 104	− 21	+ 66	− 67
10 17	+ 1	− 14	− 139	− 144	− 175	− 162	− 172	− 188	− 274	− 193	− 65	+ 2	− 128
11 17	− 84	− 43	− 187	− 163	− 152	− 190	− 165	− 166	− 278	− 188	− 58	− 70	− 144
12 17	− 47	− 11	− 140	− 118	− 107	− 151	− 113	− 118	− 197	− 82	+ 1	− 66	− 97
13 17	− 26	+ 28	− 48	− 43	− 32	− 72	− 41	− 59	− 66	+ 18	+ 30	− 54	− 32
14 17	− 50	+ 30	+ 42	+ 23	+ 17	− 9	+ 10	+ 2	+ 39	+ 75	+ 15	− 62	+ 10
15 17	− 57	− 8	+ 55	+ 55	+ 53	+ 37	+ 35	+ 28	+ 79	+ 50	− 17	− 52	+ 20
16 17	− 50	− 40	+ 14	+ 50	+ 53	+ 49	+ 34	+ 46	+ 62	− 16	− 44	− 29	+ 10
17 17	− 50	− 61	− 26	+ 10	+ 21	+ 37	+ 18	+ 18	+ 8	− 66	− 55	− 46	− 17
18 17	− 22	− 33	− 24	− 13	− 13	− 5	− 11	− 29	+ 7	− 24	− 11	− 19	− 17
19 17	+ 9	+ 4	+ 14	− 5	− 24	− 28	− 39	− 27	+ 23	+ 4	− 5	− 7	− 8
20 17	+ 9	+ 11	+ 20	+ 18	− 3	− 5	− 4	− 8	+ 34	+ 2	− 7	− 6	+ 4
21 17	+ 2	+ 6	+ 20	+ 27	+ 9	+ 10	+ 9	+ 9	+ 36	+ 9	− 5	+ 5	+ 11
22 17	+ 15	+ 19	+ 31	+ 32	+ 25	+ 19	+ 28	+ 25	+ 55	+ 39	+ 16	+ 21	+ [illegible]
23 17	+ 25	+ 36	+ 46	+ 40	+ 29	+ 29	+ 35	+ 35	+ 65	+ 47	+ 25	+ 29	+ 3[illegible]
Range ...	180	97	255	257	299	317	310	343	437	275	96	139	225
Average progressive increase per day.	+ 5	− 5	− 11	− 14	− 13	− 2	+ 9	+ 7	+ 4	+ 7	+ 6	+ 4	0

* The inequalities for 1894 have been derived by the direct application of formula referred to in paragraph 291.

PRINCIPAL MAGNETIC DISTURBANCES, HORIZONTAL FORCE, BOMBAY.

Plate 81.



Govt. Photozinco. Office, Poona, 1910

Plate 81 A.

PRINCIPAL MAGNETIC DISTURBANCES, HORIZONTAL FORCE, BOMBAY.

Govt. Photozinc. Office, Poona, 1910.

Principal Magnetic Disturbances, Horizontal Force, Bombay.

Principal Magnetic Disturbances, Horizontal Force, Bombay.

Plate 81 C.

Govt. Photozinco. Office, Poona, 1910.

PRINCIPAL MAGNETIC DISTURBANCES, HORIZONTAL FORCE, BOMBAY.

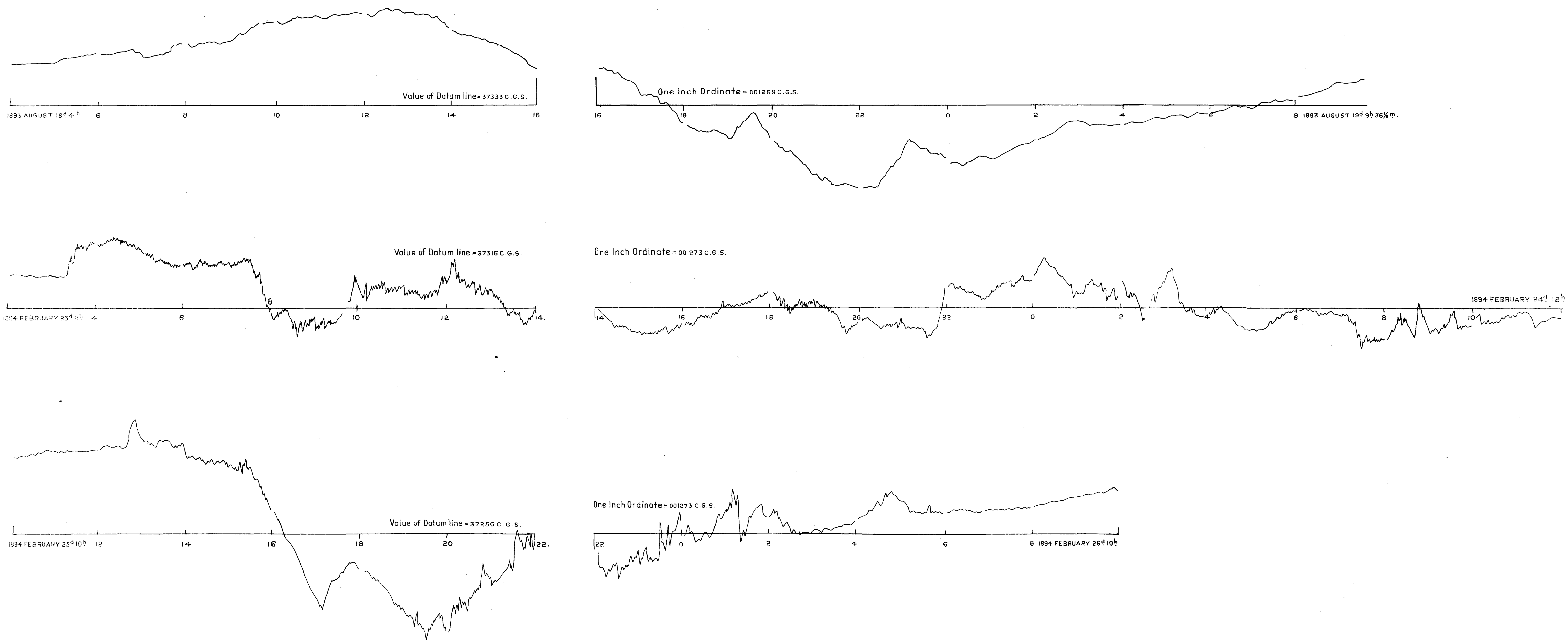
Govt. Photozinco. Office, Poona, 1910.

Principal Magnetic Disturbances, Horizontal Force, Bombay.

Plate 81 E.

Govt Photozinco Office, Poona, 1910.

Principal Magnetic Disturbances, Horizontal Force, Bombay.



Govt. Photozinco. Office, Poona, 19..

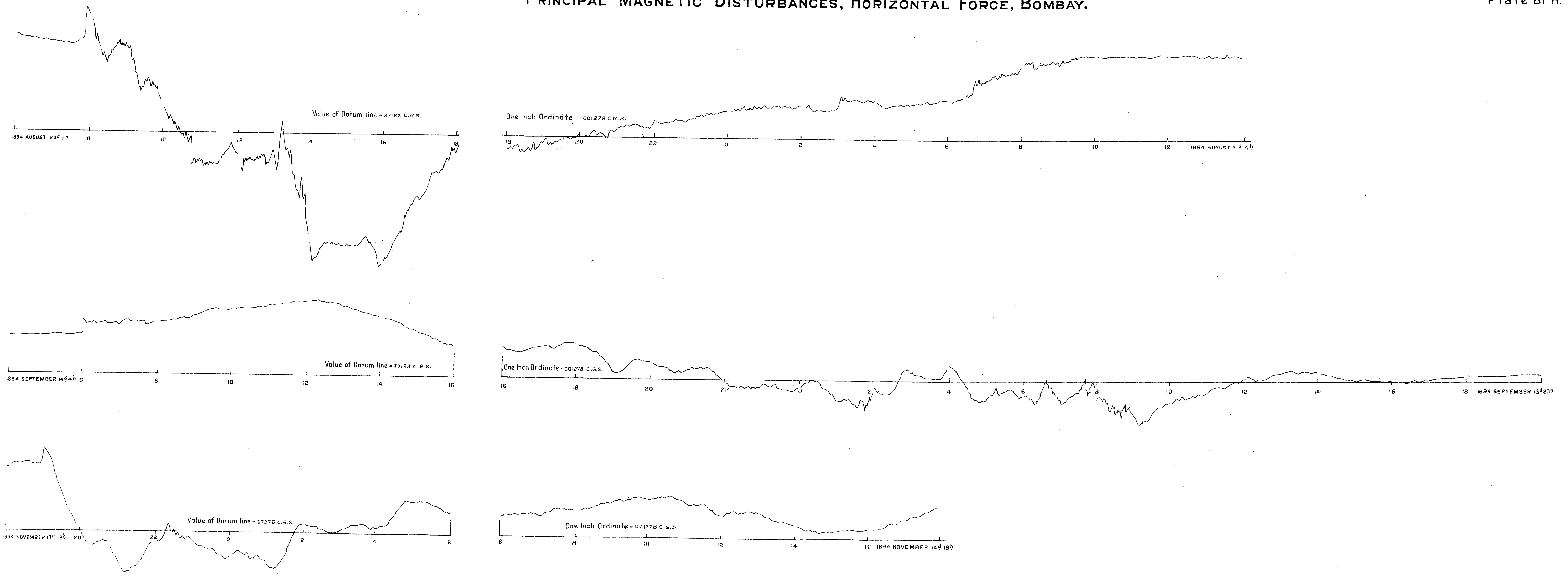
Principal Magnetic Disturbances, Horizontal Force, Bombay.

Plate 81 G.

Govt Photozinco Office, Poona 1910.

Principal Magnetic Disturbances, Horizontal Force, Bombay.

Plate 81 H.



Govt. Photozinco Office Poona 1919

PRINCIPAL MAGNETIC DISTURBANCES, HORIZONTAL FORCE, BOMBAY.

Govt. Photozinco Office, Poona, 1910

Principal Magnetic Disturbances, Horizontal Force, Bombay.

Govt. Photozinco. Office, Poona. 1910