

GENERAL RESULTS  
OF THE  
OBSERVATIONS  
IN  
MAGNETISM AND METEOROLOGY,  
MADE AT  
MAKERSTOUN IN SCOTLAND,  
IN THE OBSERVATORY OF  
GENERAL SIR THOMAS MAKDOUGALL BRISBANE, BART.,  
G.C.B., G.C.H., D.C.L., LL.D., F.R.S., F.R.A.S., H.M.R.I.A., PRESIDENT OF THE ROYAL SOCIETY OF EDINBURGH,  
AND CORRESPONDING MEMBER OF THE INSTITUTE OF FRANCE,  
WITH DETAILED TABLES OF RESULTS  
FOR THE YEARS 1845 AND 1846.

FORMING VOL. IX. PART II. OF THE TRANSACTIONS OF THE ROYAL SOCIETY OF EDINBURGH.

By JOHN ALLAN BROUN, Esq.,  
DIRECTOR OF THE OBSERVATORY.

EDINBURGH:  
PRINTED BY NEILL AND COMPANY.

---

MDCCCL.

## TABLE OF CONTENTS.

	NO.	PAGE
<b>GENERAL RESULTS OF THE MAKERSTOUN OBSERVATIONS—</b>		
System of Observation in different years, .....	2	xi
 <b>MAGNETIC DECLINATION—</b>		
Mean Declination and Secular Change, .....	4	xii
<i>Annual Variations—</i>		
Mean Declination, .....	7	xii
Difference of Daily Means from the Monthly Means, .....	11	xiv
Diurnal Ranges, .....	12	xv
Ranges of the Monthly Mean Diurnal Variation, .....	13	xvi
Effect of Disturbance on the Range of the Diurnal Variation, .....	15	xvi
Mean Difference of an Observation from the Monthly Mean, .....	16	xvii
Number of Positive Differences, .....	17	xviii
Probable Error of an Observation from the Monthly Mean, .....	20	xviii
<i>Monthly Variations—</i>		
Mean Declination, .....	21	xix
Diurnal Ranges, .....	22	xix
Mean Difference of an Observation from the Monthly Mean, .....	24	xix
<i>Diurnal Variations—</i>		
Method of combining Results for Different Years, .....	26	xx
Results from all the Observations, for each Month, .....	28	xxi
Results from all the Observations, for Groups of Months, .....	32	xxii
Results from Undisturbed Days, for Groups of Months, .....	36	xxiii
Effect of Disturbance on the Mean for a Month and for the Year, .....	38	xxiv
Effect of Disturbance on the Mean for each Hour, .....	39	xxiv
Frequency of the Positive and Negative Excursions from the Hourly Mean Position, .....	40	xxv
Sums of Disturbances from the Hourly Mean Position, .....	42	xxvi
Mean Excursions of the Magnet from the Monthly Mean Position for each Hour, .....	43	xxvii
Probable Error of an Observation from the Monthly Mean, .....	46	xxviii
Variations with reference to the Moon's Hour-Angle, .....	47	xxix

	NO.	PAGE
<b>HORIZONTAL COMPONENT OF MAGNETIC FORCE—</b>		
Horizontal Component in Absolute Measure, .....	48	xxx
Secular Change from Observations of Absolute Measure, .....	49	xxx
Mean Values of the Variations of the Horizontal Component .....	51	xxxii
Comparison of the Secular Change from Observations of Absolute Measure with that from Observations of the Bifilar Magnetometer, .....	53	xxxii
Effect of Disturbance on the Mean Value, .....	54	xxxii
Secular change employed in Deducing the Annual Variations, .....	55	xxxii
<i>Annual Variations—</i>		
Mean Horizontal Component, .....	56	xxxii
Foot-note on the Annual Period Deduced from the Observations at Toronto and Munich, .....		xxxii
Effect of Disturbance on the Monthly Means, .....	57	xxxiii
Mean Horizontal Component from Undisturbed Days, .....	58	xxxiii
Differences of the Daily Means from the Monthly Means, .....	59	xxxiv
Diurnal Ranges, .....	60	xxxv
Ranges of the Monthly Mean Diurnal Variation, from all the Observations and from Selected Days, .....	61	xxxv
Mean Difference of an Observation from the Monthly Mean, .....	63	xxxv
Probable Error of an Observation of the Horizontal Component, .....	64	xxxvi
Number of Observations greater than the Monthly Mean, .....	65	xxxvi
<i>Monthly Variations—</i>		
Mean Horizontal Component, .....	66	xxxvi
Diurnal Ranges, .....	67	xxxvii
Mean Difference of an Observation from the Monthly Mean, .....	68	xxxvii
<i>Diurnal Variations—</i>		
Results from all the Observations, for each Month, .....	69	xxxviii
Results from all the Observations, for Groups of Months, .....	70	xxxix
Results from Undisturbed Observations, for Groups of Months, .....	71	xl
Effect of Disturbance on the Hourly Means, .....	72	xl
Frequency of Positive and Negative Departures from the Hourly Mean Positions, .....	74	xlii
Mean Difference of an Observation from the Hourly Mean Position for each Hour, .....	76	xlii
Probable Error of an Observation from the Monthly Mean, .....	78	xliv
Variations with reference to the Moon's Hour-Angle, .....	79	xliv
<b>VERTICAL COMPONENT OF MAGNETIC FORCE—</b>		
Vertical Component in Absolute Measure, .....	81	xlv
Adjustment of Balance Magnetometer in different Years, .....	82	xlv
Yearly Means of the Variations of the Vertical Component with the Secu- lar Change, .....	83	xlvi
Effect of Disturbance on the Yearly Mean, .....	85	xlvi

CONTENTS.

	NO.	PAGE
<i>Annual Variations—</i>		
Mean Vertical Component,.....	86	xlvi
Mean Change of the Vertical Component from Month to Month,.....	88	xlvii
Effect of Disturbances on the Monthly Means, .....	89	xlvii
Difference of the Daily Means from the Monthly Means, .....	90	xlvii
Diurnal Ranges, .....	91	xlviii
Ranges of the Monthly Mean Diurnal Variations from all the Observations, and from Selected Days, .....	92	xlix
General Law of the Ranges of the Undisturbed Mean Diurnal Variation,	93	xlix
Mean Difference of an Observation from the Monthly Mean,.....	94	xlix
Number of Observations greater than the Monthly Mean,.....	95	xlix
<i>Monthly Variations—</i>		
Mean Vertical Component, .....	96	l
Diurnal Ranges, .....	97	li
Mean Difference of an Observation from the Monthly Mean, .....	98	li
<i>Diurnal Variations—</i>		
Results from all the Observations, for each Month.....	99	li
Results from all the Observations, for Groups of Months,.....	100	liii
Results from Undisturbed Observations, for Groups of Months, .....	101	liii
Effect of Disturbance on the Hourly Means, .....	102	liv
Frequency of Positive and Negative Departures from the Hourly Mean Position, .....	104	lv
Mean Difference of an Observation from the Monthly Mean Position for each Hour, .....	105	lvi
Mean Difference from Undisturbed Mean Positions for each Hour, .....	108	lvi
Variations with reference to the Moon's Hour-Angle, .....	111	lvii
<b>MAGNETIC DIP—</b>		
Places of Observation for Different Epochs and General Remarks, .....	113	lviii
Observations in 1849 on Original Dip-Pillar, .....	114	lviii
Observations to determine Local Error, .....	115	lviii
Secular Change, .....	116	lviii
Result of Observations with Inclinometer in different Azimuths, .....	117	lix
Observations with the Inclinometer of the Royal Society of Edinburgh, ...	118	lix
<i>Variations of Magnetic Dip, deduced from the two Component Magnetometers—</i>		
Similarity between Results for Magnetic Dip and for Horizontal Com- ponent, .....	119	lix
Secular Change, .....	120	lix
Effect of Disturbance on the Yearly Mean, .....	121	lix
Annual Period, from all the Observations, .....	122	lix
Annual Period, from Undisturbed Observations, .....	123	lx
Annual Variation of Ranges of Monthly Mean Diurnal Variation, .....	124	lx
Variations of Magnetic Dip with the Moon's Age,.....	125	lx

	NO.	PAGE
Variations of Magnetic Dip with the Moon's Declination,.....	126	lx
Remarks on the Variations of Ranges of Magnetic Dip,.....	127	lx
<i>Diurnal Variations—</i>		
Results from all the Observations for each Month,.....	128	lxj
Results from all the Observations, for Groups of Months,.....	129	lxii
Results from Undisturbed Observations, for Groups of Months,.....	130	lxii
Effect of Disturbance on the Hourly Means,.....	131	lxiv
Variations with reference to the Moon's Hour-Angle.....	132	lxiv
<b>TOTAL MAGNETIC FORCE—</b>		
Absolute Value,.....	133	lxv
Secular Change,.....	134	lxv
Effect of Disturbance on the Yearly Mean Value,.....	135	lxv
Annual Period,.....	136	lxv
Effect of Disturbance on the Monthly Means,.....	137	lxv
Annual Variation of Ranges of Monthly Mean Diurnal Variation,.....	138	lxv
Variations with Reference to the Moon's Age,.....	139	lxv
Variations with reference to the Moon's Declination,.....	140	lxvi
Remark on the Variations of Ranges of Total Force,.....	141	lxvi
<i>Diurnal Variations—</i>		
Results from all the Observations, for each Month,.....	142	lxvii
Results from all the Observations, for Groups of Months,.....	143	lxvii
Results from Undisturbed Observations, for Groups of Months,.....	144	lxviii
Effect of Disturbance on the Hourly Means,.....	145	lxix
Variations with reference to the Moon's Hour-Angle,.....	146	lxx
<b>COMBINED MOTIONS OF THE MAGNETIC NEEDLE—</b>		
Process of Projection and General Remarks.....	147	lxx
Annual Motions,.....	148	lxx
Monthly Motions,.....	150	lxxi
Similarity of the Motions for the Positions of the Sun and Moon in De- clination.....	151	lxxi
Diurnal Motions,.....	153	lxxi
Foot-note on the Determination of the Epochs of Maximum and Minimum, Perimeters of the Figures of the Diurnal Motions for each Month,.....	156	lxxii
Perimeters of the Figures for Disturbed and Undisturbed Observations,...	157	lxxii
Mean Angular Motions from Hour to Hour,.....	158	lxxii
Diurnal Variation of Velocity of Diurnal Motion and Relation to that of Disturbance,.....	159	lxxiii
Variations in the Velocity of Motion not related to Variations of Tem- perature of the Air,.....	161	lxxiii
Relation of Points of Greatest and Least Velocity to the Astronomical Meridian,.....	162	lxxiii

CONTENTS.

ix

	NO.	PAGE
General Form and Turning Points of the Diurnal Motions,.....	163	lxxiii
Angular Distances between the Disturbed and Undisturbed Hourly Mean Positions, .....	165	lxxiii
Motions with reference to the Moon's Hour-Angle, .....	167	lxxv
 <b>AURORA BOREALIS—</b>		
List of Auroræ Boreales seen at Makerstoun in the years 1843–9,.....	169	lxxv
Additional Notes on Aurora Borealis seen in 1847–9,.....	170	lxxix
Diurnal Variations of Visible Frequency of the Aurora Borealis,.....	171	lxxxix
Annual Variation of Frequency of the Aurora Borealis,.....	172	lxxxix
Foot-note on Results of Mairan, Kämtz, and Hansteen,.....		lxxxix
Annual Variation from Auroræ Observed near Midnight,.....	172	lxxxix
Variation of Frequency of the Aurora Borealis with the Moon's Age,.....	173	lxxxix
Foot-note on the Preferability of Mean Latitudes for the Determination of the Laws of Frequency of the Aurora Borealis,.....		lxxxix
Note on the Theory of the Aurora Borealis,.....	175	lxxxix
 <b>METEOROLOGICAL RESULTS—</b>		
<i>Temperature of the Air—</i>		
Mean Temperature at Makerstoun, with Probable Error,.....	176	lxxxix
Annual Variation,.....	177	lxxxix
Probable Error of the Mean Temperature for any Month,.....	178	lxxxix
Annual Variation of the Diurnal Range of Temperature, and the Ranges of the Mean Diurnal Variations,.....	179	lxxxix
Differences of the Daily Mean Temperature from the Monthly Mean,.....	180	lxxxix
Diurnal Variation of Temperature,.....	182	lxxxix
 <i>Pressure of Aqueous Vapour—</i>		
Annual Variation,.....	183	lxxxix
Variations with Reference to the Moon's Age and Declination .....	184	lxxxix
Diurnal Variation,.....	185	lxxxix
 <i>Relative Humidity—</i>		
Annual Variation,.....	186	lxxxix
Variations with Reference to the Moon's Age and Declination,.....	187	lxxxix
Diurnal Variation,.....	188	xc
 <i>Atmospheric Pressure—</i>		
Mean Atmospheric Pressure at Makerstoun,.....	189	xc
Annual Variation, and Probable Error for each Month,.....	190	xc
Foot-note on the Differences of Mean Pressure at Greenwich and Makerstoun,.....		xc
Quarters giving greatest Range of Mean Pressure,.....	191	xc
Annual Variation of Differences of the Daily Mean from the Monthly Mean Pressures,.....	192	xcii

b

	NO.	PAGE
Annual Variation of the Diurnal Range of Atmospheric Pressure,.....	193	xcii
Variation of the Diurnal Range with the Moon's Age,.....	194	xciii
Variation of the Diurnal Range with the Moon's Declination,.....	195	xciii
Diurnal Variation of the Atmospheric Pressure,.....	196	xciv
Amount of Oscillation in the Diurnal Variation,.....	197	xcv
 <i>Pressure and Direction of the Wind—</i>		
Remark on the Observations from which Results are deduced,.....	198	xcv
Annual Variation of the Mean Pressure,.....	199	xcvi
Variation of Pressure with the Moon's Age,.....	200	xcvi
Variation of Pressure with the Moon's Declination,.....	201	xcvi
Diurnal Variation of the Mean Pressure,.....	202	xcvii
Annual Variation of the Number of Hours at which the Wind blew,.....	203	xcviii
Annual Variation of the Mean Pressure while blowing,.....	204	xcviii
Diurnal Variation of the Number of Hours at which the Wind blew,.....	205	xcviii
Diurnal Variation of the Mean Pressure while blowing,.....	206	xcviii
Yearly Mean Value and Direction of the Resultant Wind,.....	207	xcix
Annual Variation of the Pressure and Direction of the Resultant Winds,	208	xcix
Annual Variation of the Variability of the Wind,.....	209	c
Diurnal Variation of the Resultant Mean Pressure of the Wind,.....	210	c
Diurnal Variation of the Direction of the Resultant Wind,.....	211	c
Diurnal Variation of the Variability of the Wind,.....	212	ci
Times which the Wind blew from each Point of the Compass,.....	213	ci
Sums of the Pressures for each Point of the Compass,.....	214	cii
Mean Pressure while blowing for each Point of the Compass,.....	215	cii
 <i>Motions of different Currents of Air—</i>		
Processes adopted in obtaining the Results,.....	216	cii
Classification of Clouds and order of Reckoning of Motions,.....	217	cii
Explanation of Tabular Results, .....	218	cii
Combined Results for each Current, .....	220	ciii
Resultant Direction of each Current, .....	220	civ
Comparison of Mean Upper Current with the Surface Current, .....	221	civ
Comparison of Mean Highest Current with Surface Current,.....	222	civ
General Conclusions, .....	223	civ
 <i>Extent of Sky Clouded—</i>		
Mean Extent of Sky Clouded, .....	224	cv
Annual Variation,.....	225	cv
Variation with the Moon's Age, .....	226	cv
Foot-note on Statement by Sir John Herschel,.....		cvi
Variation with the Moon's Declination, .....	228	cvii
Diurnal Variation,.....	229	cvii
Ranges of the Diurnal Variation,.....	230	cviii

CONTENTS.

XI

	NO.	PAGE
<i>Quantity of Rain.</i>		
Factors for converting Garden-Gauge Results into Observatory-Gauge Results,.....	231	cviii
Mean Yearly Amount of Rain,.....	232	cviii
Greatest and Least Monthly Falls, .....	233	cviii
Annual Variation,.....	234	cix
Amount of Rain with reference to the Moon's Age,.....	235	cix

DETAILED TABLES OF MAGNETICAL RESULTS FOR 1845 AND 1846—

Magnetic Declination for 1845, .....	2
Horizontal Component of Magnetic Force for 1845, .....	11
Vertical Component of Magnetic Force for 1845,.....	18
Magnetic Dip for 1845,.....	24
Total Magnetic Force for 1845, .....	26
Daily Ranges of the Three Elements for 1845,.....	28
Magnetic Declination for 1846, .....	29
Horizontal Component of Magnetic Force for 1846,.....	32
Vertical Component of Magnetic Force for 1846,.....	35
Magnetic Dip for 1846,.....	38
Total Magnetic Force for 1846,.....	39
Daily Ranges of the Three Elements for 1846,.....	04

DETAILED TABLES OF METEOROLOGICAL RESULTS FOR 1845 AND 1846—

Dry Bulb Thermometer for 1845, .....	42
Wet Bulb Thermometer for 1845, .....	45
Pressure of Aqueous Vapour for 1845, .....	47
Relative Humidity for 1845, .....	49
Atmospheric Pressure for 1845, .....	51
Pressure and Direction of the Wind for 1845, .....	55
Motions of different Currents of Air for 1845, .....	65
Extent of Clouded Sky for 1845, .....	65
Quantity of Rain for 1845, .....	67
Dry Bulb Thermometer for 1846,.....	68
Wet Bulb Thermometer for 1846, .....	70
Pressure of Aqueous Vapour for 1846, .....	71
Relative Humidity for 1846,.....	72
Atmospheric Pressure for 1846, .....	74
Pressure and Direction of the Wind for 1846, .....	76
Motions of different Currents of Air for 1846, .....	85
Extent of Clouded Sky for 1846, .....	85
Quantity of Rain for 1846-9,.....	86



## CORRIGENDA IN THIS VOLUME OF GENERAL RESULTS.

Page xvi., Table 6, heading of last column, for mean read year

- 21, Table xxxviii., column "March" mean for 22<sup>h</sup>, for 448·5 read 548·5
- 22, Table xxxix., column "Winter" mean for 10<sup>h</sup>, for 0008 read 0036
- 33, Heading of page, for Magnetic Declination read Horizontal Component of Magnetic Force

---

## CORRIGENDA IN THE VOLUME OF OBSERVATIONS FOR 1845 AND 1846.

Page 111, column "Gött. Mean Time," for October 1<sup>d</sup> 5<sup>h</sup> read October 1<sup>d</sup> 17<sup>h</sup>

- 116, Dec. 3<sup>d</sup> 11<sup>h</sup> 40<sup>m</sup> Declination, for 25° 57'·51 read 24° 57'·51
- 153, Feb. 14<sup>d</sup> 18<sup>h</sup> wet Thermometer, for 33°·3 read 30°·3
- 153, Feb. 16<sup>d</sup> 18<sup>h</sup>, wet Thermometer, for 36°·5 read 35°·5
- 166, March 21<sup>d</sup> 9<sup>h</sup>, Diff., for 1°·4 read 2°·4
- 220, Aug. 14<sup>d</sup> 14<sup>h</sup>, dry Thermometer, for 56°·3 read 50°·3
- 245, Oct. 21<sup>d</sup> 13<sup>h</sup>, Barometer, for 29·045 read 30·045
- 312, 2d division, column "Gött. Mean Time," for 2<sup>d</sup> 2<sup>h</sup> 0<sup>m</sup> read 5<sup>d</sup> 2<sup>h</sup> 0<sup>m</sup>
- 312, column "Gött Mean Time," for Sept. 1<sup>d</sup> 23<sup>h</sup> 0<sup>m</sup> read 1<sup>d</sup> 22<sup>h</sup> 0<sup>m</sup>
- 340, first column, first line, for Nov. 17<sup>d</sup> 8<sup>h</sup> read Nov. 17<sup>d</sup> 6<sup>h</sup>
- 342, heading of page, for 1845 read 1846
- 343, last line, for Dec. 8<sup>d</sup> 9<sup>h</sup> 15<sup>m</sup> read Dec. 9<sup>d</sup> 9<sup>h</sup> 15<sup>m</sup>
- 380, June 12<sup>d</sup> 18<sup>h</sup>, Dry Thermometer, for 67°·0 read 57°·0

*Note.*—All the hourly observations of the bifilar magnetometer, from Dec. 4<sup>d</sup> 3<sup>h</sup> 1845 to the end of the year 1845, must be increased one scale division, the correction of  $-1$  scale division (see Introduction, 1845, No. 43) having been accidentally applied twice. All the other Observations were corrected aright, and daily, monthly, and other mean values, are unaffected by the error.

---

## CORRIGENDA IN THE VOLUME OF OBSERVATIONS FOR 1844.

Page 342, Table xi., transpose headings "Summer" and "Winter"

- 352, Table xix., first column opposite January, for 528 read 522
- 404, 3d line from bottom, for 36°·63 read 35°·63.
- 424, 2d line after Table xxiii., for Range = 6·774 in. read Range = 1·774 in.

---

## CORRIGENDA IN THE VOLUME OF OBSERVATIONS FOR 1843.

Page 61, 4th line from bottom, for April 7<sup>d</sup> 14<sup>h</sup> 0<sup>m</sup> read April 6<sup>d</sup> 14<sup>h</sup> 0<sup>m</sup>

- 241, last line, for 0·00003 read 0·000030
- 276, Table xv., mean for Jan. 31, for 28·316 read 29·316
- 276, Table xv., mean for June 3, for 26·189 read 29·189

MAKERSTOUN, *May* 1850.