and latitude 50° S., which was approximately our position at Observatory Bay, we obtain a secular variation of $-2'\cdot 3$. We may therefore fairly conclude that $-2'\cdot 5$ represents the annual change with considerable accuracy.

Passing from the dip to the total force we find 11·323 to be in British units the mean of three determinations from observations made on shore by H.M.S. 'Erebus' and 'Terror.' If, now, we apply the correction +0·1 for the change from Christmas Harbour to Royal Sound, the result is still somewhat less than the mean of the observations taken near the eastern extremity of Kerguelen during the epoch 1840–45. Adopting 11·423 as the mean value for 1842–45, and 11·143 for 1875, we obtain a secular diminution of 0·0086 in this element of terrestrial magnetism.

The annual increase of the declination will be $+7'\cdot 0$, if we take the approximate value of 32·0 W. from the map of Sir E. Sabine as representing the declination for the epoch 1842–45.

IV. "On the Variations of the Daily Range of the Magnetic Declination as recorded at the Kew Observatory." By BALFOUR STEWART, LL.D., F.R.S., Professor of Natural Philosophy at the Owens College, Manchester. Received February 28, 1877.

1. The daily range of the magnetic declination at any station may perhaps be regarded as a convenient representative of the magnetic activity of the place. For while a thorough discussion of the diurnal magnetic changes must embrace along with the declination the two components of the force, yet, as regards such daily ranges, the declination gives results which are not only more prominent but also more easily procurable and subject to fewer uncertainties than similar ones for the other two elements.

In estimating the daily range of the magnetic declination, as recorded at the Kew Observatory, I have excluded the disturbed observations, conceiving that by so doing a better indication of the true magnetical activity of the place would be obtained than by including them, inasmuch as they follow a very different set of laws from that of the well-known diurnal declination-range. The disturbed observations have been separated by the method of Sir E. Sabine, those being rejected as disturbed for which the measurements on the photographic curve are 0·150 inch either above or below the mean value for that month and hour, one inch denoting $22'\cdot 04$ of angular change. The daily ranges are here given in inches, and they denote the differences between the greatest and least values of each day's hourly tabulations from the curve, disturbances being excluded. I am indebted to the kindness of the Kew Committee for giving me the daily ranges herein discussed, extending from the beginning of 1858 to the end of 1873, thus embracing in all sixteen years' observations.

A. *Annual Variation of Declination-range.*

2. The following Table exhibits mean monthly results of the declination-range corresponding to 48 points in the year. It will afterwards be seen (art. 7) that the declination-range depends amongst other things on the relative position of the sun and moon, and hence to eliminate this inequality I have resorted to monthly means.

TABLE I.—Containing Monthly Means (48 to the year) of the Diurnal Declination-ranges, thus :—January (0) gives the Monthly Mean of which the Middle Date is the very commencement of the Year, January (1) that for one Week after the commencement, and so on.

Date.		1858–61.	1862–65.	1866–9.	1870–3.	Mean.
Jan.	(0)	·325	·320	·249	·352	·312
"	(1)	·334	·329	·265	·367	·323
"	(2)	·344	·348	·279	·389	·340
"	(3)	·356	·363	·313	·414	·362
Feb.	(0)	·389	·369	·347	·435	·385
"	(1)	·414	·371	·359	·458	·401
"	(2)	·438	·379	·378	·476	·418
"	(3)	·479	·389	·388	·496	·438
Mar.	(0)	·512	·418	·395	·545	·467
"	(1)	·554	·465	·425	·589	·508
"	(2)	·593	·504	·463	·634	·548
"	(3)	·635	·538	·499	·675	·587
April	(0)	·664	·554	·537	·704	·615
"	(1)	·689	·552	·556	·731	·632
"	(2)	·697	·547	·555	·755	·639
"	(3)	·664	·535	·545	·738	·620
May	(0)	·641	·526	·516	·713	·599
"	(1)	·605	·528	·504	·688	·581
"	(2)	·600	·532	·508	·652	·573
"	(3)	·619	·549	·516	·657	·586
June	(0)	·626	·568	·529	·663	·596
"	(1)	·637	·574	·538	·669	·605
"	(2)	·633	·582	·541	·685	·610
"	(3)	·614	·581	·539	·683	·604
July	(0)	·613	·566	·533	·692	·601
"	(1)	·606	·558	·533	·692	·597
"	(2)	·611	·547	·526	·678	·591
"	(3)	·612	·537	·528	·692	·593
Aug.	(0)	·611	·546	·538	·681	·594
"	(1)	·623	·551	·544	·684	·601
"	(2)	·635	·558	·550	·700	·611
"	(3)	·631	·562	·544	·686	·606
Sept.	(0)	·623	·547	·534	·671	·594

TABLE I. (*continued*).

Date.	1858–61.	1862–65.	1866–9.	1870–3.	Mean.
Sept. (1)	·609	·540	·514	·646	·577
,, (2)	·581	·523	·494	·621	·554
,, (3)	·559	·493	·481	·595	·532
Oct. (0)	·537	·483	·458	·573	·513
,, (1)	·522	·464	·445	·552	·496
,, (2)	·504	·448	·437	·522	·478
,, (3)	·486	·445	·418	·503	·463
Nov. (0)	·465	·427	·408	·480	·445
,, (1)	·420	·402	·389	·462	·418
,, (2)	·389	·376	·361	·430	·389
,, (3)	·363	·354	·333	·390	·360
Dec. (0)	·341	·337	·309	·371	·340
,, (1)	·341	·321	·279	·345	·322
,, (2)	·323	·311	·259	·339	·308
,, (3)	·325	·305	·254	·349	·308

3. It will be seen from Table I. that while there is a maximum of declination-range in June about the time of the summer solstice, there are also maxima in April and August, and that a behaviour of this kind is indicated in each four years' observations. Comparing this result with that embodying the annual variation of temperature-range at Kew (Proc. Roy. Soc. 1877, vol. xxv. p. 578), it will be seen that the latter variation has only one maximum in July. Perhaps there is a reference to the equinoxes as well as to the solstices in the annual variation of the declination-range. A comparison of the two is exhibited in Figs. IX., X., p. 120 (Fig. IX. giving declination- and Fig. X. temperature-ranges).

B. *Variations of Long Period.*

4. It is well known that the range of the magnetic declination has a long-period variation, apparently connected with the physical state of the sun's surface. In order to investigate the nature and closeness of this connexion the following plan has been adopted:—Let us assume as the most probable hypothesis that the cause which exalts or depresses the mean annual declination-range exalts or depresses also in a similar manner the variations of this from one month to another. This is what would take place if we could imagine the effect to be produced by some influence *emanating* from the sun, which acted more powerfully on some years than on others, while the variations of this effect due to the sun's position in the ecliptic were also altered in the same proportion. On the whole this is borne out by Table I. Constructing, now, a Table for each year, and for 48 points in each year, and reckoning the mean of the 16 years' ranges for each of these points (as exhibited in the last column of Table I.) equal to 1000, we find in Table II. a series of values exhibiting the proportion between the observed range for any point of any one year,

and the mean of the whole 16 years for the same point. For instance, the monthly value corresponding to Feb. (0) 1866 is ·3535, while the normal value for the whole 16 years for this point is (by Table I.) ·385, and hence the proportional value of the range for Feb. (0) 1866 is $1000 \times \frac{\cdot 3535}{\cdot 385} = 918$. By these means it is believed that the results of Table II. are freed from any recognized inequality, depending either on the month of the year or on the relative position of the sun and moon.

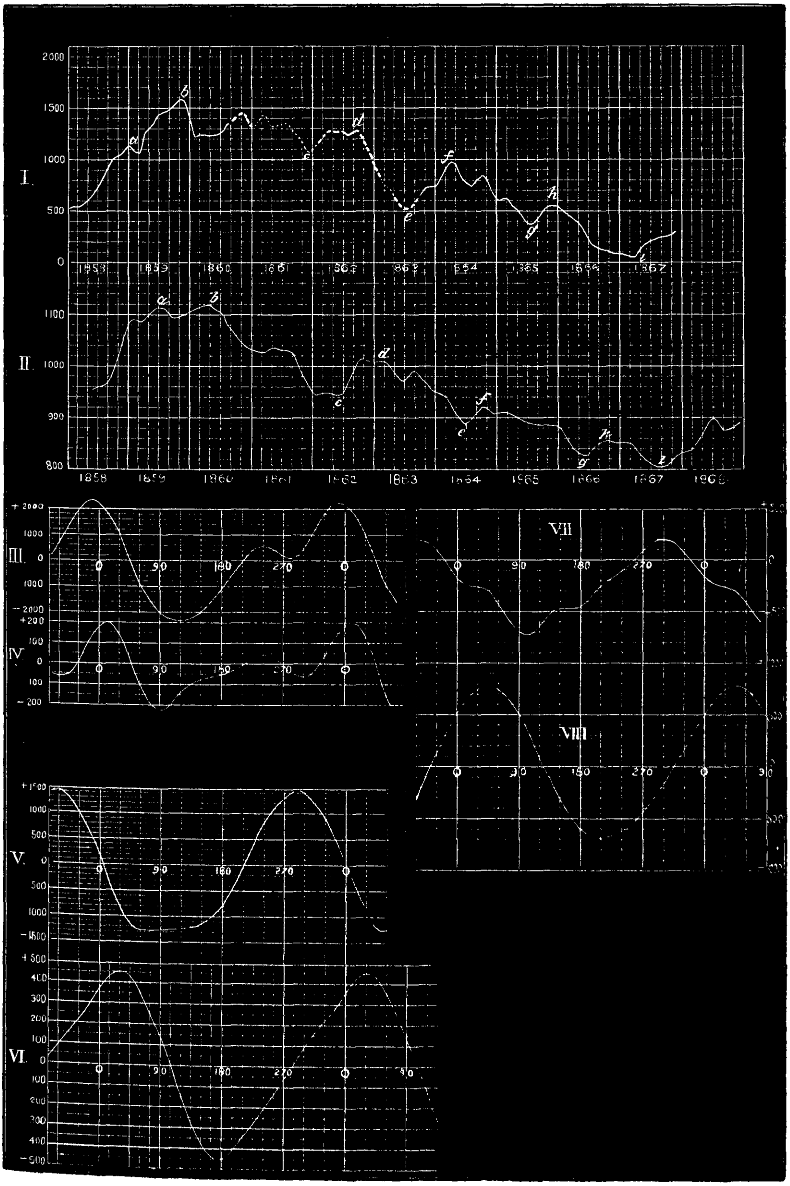


Table II.—Exhibiting Monthly Means of Declination-range (48 points to each year), the Mean Value of the Range for the whole Series for each point being reckoned = 1000.

		1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.
January	(0)........	—	1070	1140	970	1015	1127	979	991	887	921	709	676	913	1135	1155	1217
,,	(1)........	—	1018	1132	944	977	1120	1007	985	920	923	764	683	972	1142	1238	1203
,,	(2)........	913	986	1134	1017	956	1146	980	1011	925	852	793	710	1006	1089	1270	1212
,,	(3)........	924	1007	1011	1002	960	1143	903	1014	942	870	830	818	1011	1094	1280	1193
February	(0)........	966	1006	1044	1028	942	1048	921	923	918	871	881	931	1091	1059	1249	1122
,,	(1)........	1001	1061	1016	1053	935	1031	832	909	901	866	830	991	1143	1080	1203	1147
,,	(2)........	1010	1108	1037	1032	873	1003	805	948	888	882	836	1017	1154	1159	1149	1098
,,	(3)........	1034	1139	1140	1065	848	966	844	892	873	873	844	954	1156	1169	1094	1109
March	(0)........	1022	1147	1172	1040	825	928	876	949	816	836	813	915	1161	1256	1099	1145
,,	(1)........	1025	1149	1175	1013	830	948	943	936	793	817	845	891	1167	1256	1106	1103
,,	(2)........	1025	1161	1168	968	885	949	946	897	781	827	852	915	1173	1219	1104	1129
,,	(3)........	988	1185	1147	1011	907	936	924	898	806	791	867	938	1138	1216	1145	1102
April	(0)........	952	1228	1084	1059	881	972	876	879	847	765	932	946	1143	1198	1114	1126
,,	(1)........	940	1253	1090	1081	870	980	821	821	876	770	933	938	1162	1221	1109	1135
,,	(2)........	910	1259	1057	1138	855	958	801	810	841	752	957	930	1197	1284	1123	1128
,,	(3)........	889	1223	1056	1112	830	974	830	814	821	797	936	960	1230	1285	1134	1110
May	(0)........	896	1180	1101	1102	869	983	836	825	791	779	906	969	1262	1279	1175	1047
,,	(1)........	836	1135	1124	1068	869	1003	869	892	787	791	895	993	1261	1290	1178	1009
,,	(2)........	880	1091	1150	1063	906	1024	900	887	862	792	847	1046	1256	1186	1124	986
,,	(3)........	878	1113	1190	1052	951	1022	894	886	843	767	850	1064	1222	1211	1097	959
June	(0)........	886	1089	1184	1041	972	1024	917	894	875	773	844	1055	1180	1225	1096	947
,,	(1)........	902	1051	1189	1072	994	992	933	880	847	770	872	1072	1171	1187	1115	954
,,	(2)........	845	1078	1180	1047	1030	972	916	895	812	786	868	1081	1190	1221	1153	926
,,	(3)........	858	1053	1113	1040	1014	987	948	898	816	799	883	1073	1231	1209	1168	911

July (0)........	892	1083	1079	1027	1007	965	931	866	780	817	880	1071	1282	1196	1177	948
,, (1)........	911	1071	1059	1016	1016	947	920	856	810	815	849	1095	1318	1203	1168	947
,, (2)........	982	1042	1122	994	981	954	928	843	796	810	870	1085	1266	1194	1144	990
,, (3)........	949	1037	1141	1004	982	938	884	828	794	798	881	1093	1286	1203	1156	1026
August (0)........	930	1007	1168	1008	983	951	891	850	803	812	919	1090	1254	1209	1131	994
,, (1)........	919	1058	1164	1011	983	926	888	874	751	838	971	1064	1206	1258	1088	1001
,, (2)........	891	1104	1115	1050	985	912	883	872	770	852	956	1024	1228	1268	1111	977
,, (3)........	922	1084	1101	1062	998	914	892	904	774	867	929	1025	1218	1239	1075	998
September (0)........	956	1118	1048	1072	985	930	870	903	778	853	908	1057	1230	1244	1041	1007
,, (1)........	980	1129	1031	1081	1001	952	877	915	805	824	870	1060	1236	1163	1071	1004
,, (2)........	1014	1109	1027	1040	985	974	864	947	789	808	894	1071	1277	1118	1061	1021
,, (3)........	1069	1148	1005	981	959	961	839	948	819	801	929	1067	1237	1137	1098	1002
October (0)........	1052	1108	1074	954	960	951	871	984	834	788	918	1035	1225	1143	1117	985
,, (1)........	1097	1102	1072	938	937	963	885	960	835	795	948	1014	1228	1180	1073	974
,, (2)........	1124	1100	1070	925	953	946	916	936	839	820	971	1029	1170	1205	1070	926
,, (3)........	1096	1072	1085	944	984	1001	928	934	866	813	927	1004	1233	1174	1036	903
November (0)........	1074	1094	1046	967	996	1018	920	905	890	822	918	1036	1220	1137	1047	907
,, (1)........	1025	1060	1000	934	1026	1021	890	907	934	811	915	1058	1294	1125	1099	902
,, (2)........	1003	1007	988	1002	1038	1052	868	909	1000	827	885	997	1277	1137	1109	903
,, (3)........	939	1094	963	1039	1081	1076	872	900	981	795	906	1016	1204	1117	1150	865
December (0)........	966	1090	922	1042	1057	1095	937	881	955	791	908	986	1195	1172	1117	885
,, (1)........	1018	1147	999	1082	1041	1120	976	860	948	777	813	929	1069	1236	1115	871
,, (2)........	1010	1187	938	1057	1039	1147	1000	850	946	727	745	946	1124	1263	1149	874
,, (3)........	1054	1185	966	1008	1016	1081	1040	821	899	749	684	971	1164	1299	1140	

5. The numbers of Table II. require to be further dealt with before they can be made to furnish a curve, bringing out the long-period variation of the declination-range. Let us first take for this purpose, as well as for other objects to be afterwards mentioned, a series of values derived from the numbers of Table II., each representing the mean of 12 consecutive values of Table II. These may be termed three-monthly values. Thus, for instance, we have as follows :—

TABLE III.—Exhibiting the Method of obtaining Three-monthly Values.

Date, 1858.	Monthly Values for Table II.	Three-Monthly Values.	
Feb. (3)	1034		
		 983	
Mar. (0)	1022		.. 983
		 983	
„ (1)	1025		
		 980	
„ (2)	1025		.. 977
		 974	
„ (3)	988		
		 961	
Apr. (0)	952		.. 955
		 950	
„ (1)	940		

We have thus, in the last column of Table III., a series of three-monthly values corresponding to the beginning and middle points of each month. In the next place, by adding together a certain three of these values, we may obtain nine-monthly values. Thus the three-monthly value for March (0), as above, is 983, while that for June (0) is 885, and for Sept. (0) 986 ; the mean of these (being 951) is the nine-monthly value corresponding to June (0). Nine-monthly values have thus been obtained corresponding to the beginnings of each month; and finally, by adding these together, two and two, a series of nine-monthly values have been obtained corresponding to the middle points of each month. These are given in Table IV., and a curve exhibiting them is likewise given in Fig. II. attached to this paper. Again, the numbers given by Messrs. De La Rue, Stewart, and Loewy in their paper on "Solar Physics" (Phil. Trans. 1870, page 111), exhibiting the spotted area of the sun's visible hemisphere for the years for which we have Kew declination results, have been treated in a manner precisely similar to the above; that is to say, nine-monthly values corresponding to the middle of each month have been obtained. These values are given in Table V., and a curve exhibiting them is likewise given in Fig. I. (p. 105).

TABLE IV.—Declination-range, Nine-monthly Values.

	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.
Jan. (2)	...	1082	1109	1030	945	1008	945	909	879	851	832
Feb. (2)	...	1090	1113	1029	942	1009	942	910	867	850	837
Mar. (2)	...	1088	1116	1026	947	1006	934	907	850	844	846
April (2)	...	1094	1117	1030	946	996	916	902	837	832	859
May (2)	...	1105	1109	1036	941	983	895	898	829	820	876
June (2)	957	1112	1104	1032	942	971	887	894	826	811	891
July (2)	960	1112	1093	1029	956	976	890	890	832	804	898
Aug. (2)	962	1107	1075	1027	979	988	900	889	844	799	887
Sept. (2)	975	1095	1063	1016	1002	986	914	888	851	801	874
Oct. (2)	997	1092	1050	995	1013	974	921	888	854	807	878
Nov. (2)	1030	1097	1040	975	1010	962	918	888	852	816	885
Dec. (2)	1061	1102	1034	960	1007	952	911	884	851	827	

TABLE V.—Spotted Areas, Nine-monthly Values.

	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.
Jan. (2)	504	1122	1311	1343	1112	913	770	598	522	72
Feb. (2)	530	1086	1220	1400	1173	829	868	605	482	65
Mar. (2)	538	1107	1246	1426	1249	745	943	574	438	55
April (2)	595	1241	1240	1359	1266	698	982	510	410	86
May (2)	654	1316	1244	1313	1268	623	904	474	361	153
June (2)	706	1361	1254	1333	1285	560	803	415	283	194
July (2)	778	1446	1292	1352	1249	515	766	366	198	211
Aug. (2)	871	1462	1357	1316	1271	528	760	398	144	234
Sept. (2)	983	1485	1370	1265	1294	606	823	461	120	251
Oct. (2)	1030	1532	1402	1236	1231	671	830	513	100	262
Nov. (2)	1051	1563	1437	1150	1133	710	736	535	85	305
Dec. (2)	1100	1500	1378	1077	1005	715	643	537	78	

6. If we compare together Figs. I. and II. (p. 105), it will be seen that there are a good many points in the one curve which we are fairly entitled to identify with corresponding points in the other; of these, *b* and *i* represent the respective maximum and minimum points. There is, however, a fluctuation between *d* and *e* on the declination-curve that has no corresponding fluctuation on the sun-spot curve; while, on the other hand, there are a series of small fluctuations on the sun-spot curve between *b* and *c* which have no distinct analogues on the declination-curve. It will, however, be seen that both of these discordant regions are represented by dotted lines on the sun-spot curve; that is to say, they represent results derived either wholly or in part from Schwabe's eye-observations while the Kew photo-heliograph was not in action.

Again, it will be remarked that each of the corresponding points occurs later in point of time in the declination than in the sun-spot curve. Thus we have :—

	Date in Solar curve.	Date in Declination-curve.	Difference, in Months.
a.	Jan. 15, 1859	July 15, 1859	6
b.	Nov. 15, 1859	Apr. 15, 1860	5
c.	Dec. 15, 1861	June 0, 1862	5½ doubtful.
d.	Sept. 15, 1862	Mar. 0, 1863	5½
e.	Aug. 0, 1863	June 15, 1864	10½ doubtful.
f.	Apr. 15, 1864	Oct. 15, 1864	6
g.	July 15, 1865	June 0, 1866	10½
h.	Dec. 15, 1865	Oct. 15, 1866	10
i.	Mar. 15, 1867	Aug. 15, 1867	5

I shall return again to this subject at a future part of this paper.

C. *Lunar Annual Variation.*

7. For the purpose of discovering this variation the whole period of observation has been portioned out into lunations, beginning with new moon. Each lunation is divided into eight parts, entitled (0), (1), (2), (3), (4), (5), (6), (7); (0) denoting new, and (4) full moon.

These various lunations thus divided, with the corresponding values of the declination-range, are exhibited in Table VI., the values of which have been obtained by a method of treatment precisely similar to that adopted for the Kew temperature-ranges, and described in a previous paper (Proc. Roy. Soc. 1877, vol. xxv. p. 581).

TABLE VI.—Exhibiting the Declination-ranges grouped according to Lunations.

Running No.	Lunation commencing new moon.	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Jan. 15, 1858.	·287	·322	·296	·261	·317	·437	·417	·387
2.	Feb. 13, ,,	·504	·470	·383	·383	·473	·557	·519	·504
3.	Mar. 15, ,,	·565	·609	·591	·531	·550	·622	·628	·529
4.	Apr. 13, ,,	·558	·606	·636	·559	·542	·465	·520	·510
5.	May 13, ,,	·488	·412	·446	·561	·578	·544	·542	·487
6.	June 11, ,,	·561	·546	·536	·439	·426	·558	·563	·536
7.	July 10, ,,	·572	·616	·539	·568	·617	·615	·534	·462
8.	Aug. 9, ,,	·537	·570	·556	·541	·552	·582	·575	·500
9.	Sept. 7, ,,	·526	·633	·595	·531	·486	·537	·613	·602
10.	Oct. 7, ,,	·506	·499	·508	·539	·580	·524	·522	·480
11.	Nov. 5, ,,	·415	·362	·417	·404	·337	·382	·375	·276
12.	Dec. 5, ,,	·220	·289	·367	·367	·351	·374	·319	·286
13.	Jan. 4, 1859.	·289	·348	·364	·366	·387	·294	·293	·368
14.	Feb. 3, ,,	·387	·482	·471	·426	·479	·500	·493	·511
15.	Mar. 4, ,,	·555	·569	·624	·645	·664	·704	·676	·742
16.	Apr. 3, ,,	·742	·746	·867	·914	·894	·819	·766	·711
17.	May 2, ,,	·603	·613	·621	·655	·670	·640	·570	·622
18.	June 1, ,,	·736	·710	·667	·625	·607	·576	·647	·694
19.	June 30, ,,	·740	·662	·561	·656	·681	·537	·537	·599
20.	July 29, ,,	·646	·685	·599	·586	·638	·652	·697	·739
21.	Aug. 28, ,,	·753	·616	·547	·652	·646	·670	·631	·611

TABLE VI. (*continued*).

Running No.	Lunation commencing new moon.	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
22.	Sept. 26, 1859.	·603	·621	·558	·520	·472	·503	·548	·532
23.	Oct. 26, „	·549	·475	·413	·451	·464	·433	·392	·370
24.	Nov. 24, „	·340	·332	·388	·412	·386	·378	·345	·366
25.	Dec. 24, „	·317	·317	·402	·450	·365	·315	·347	·398
26.	Jan. 23, 1860.	·442	·403	·359	·342	·382	·467	·435	·445
27.	Feb. 21, „	·458	·461	·533	·590	·633	·709	·662	·594
28.	Mar. 22, „	·662	·661	·617	·720	·720	·643	·719	·716
29.	Apr. 21, „	·684	·625	·598	·597	·677	·660	·639	·688
30.	May 20, „	·687	·663	·624	·659	·788	·822	·690	·686
31.	June 19, „	·738	·684	·629	·573	·634	·652	·594	·546
32.	July 18, „	·617	·760	·772	·786	·738	·677	·613	·648
33.	Aug. 16, „	·700	·701	·668	·700	·697	·614	·492	·486
34.	Sept. 15, „	·504	·568	·620	·573	·521	·470	·518	·539
35.	Oct. 14, „	·586	·527	·483	·522	·509	·460	·446	·419
36.	Nov. 13, „	·400	·367	·319	·323	·380	·359	·272	·293
37.	Dec. 12, „	·274	·303	·353	·318	·244	·243	·321	·295
38.	Jan. 11, 1861.	·300	·297	·361	·395	·417	·390	·395	·362
39.	Feb. 9, „	·417	·418	·466	·511	·448	·452	·518	·511
40.	Mar. 11, „	·524	·511	·576	·468	·485	·670	·760	·781
41.	Apr. 10, „	·765	·703	·712	·709	·714	·683	·627	·639
42.	May 9, „	·638	·596	·557	·551	·586	·622	·632	·659
43.	June 8, „	·655	·634	·638	·668	·690	·584	·565	·617
44.	July 8, „	·637	·597	·563	·621	·604	·555	·559	·593
45.	Aug. 6, „	·684	·631	·565	·624	·671	·718	·644	·615
46.	Sept. 4, „	·653	·628	·569	·601	·599	·538	·449	·392
47.	Oct. 4, „	·436	·450	·425	·478	·526	·466	·394	·388
48.	Nov. 2, „	·374	·410	·439	·406	·405	·374	·386	·347
49.	Dec. 2, „	·354	·371	·343	·318	·330	·318	·281	·288
50,	Dec. 31, „	·335	·302	·252	·374	·345	·308	·328	·319
51,	Jan. 30, 1862.	·358	·370	·394	·408	·374	·374	·343	·275
52,	Feb. 28, „	·314	·412	·478	·473	·484	·512	·500	·525
53.	Mar. 30, „	·553	·588	·539	·480	·577	·548	·501	·484
54.	Apr. 28, „	·552	·498	·511	·522	·533	·497	·477	·553
55.	May 28, „	·579	·626	·622	·587	·631	·583	·568	·629
56.	June 27, „	·692	·637	·562	·558	·578	·635	·610	·537
57.	July 26, „	·576	·582	·557	·567	·558	·623	·623	·604
58.	Aug. 25, „	·646	·635	·588	·582	·522	·527	·519	·570
59.	Sept. 23, „	·578	·522	·450	·442	·407	·446	·492	·448
60.	Oct. 23, „	·445	·483	·460	·414	·448	·394	·395	·422
61.	Nov. 21, „	·390	·383	·377	·382	·370	·297	·292	·273
62.	Dec. 21, „	·305	·337	·314	·300	·388	·438	·429	·404
63.	Jan. 19, 1863.	·347	·321	·413	·434	·423	·454	·400	·345
64.	Feb. 18, „	·385	·430	·443	·446	·453	·459	·445	·497
65.	Mar. 19, „	·566	·600	·589	·608	·580	·552	·625	·654
66.	Apr. 18, „	·678	·630	·573	·547	·521	·580	·586	·615
67.	May 17, „	·663	·621	·612	·572	·606	·581	·566	·629
68.	June 16, „	·634	·595	·538	·575	·599	·610	·617	·573
69.	July 15, „	·549	·533	·492	·551	·590	·577	·584	·590
70.	Aug. 14, „	·580	·454	·474	·538	·578	·561	·569	·581
71.	Sept. 13, „	·590	·538	·502	·515	·497	·487	·448	·451
72.	Oct. 12, „	·497	·469	·467	·480	·418	·455	·478	·457
73.	Nov. 11, „	·443	·411	·376	·340	·321	·355	·418	·430
74.	Dec. 10, „	·422	·340	·314	·341	·298	·327	·319	·317
75.	Jan. 9, 1864.	·265	·278	·374	·380	·332	·358	·323	·300
76.	Feb. 7, „	·325	·371	·382	·297	·293	·360	·406	·427
77.	Mar. 8, „	·528	·550	·534	·576	·589	·516	·477	·516

TABLE VI. (*continued*).

Running No.	Lunation commencing new moon.	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
78.	Apr. 6, 1864.	·587	·557	·500	·468	·518	·478	·507	·536
79.	May 6, „	·523	·491	·469	·479	·504	·548	·520	·571
80.	June 4, „	·572	·598	·563	·557	·584	·556	·505	·540
81.	July 4, „	·628	·583	·523	·510	·553	·522	·486	·494
82.	Aug. 2, „	·497	·544	·526	·567	·600	·548	·520	·546
83.	Sept. 1, „	·531	·542	·471	·433	·452	·519	·456	·407
84.	Sept. 30, „	·439	·406	·436	·422	·443	·483	·490	·441
85.	Oct. 30, „	·403	·369	·346	·368	·385	·370	·296	·275
86.	Nov. 29, „	·269	·286	·311	·341	·366	·315	·325	·309
87.	Dec. 28, „	·247	·212	·329	·387	·326	·303	·357	·335
88.	Jan. 27, 1865.	·364	·348	·384	·424	·314	·358	·390	·425
89.	Feb. 25, „	·484	·470	·400	·408	·513	·531	·515	·550
90.	Mar. 27, „	·559	·533	·531	·564	·561	·476	·414	·485
91.	Apr. 25, „	·563	·556	·509	·442	·523	·539	·526	·521
92.	May 24, „	·512	·493	·492	·535	·559	·588	·565	·499
93.	June 23, „	·543	·552	·539	·514	·479	·495	·478	·489
94.	July 22, „	·530	·504	·492	·473	·542	·553	·539	·567
95.	Aug. 21, „	·568	·509	·529	·502	·557	·548	·500	·520
96.	Sept. 19, „	·528	·513	·516	·480	·463	·486	·496	·454
97.	Oct. 19, „	·423	·443	·409	·387	·376	·440	·393	·356
98.	Nov. 18, „	·303	·346	·310	·295	·305	·285	·277	·224
99.	Dec. 18, „	·230	·244	·243	·274	·263	·234	·317	·376
100.	Jan. 16, 1866.	·329	·308	·315	·332	·313	·333	·378	·426
101.	Feb. 15, „	·399	·346	·349	·372	·359	·399	·471	·410
102.	Mar. 16, „	·395	·415	·460	·450	·528	·580	·579	·614
103.	Apr. 15, „	·638	·569	·490	·396	·437	·498	·382	·435
104.	May 14, „	·516	·538	·507	·511	·515	·474	·482	·547
105.	June 12, „	·606	·560	·455	·442	·505	·463	·429	·434
106.	July 12, „	·498	·543	·519	·477	·445	·444	·438	·488
107.	Aug. 10, „	·503	·473	·427	·449	·489	·479	·480	·452
108.	Sept. 9, „	·477	·453	·440	·402	·428	·416	·372	·447
109.	Oct. 8, „	·472	·460	·445	·365	·334	·332	·353	·442
110.	Nov. 7, „	·448	·427	·389	·349	·296	·309	·388	·314
111.	Dec. 7, „	·296	·305	·324	·319	·219	·233	·289	·217
112.	Jan. 6, 1867.	·309	·349	·358	·343	·288	·238	·241	·294
113.	Feb. 4, „	·346	·419	·442	·395	·356	·311	·358	·397
114.	Mar. 6, „	·400	·477	·500	·443	·447	·466	·487	·496
115.	Apr. 4, „	·446	·395	·483	·534	·547	·477	·472	·515
116.	May 4, „	·503	·429	·385	·400	·514	·443	·384	·503
117.	June 2, „	·508	·468	·396	·469	·521	·507	·509	·465
118.	July 1, „	·508	·512	·430	·473	·481	·500	·455	·457
119.	July 31, „	·504	·486	·470	·519	·547	·583	·550	·528
120.	Aug. 29, „	·543	·493	·484	·431	·453	·485	·420	·401
121.	Sept. 27, „	·424	·431	·387	·348	·339	·418	·426	·410
122.	Oct. 27, „	·408	·349	·341	·298	·309	·361	·304	·314
123.	Nov. 26, „	·358	·247	[·212]	[·237]	·233	·208	·237	·222
124.	Dec. 26, „	·224	·245	·231	·242	[·254]	[·266]	·277	·323
125.	Jan. 24, 1868.	·361	·319	·293	·369	·376	·348	·318	·336
126.	Feb. 23, „	·426	·391	·392	·421	·419	·398	·464	·504
127.	Mar. 24, „	·556	·538	·545	·588	·640	·646	·626	·550
128.	Apr. 22, „	·580	·636	·557	·487	·502	·507	·489	·473
129.	May 22, „	·495	·524	·468	·450	·553	·536	·516	·558
130.	June 20, „	·563	·515	·509	·512	·539	·508	·497	·487
131.	July 19, „	·493	·548	·516	·532	·573	·594	·584	·616
132.	Aug. 18, „	·671	·603	·548	·511	·480	·512	·530	·488
133.	Sept. 16, „	·452	·480	·533	·504	·463	·493	·442	·384

TABLE VI. (*continued*).

Running No.	Lunation commencing new moon.	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
134.	Oct. 15, 1868.	·437	·498	·474	·491	·391	·353	·384	·310
135.	Nov. 14, „	·295	·351	·384	·353	·253	·239	·258	·276
136.	Dec. 14, „	·240	·213	·186	·205	·200	·181	·197	·275
137.	Jan. 12, 1869.	·258	·212	·239	·215	·283	·327	·417	·492
138.	Feb. 11, „	·501	·417	·400	·412	·399	·351	·419	·521
139.	Mar. 13, „	·527	·467	·476	·586	·586	·560	·578	·611
140.	Apr. 12, „	·666	·591	·538	·530	·582	·609	·584	·616
141.	May 11, „	·623	·588	·521	·509	·624	·689	·682	·711
142.	June 10, „	·602	·561	·601	·653	·704	·713	·684	·655
143.	July 9, „	·612	·593	·619	·643	·690	·679	·661	·668
144.	Aug. 7, „	·656	·601	·591	·619	·646	·635	·593	·668
145.	Sept. 6, „	·667	·640	·622	·565	·550	·565	·496	·529
146.	Oct. 5, „	·575	·522	·477	·436	·441	·504	·496	·475
147.	Nov. 3, „	·439	·443	·475	·392	·359	·378	·304	·258
148.	Dec. 3, „	·320	·367	·339	·311	·234	·218	·245	·290
149.	Jan. 2, 1870.	·344	·316	·294	·269	·284	·345	·380	·374
150.	Jan. 31, „	·414	·475	·518	·488	·461	·500	·483	·453
151.	Mar. 2, „	·535	·592	·644	·649	·651	·709	·690	·659
152.	Apr. 1, „	·742	·704	·811	·775	·741	·811	·790	·786
153.	Apr. 30, „	·745	·665	·714	·753	·761	·702	·692	·738
154.	May 30, „	·732	·692	·619	·643	·759	·806	·715	·751
155.	June 28, „	·840	·742	·709	·826	·823	·852	·790	·695
156.	July 28, „	·659	·696	·776	·745	·722	·799	·719	·681
157.	Aug. 26, „	·739	·766	·750	·713	·720	·729	·637	·652
158.	Sept. 25, „	·721	·704	·614	·547	·570	·589	·601	·562
159.	Oct. 24, „	·470	·586	·611	·571	·509	·528	·590	·559
160.	Nov. 23, „	·418	·375	·325	·335	·343	·390	·363	·312
161.	Dec. 22, „	·339	·335	·373	·361	·367	·360	·372	·357
162.	Jan. 21, 1871.	·372	·359	·378	·461	·471	·442	·419	·495
163.	Feb. 19, „	·489	·557	·582	·582	·603	·682	·735	·712
164.	Mar. 21, „	·679	·680	·673	·690	·812	·823	·797	·758
165.	Apr. 19, „	·819	·852	·887	·814	·671	·629	·650	·779
166.	May 19, „	·747	·600	·583	·717	·793	·855	·773	·750
167.	June 18, „	·699	·635	·716	·751	·762	·673	·677	·738
168.	July 17, „	·748	·634	·589	·704	·767	·761	·722	·737
169.	Aug. 16, „	·841	·829	·797	·748	·702	·684	·713	·663
170.	Sept. 14, „	·679	·678	·495	·476	·583	·626	·638	·625
171.	Oct. 14, „	·625	·617	·559	·489	·504	·512	·449	·421
172.	Nov. 12, „	·478	·493	·432	·419	·396	·333	·359	·434
173.	Dec. 12, „	·445	·449	·422	·396	·318	·364	·358	·412
174.	Jan. 10, 1872.	·392	·431	·478	·475	·496	·504	·484	·478
175.	Feb. 9, „	·482	·508	·484	·446	·478	·474	·467	·501
176.	Mar. 9, „	·584	·628	·628	·671	·664	·632	·728	·741
177.	Apr. 8, „	·733	·704	·668	·724	·763	·732	·625	·678
178.	May 7, „	·719	·679	·671	·604	·611	·621	·590	·610
179.	June 6, „	·723	·753	·671	·692	·759	·704	·671	·678
180.	July 5, „	·679	·744	·735	·731	·684	·608	·588	·649
181.	Aug. 4, „	·728	·729	·684	·615	·646	·621	·639	·686
182.	Sept. 3, „	·629	·609	·568	·560	·608	·609	·572	·561
183.	Oct. 2, „	·591	·608	·524	·466	·428	·455	·483	·489
184.	Nov. 1, „	·507	·459	·459	·440	·432	·432	·391	·393
185.	Nov. 30, „	·411	·405	·338	·302	·329	·349	·365	·347
186.	Dec. 30, „	·355	·413	·376	·377	·419	·411	·386	·459
187.	Jan. 28, 1873.	·447	·467	·476	·413	·407	·446	·494	·456
188.	Feb. 27, „	·520	·571	·532	·580	·597	·583	·623	·712
189.	Mar. 28, „	·706	·658	·693	·795	·791	·694	·710	·729

TABLE VI. (*continued*).

Running No.	Lunation commencing new moon.	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
190.	Apr. 26, 1873.	·733	·599	·568	·547	·548	·575	·516	·559
191.	May 26, „	·627	·616	·560	·519	·547	·568	·593	·585
192.	June 24, „	·567	·556	·529	·530	·625	·628	·524	·561
193.	July 24, „	·649	·651	·566	·622	·612	·575	·575	·602
194.	Aug. 23, „	·599	·614	·627	·608	·606	·578	·539	·520
195.	Sept. 21, „	·570	·578	·534	·513	·477	·478	·424	·393
196.	Oct. 21, „	·465	·417	·411	·411	·383	·336	·385	·349
197.	Nov. 20, „	·315	·375	·323	·236	·223	[·243]	[·263]	·282

8. Making use of the whole series of lunations of Table VI. we obtain the following results:—

Phase of lunation...	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Value of range......	·519	·512	·499	·499	·507	·508	·499	·503	(A)

a series which presents the appearance of a double period with maxima about new and full moon. A similar result has been obtained for Lisbon by Senhor Capello, Director of the observatory there ('Annals of the Observatory,' 1876), who finds that the declination-ranges, or rather the differences of the declination at 8 A.M. and at 2 P.M., obey a law similar to that stated above.

It may likewise be remarked (as was done in the corresponding discussion of temperate-ranges) that the sum of the four left-hand numbers is larger than that of the four right-hand numbers—the former being 2·029, while the latter is 2·017.

D. *Semiannual Lunar Variation.*

9. If we now make use of the lunations corresponding to the six months of which the middle point is the winter solstice, employing for this purpose lunations 1–2, 9–15, 22–27, 34–39, 47–52, 59–64, 71–76, 84–89, 96–101, 108–114, 121–126, 133–138, 146–151, 158–163, 170–175, 183–188, 195–197 (in all 97 lunations) we obtain the following result:—

Phase of lunation...	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Value of winter range...........	·415	·420	·415	·408	·401	·409	·413	·412	(B)

But before making use of these numbers we must apply to them a small correction. For it is possible that the sum of the various new-moon observations for any six winter months, inasmuch as they occur at dates preceding those of the corresponding full-moon observations, or observations for other phases, may be affected differently from the latter by the annual variation indicated in Table I. A correction on this account has therefore been obtained from Table I., and when applied to (B) we obtain the following result:—

Phase of lunation...	(0)	(1)	(2)	(3	(4)	(5)	(6)	(7)	
Corrected value of winter range......	·417	·422	·416	·409	·402	·409	·411	·408	(C)

Series (C) is represented in Fig. XI. (p. 120).

10. If we now make use of the observations corresponding to the six months grouped around the summer solstice (100 in all), we obtain the following results :—

Phase of lunation...	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Value of summer range............	·621	·601	·580	·587	·610	·604	·582	·591	(D)

and if we apply to this a residual correction analogous to that applied to (B), we obtain as follows:—

Phase of lunation...	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Corrected value of summer range.	·620	·600	·578	·586	·609	·604	·584	·596	(E)

In series (E) we have well-marked maxima corresponding to new and to full moon.

E. *Variations which seem to depend on Planetary Configurations.*

11. From art. 6 we may conclude that the connexion between solar spotted areas and declination-ranges is an intimate one. Now Messrs. De La Rue, Stewart, and Loewy, in a paper already quoted (Phil. Trans. 1870), have shown that the amount of spotted area of the sun's surface exhibits a reference to the chief planetary configurations. It becomes, therefore, a question of interest to ask whether declination-ranges exhibit a reference of the same kind*.

In order to reply to this I have selected those configurations which occur most frequently, and which might therefore be supposed to be sufficiently well indicated by sixteen years' observations.

These are, (α) the period of conjunction of Venus and Mercury, (β) the solar period of Mercury, (γ) the period of conjunction of Venus and Jupiter.

In the next place, three-monthly values for every week have been constructed after the manner indicated in Table III. Now inasmuch as the periods of the three configurations already alluded to are not very far different from three months, we may imagine that these three-monthly values are to a great extent free from any inequality depending on these periods. The differences between the monthly and the three-monthly values will, however, exhibit any such inequality as may exist. These

* Mr. C. Chambers, of the Bombay Observatory, has discussed the question as to whether certain other magnetic elements have a reference of this kind (Phil. Trans. 1875, p. 361).

differences, slightly equalized, are therefore made to form the ordinates of a curve of which the time is the abscissa, and we may expect to derive from such a curve materials for determining whether there be any inequality in the declination-range due to such configurations. The method employed in plotting this curve will be understood from the following example :—

TABLE VII.

Date, 1858.	Monthly value.	Three-monthly value.	Difference.	Final equalized difference, plotted in the curve.
Feb. (3)	1034			
		 983	.... +45	
Mar. (0)	1022			+43
		 983	.... +40	
„ (1)	1025			+42
		 980	.... +45	
„ (2)	1025			+38
		 974	.... +32	
„ (3)	988			+21
		 961	.... + 9	
April (0)	952			+ 2
		 950	.... − 4	
„ (1)	940			

12. With regard to the first configuration mentioned (the period of conjunction of Venus and Mercury), these observations embrace 39 periods in all; and summing up the ordinates of the curve corresponding to each 30 degrees of angular separation for the various 39 periods, precisely after the manner employed in the paper on Solar Physics already referred to, we obtain the following result:—

TABLE VIII.—*Venus and Mercury together (0° denotes conjunction).*

Between	$\overset{\circ}{0}$	and	$\overset{\circ}{30}$	+193
„	30	„	60	+ 23
„	60	„	90	−196
„	90	„	120	−207
„	120	„	150	− 93
„	150	„	180	− 59
„	180	„	210	− 43
„	210	„	240	+ 13
„	240	„	270	+ 26
„	270	„	300	− 52
„	300	„	330	− 49
„	330	„	360	119

In Figs. III. and IV. (p. 105) the sun-spot and the declination-curve for this configuration are exhibited together. It will be noticed that there is a very striking likeness between the two, the declination-curve, however, lagging behind the other in point of time, as might be expected from art. 6.

13. Next with regard to the second configuration (the solar period of Mercury), the results are so decided that half the declination observations are sufficient to give a tolerably good value. This will be seen from the following Table:—

TABLE IX.—Period of Mercury about the Sun (in all 65 sets: 0° denotes Perihelion).

				First half.	Second half.	Whole series.
Between	0°	and	30°	+217	+212	+429
„	30	„	60	+153	+280	+433
„	60	„	90	− 3	+259	+256
„	90	„	120	−168	+173	+ 5
„	120	„	150	−281	+ 1	−280
„	150	„	180	−276	−163	−439
„	180	„	210	−151	−262	−413
„	210	„	240	− 5	−274	−279
„	240	„	270	+ 73	−213	−140
„	270	„	300	+114	−101	+ 13
„	300	„	330	+145	+ 13	+158
„	330	„	360	+181	+ 97	+278

In Figs. V. and VI. the supposed inequalities due to this period are compared together for spotted solar area and declination-range. It will be observed that the latter lags visibly behind the former in point of time.

14. Let us, in the last place, consider the period of the conjunction of Jupiter and Mercury. In this case, as in the previous one, the inequality is so well marked that the observations may be split into two series; this will be seen from the following Table:—

TABLE X.—Period of Conjunction of Mercury and Jupiter (in all 63 sets: 0° denotes conjunction).

				First half.	Second half.	Whole series.
Between	0°	and	30°	+198	+435	+633
„	30	„	60	+236	+523	+759
„	60	„	90	+225	+427	+652
„	90	„	120	+119	+209	+328
„	120	„	150	− 46	− 73	−119
„	150	„	180	−185	−319	−504
„	180	„	210	−251	−427	−678
„	210	„	240	−230	−447	−677
„	240	„	270	−157	−391	−548
„	270	„	300	− 91	−231	−322
„	300	„	330	0	− 10	− 10
„	330	„	360	+118	+225	+343

In Figs. VII. and VIII. the supposed inequalities due to the above period are compared together for solar spotted area and declination-range. It will be noticed that the latter lags visibly behind the former in point of time.

F. *Remarks on the supposed relations between Solar spotted areas, Declination-ranges, and Temperature-ranges.*

15. A few remarks on this subject will not be considered unallowable if the object be not so much to introduce a final theory as to suggest a working hypothesis which, while not inconsistent with any well-established fact, may perhaps serve to direct future inquiry.

In the first place, we may conclude, as the result of the comparison of Figs. I. and II., that the connexion between spotted areas and declination-ranges is of an intimate nature, the smaller inequalities of the one being reproduced in the other with modifications.

16. In the next place, it seems almost certain that sun-spots are not the chief cause of magnetic action. Mr. Broun, in a recent paper "On the Decennial Period in the Range and Disturbance of the Diurnal Oscillations of the Magnetic Needle and in Sun-spot area" (Trans. Roy. Soc. Edinb. 1876), has made a remark similar to the above, founding it upon the fact that sun-spots appear only when the magnetic action exceeds a given value.

17. Nevertheless it is most probable that magnetic activity is somehow caused by the sun, depending perhaps on the physical state of his surface, while sun-spots give us only a rough mode of estimating this physical state, just as rainfall might in estimating the climate of a place. For it will be seen that the effect of the sun upon magnetic range bears all the appearances of being due to an influence *emanating* from our luminary. For just as the maxima of yearly and daily temperature lag behind the corresponding maxima of solar heat influence, so do the maxima and minima of declination-range lag behind the corresponding maxima and minima in the solar curve, while the same lagging behind appears in the curves, denoting the supposed influence of the planets on the state of the solar surface and (through it?) on the magnetic range.

18. Again, we may probably imagine that sun-spots give us a roughly true indication of solar activity; for if this were not so it would be difficult to account for the striking likeness between the sun-spot planetary curves and the declination-range planetary curves. That the sun-spots afford but a rough indication of the physical state of the sun will of course be gathered from the fact that the sun is influential both in meteorology and magnetism when there are no spots; and the same conclusion appears to be supported by the fact that the planetary inequalities appear to be more pronounced when derived from declination-ranges than when derived from sun-spots.

19. There seems, however, to be something more than this; there

appears to be in the march of the declination-range from year to year (Fig. II.) traces of a force which prevents this range from being strictly comparable with that of sun-spots. It will be seen that after the date of peculiarity *a* (Figs. I. and II.) the sun-spot curve marches rapidly up, while the declination-range curve does not so mount; also, after the maximum *b*, the sun-spot curve falls more rapidly than the declination-curve. Similar remarks will apply to other points; in fine we have grounds for supposing the declination-range to be acted upon by some other influence than one so represented by sun-spots as to follow their increase and diminution.

Mr. J. A. Broun, in a series of interesting investigations, has indicated the probability that there is an influence of this nature; and it may fairly be said that the results of this paper are at least consistent with such an hypothesis.

20. I would next remark that the hypothesis asserting a connexion of some kind between magnetical and meteorological phenomena appears to be borne out by the results of this paper*.

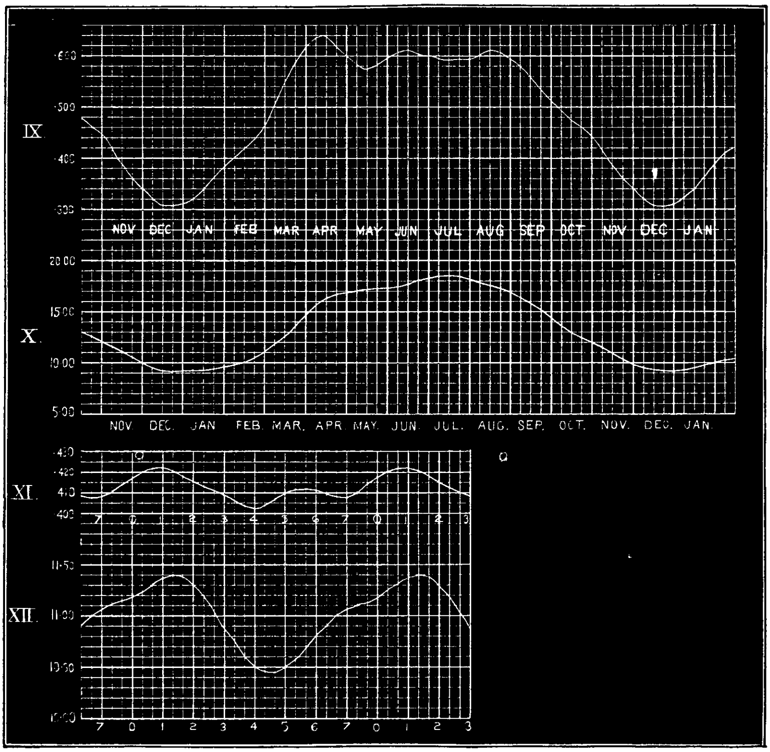
It will be noticed from Figs. XI., XII. (p. 120), that there is a striking likeness between the winter lunar variation for the declination and temperature ranges. There is also a likeness between the summer lunar variation for these two elements, not so striking to the eye, but which will nevertheless be seen from the following comparison:—

Phase of lunation...	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Summer lunar variation temperature-range	16·96	17·02	17·23	17·22	17·35	17·15	17·24	17·27
Summer lunar variation declination-range	·620	·600	·578	·586	·609	·604	·584	·596

Both of these, the first imperfectly and the latter fully, exhibit maxima at or near new and full moon. Again, while on the whole there is a likeness between the curves representing the annual variation for these two elements, yet there is also a dissimilarity, inasmuch as the declination-curve (Fig. IX.) has apparently a strong reference to the equinoxes, which is absent, or nearly so, in the temperature-curve. But it may be taken for granted that if there be a connexion between magnetism and meteorology, it certainly cannot be of such a nature that all the meteorological peculiarities of a place are reproduced in its magnetic phenomena, for all observation is against a connexion of this description. Indeed any hypothesis of a connexion between these two must, in order to be consistent with facts, assume that the magnet averages things so as to be free, in a great measure if not completely, from local peculiarities.

* Mr. Baxendell, of Manchester, was the first to direct attention to this subject in a paper "On a Diurnal Inequality in the Direction and Velocity of the Wind," apparently connected with the daily changes of magnetic declination. See Memoirs of the Lit. and Phil. Society of Manchester, vol. iv. ser. 3, p. 210.

The results of this paper appear to be consistent with such an hypothesis when so modified.



21. It is needless here to enter into the various reasons which induce us to believe in the existence of a connexion between the meteorology of the earth and the physical state of the sun's surface. I may, however, refer to a paper "On the Daily Range of Atmospheric Temperature at the Kew Observatory" (Proc. Roy. Soc. 1877, vol. xxv. p. 580), in which it was shown that at Kew the temperature-range is somewhat higher at times of maximum than at times of minimum sun-spots. If, however, we plot as a curve this temperature-range, it is neither like Fig. I. nor Fig. II., or at least not so like as to suggest any marked relation to the eye. (This curve is not given in this paper.) But on examining its most prominent points, I find that not a few of these agree both in direction and in time with similar peculiarities in the magnetic curve. Thus there is a well-marked prominence in the temperature-range curve corresponding to about the end of May 1861 ; now there is a prominence in the magnetic curve at about the same date. Again, there is a depression in both curves corresponding to about the end of May 1862. Again, there is a well-marked depression in the temperature-curve corresponding to the end of April 1866, while in the