comparison with the Kew standard thermometer No. 515, the property of the Royal Observatory.

If the readings of the thermometer be corrected for index errors only, as is the case under ordinary circumstances when observations are made, the difference between the Greenwich and Kew standard barometers is reduced by the amount of $(0°{\cdot}5 \times 0{\cdot}0027 =)\ {\cdot}0013$ inch, and the two barometers differ only by the amount $-\ 0{\cdot}0001$ inch, that is to say they virtually agree.

In conclusion I would beg to express my thanks to the Astronomer Royal and Messrs. Ellis and Nash for the courteous manner in which they afforded us every facility and assistance in carrying out these comparisons, and to Messrs. Baker, Foster, and Constable for the assistance they have given in the reduction of the observations, as well as in the actual comparisons.

The tables containing the detailed observations are preserved at the Kew Observatory for reference.

NOTE.—Since the effect of the gas burners upon the Greenwich barometer has had attention called to it, Mr. Ellis has fitted opal glass screens between the gas-jets and the barometer. By this means the temperature is rendered much more equable round the instrument.

II. "On the Diurnal Range of the Magnetic Declination as recorded at the Trevandrum Observatory." By BALFOUR STEWART, LL.D., F.R.S., Professor of Natural Philosophy at Owens College, Manchester. Received November 28, 1877.

1. The Observatory at Trevandrum was supported by His Highness the Rajah of Travancore, and its Director was Mr. J. A. Broun, F.R.S., who has recently published the first volume of the results of his labours, giving the individual observations of magnetic declination, and deducing from them conclusions of great scientific value.

Among the other results published by Mr. Broun, are the diurnal ranges of the magnetic declination at Trevandrum, for each civil day in the eleven years, 1854 to 1864. (Table LVIII, page 163.)

In one respect the treatment of the declination observations at Trevandrum differs from that pursued at the Kew Observatory, inasmuch as in the former place, where disturbances are little felt, the diurnal ranges are from all the observations.

The geographical position of the Trevandrum Observatory was as follows:—

Latitude, 8° 30′ 32″ N.
Longitude, 5h. 7m. 59s. E. of Greenwich.

A. *Annual Variation of Declination-Range.*

2. The following table exhibits mean monthly results of the decli-

nation-range, corresponding to 48 points in the year, the whole series of eleven years being taken.

TABLE I.—Containing monthly means (48 to the year) of the diurnal declination-range, thus:—January (0) denotes the monthly mean of which the middle date is the very commencement of the year; January (1) that of which the middle date is one quarter-month after the commencement, and so on:—

Date.	Series 1854–64.	Date.	Series 1854–64.
January (0)	′ 2·97	July (0)	′ 3·46
" (1)	2·98	" (1)	3·44
" (2)	3·06	" (2)	3·37
" (3)	3·00	" (3)	3·41
February (0)	2·86	August (0)	3·60
" (1)	2·70	" (1)	3·80
" (2)	2·50	" (2)	4·00
" (3)	2·41	" (3)	4·17
March (0)	2·29	September (0)	4·15
" (1)	2·15	" (1)	4·03
" (2)	2·04	" (2)	3·66
" (3)	1·96	" (3)	3·15
April (0)	2·06	October (0)	2·73
" (1)	2·24	" (1)	2·40
" (2)	2·42	" (2)	2·27
" (3)	2·65	" (3)	2·26
May (0)	2·87	November (0)	2·35
" (1)	3·04	" (1)	2·55
" (2)	3·25	" (2)	2·72
" (3)	3·25	" (3)	2·90
June (0)	3·29	December (0)	3·07
" (1)	3·30	" (1)	3·08
" (2)	3·32	" (2)	3·12
" (3)	3·42	" (3)	3·02

3. It will be noticed from this table that the annual variation of the declination-range at Trevandrum is very different in character from its annual variation at the Kew Observatory.

The chief feature of the annual variation at Kew is the small value of the range at the time of the winter solstice.

On the other hand, the chief features of the annual variation of declination-range at Trevandrum are two minima, nearly corresponding in time to the two equinoxes, and two maxima, one large, some time in August (after the summer solstice) and a smaller one about the time of the winter solstice. These features have been already remarked by Mr. Broun, who has likewise pointed out that the character of the diurnal variation of the declination at the summer solstice is at Trevandrum the opposite of its character at the winter solstice—the change from the one type to the other taking place about the equinoxes. He has likewise pointed out, as a result of this

change of type, that about the times of the equinoxes there is not only a small average value of the range, but likewise an uncertainty about its character, as it sometimes appears to be of the one type and at other times changes to the other type.

B. *Variations of Long Period.*

4. In order to investigate the long-period variation of the Trevandrum declination-range, I have treated these observations precisely in the way in which the Kew declination-ranges were treated (Proc. Roy. Soc., March 22, 1877). By this method proportional values of the declination-range at Trevandrum have been obtained corresponding to weekly points for each year, and it is believed that these values are freed from any recognised inequality depending either on the month of the year or on the relative position of the sun and moon. If this method should be found to furnish nearly the same results in the case of two observatories so widely apart as Kew and Trevandrum, and with such marked differences in the annual variation of the declination-range, we may conclude that this separation of inequalities has been successfully accomplished. The proportional values of the Trevandrum declination-range are given in Table II.

TABLE II.—Exhibiting monthly means of declination-range for weekly points, the mean value of the range for the whole series for each point being reckoned = 1,000.

(The date of the first point for each year is given.)

1854. Jan. 4	1855. Jan. 3.	1856. Jan. 2.	1857. Jan. 7.	1858. Jan. 6.	1859. Jan. 5.	1860. Jan. 4.	1861. Jan. 2.	1862. Jan. 1.	1863. Jan. 7.	1864. Jan. 6.
1078	876	805	873	1163	1126	1166	945	1093	1132	844
1038	888	832	891	1118	1132	1099	889	1075	1122	890
943	915	917	918	1113	1128	1094	908	1014	1189	910
932	909	976	896	1062	992	1120	931	959	1260	981
934	942	1000	928	988	1012	1113	846	998	1204	1054
944	955	946	978	1050	1005	1157	854	947	1120	1076
976	894	853	989	999	1110	1203	823	1011	1026	1089
950	922	765	928	1007	1183	1292	951	1056	1010	958
895	907	707	890	1094	1157	1411	1030	1050	990	889
925	895	694	786	1095	1221	1367	1060	1080	1074	796
939	931	733	764	1098	1116	1416	1066	1037	1107	806
962	929	767	789	1083	1064	1454	986	1031	939	945
1011	978	802	761	1160	1105	1290	981	971	962	967
970	955	850	779	1111	1094	1406	996	977	919	948
1030	934	829	804	1124	1206	1288	925	952	990	922
999	983	764	877	1033	1291	1206	903	974	1030	915
1023	935	707	1027	960	1283	1219	945	981	1023	920
1106	940	669	1053	1013	1239	1155	895	916	1074	928
1040	949	683	1053	992	1177	1185	932	951	1040	982
1042	873	731	992	1069	1117	1189	985	942	1079	1025
996	895	748	877	1015	1099	1205	965	1021	1068	1098
927	878	755	856	970	1147	1181	1031	1091	1036	1137
939	882	755	805	953	1130	1175	1096	1098	1021	1143
950	918	780	827	962	1096	1183	1111	1099	975	1088

1854. Jan. 4.	1855. Jan. 3.	1856. Jan. 2.	1857. Jan. 7.	1858. Jan. 6.	1859. Jan. 5.	1860. Jan. 4.	1861. Jan. 2.	1862. Jan. 1.	1863. Jan. 7.	1864. Jan. 6.
951	924	837	790	1012	1106	1220	1076	1103	985	1004
993	884	842	816	1030	1079	1197	1071	1069	1017	1009
970	826	828	857	1036	1106	1176	1123	1034	1103	954
932	840	826	845	1096	1112	1175	1086	1010	1114	967
923	852	855	921	1041	1123	1117	1135	981	1085	954
890	872	892	846	1060	1039	1212	1219	948	1040	969
888	883	900	810	1108	946	1410	1152	917	989	1001
890	848	919	866	1053	965	1485	1169	886	914	1018
883	842	866	813	1041	1046	1469	1251	881	885	1032
832	817	859	882	1017	1204	1473	1173	910	818	1040
877	900	864	968	919	1290	1322	1129	953	771	1010
894	940	847	1051	881	1328	1195	1178	921	776	1010
927	926	833	1160	900	1221	1177	1145	902	789	1045
1016	974	823	1189	890	1117	1144	1139	918	796	978
950	914	809	1118	919	1147	1134	1201	966	858	958
943	870	756	977	910	1251	1163	1165	1094	950	928
916	877	806	852	923	1339	1148	1081	1144	990	879
885	856	796	852	1054	1311	1032	1141	1149	992	911
949	813	812	901	1117	1260	1023	1091	1072	972	948
946	757	837	927	1235	1178	1018	1058	1048	984	996
987	715	857	966	1308	1119	1034	1102	1043	930	947
986	740	880	905	1168	1171	1098	1002	1107	1013	914
988	749	983	846	1147	1104	1159	992	1163	986	908
990	713	991	858	1044	1269	1118	1033	1129	1016	874
919	712	986	989	955	1336	1053	1019	1086	994	946
896	716	950	1031	983	1353	1007	1094	1057	929	997
854	702	872	1159	971	1377	934	1141	1076	884	1054
869	768	851	1211	1142	1160	867	1151	1054	853	1046
		865						1088		

5. The numbers of Table II have next been dealt with precisely in the way in which the corresponding numbers were dealt with in the case of the Kew Observatory, that is to say, a set of nine-monthly values of declination-range have been obtained corresponding to similar nine-monthly values of spotted solar area. These are exhibited in the following tables.

TABLE III.—Declination-Range, Nine-Monthly Values.

	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.
Jan. (2)	..	930	798	882	1033	1095	1239	1000	1044	1066	938
Feb. (2)	..	924	783	889	1025	1117	1235	988	1034	1070	963
Mar. (2)	..	916	789	888	1039	1118	1232	993	1027	1062	969
April (2)	..	903	806	881	1052	1112	1245	1009	1011	1048	971
May (2)	956	904	814	889	1038	1128	1252	1032	995	1018	983
June (2)	952	900	805	903	1023	1146	1247	1062	998	986	980
July (2)	953	883	813	905	1029	1158	1222	1074	1006	974	931
Aug. (2)	948	858	830	924	1029	1172	1182	1085	1017	970	984
Sept. (2)	934	845	849	946	1032	1169	1146	1100	1037	955	
Oct. (2)	925	841	870	964	1041	1173	1109	1098	1049	949	
Nov. (2)	920	829	875	993	1056	1203	1087	1091	1046	936	
Dec. (2)	925	819	866	1022	1066	1236	1048	1068	1052	925	

I. Solar spotted Area.
II. Kew Declination-Range.
III. Trevandrum Declination-Range.
IV. Mean of (II) and (III).

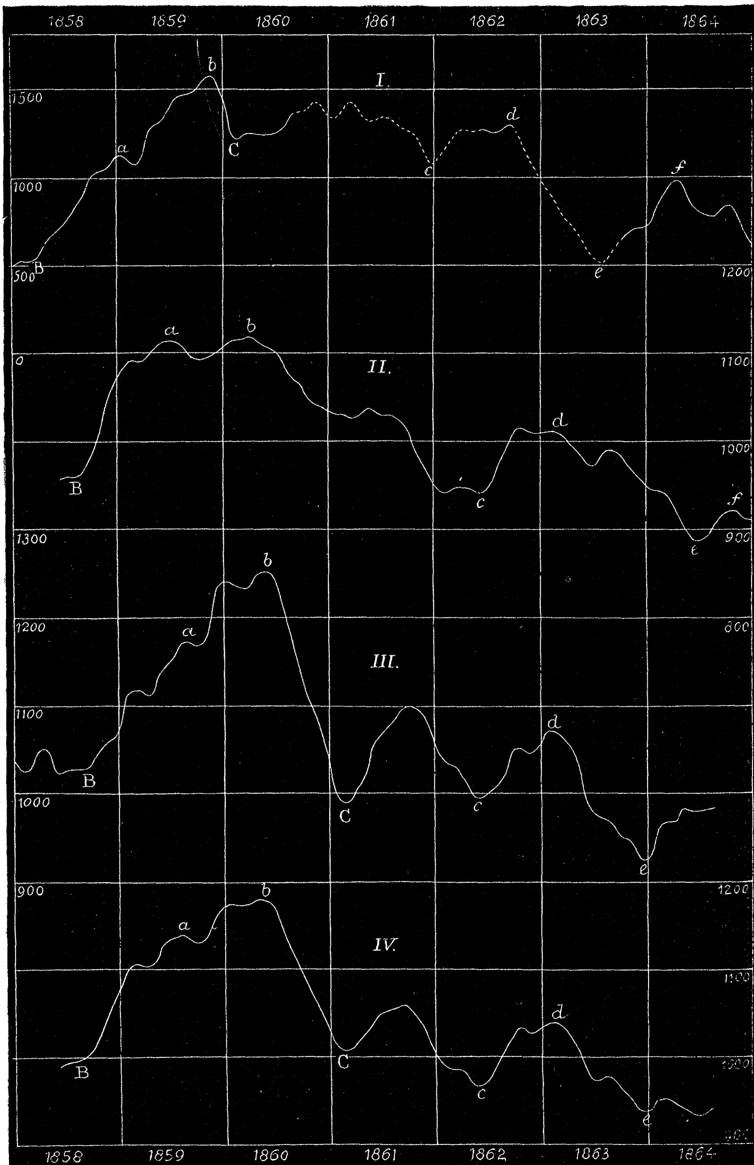

Table IV.—Spotted Solar Areas, Nine-Monthly Values.

	1853.	1854.	1855.	1856.	1857.
January (2)......	475	214	170	17	87*
February (2)......	490	173	155	17	101
March (2)......	475	141	138	16	117
April (2)......	450	126	112	21	144
May (2)......	438	127	83	27	182
June (2)......	434	131	48	26	214
July (2)......	425	140	20	26	235
August (2)......	390	147	15	32	287
September (2)......	353	165	15	40	350
October (2)......	318	191	15	44	400
November (2)......	283	193	16	51	450
December (2)......	252	182	17	70	479

6. The results of Tables III and IV are exhibited in the diagram which accompanies this paper.

In fig. 1 we have a curve representing the nine-monthly values of spotted area.

In fig. 2 we have the Kew and in fig. 3 the Trevandrum declination curve represented by nine-monthly values of the proportional numbers.

In fig. 4 we have a curve representing the mean between the proportional numbers of Kew and those of Trevandrum.

From these figures it will be seen that a lagging behind the sun is a feature both of the Kew and the Trevandrum curves, while generally the prominent points in the Kew and Trevandrum curves agree well together in point of time.

On the whole it would appear that by taking the mean of the proportional numbers for the two stations, we get a curve that represents the solar curve better than one derived from a single station.

The whole period compared together represents both for the solar curve (fig. 1) and the mean curve (fig. 4), a series of three smaller periods, one extending from B to C and embracing the maximum; another extending from C to *c*, and a third from *c* to *e*; and this is as far as the observations common to both stations allow us to go in point of time.

7. It may be of interest to compare, by means of the tables, the period between the solar minimum of 1855 and that of 1867, with the period between the corresponding declination-range minima. The first of these declination minima occurred at Trevandrum (the Kew observations not having then begun) on February 15, 1856, and the second of

* The numbers for the years 1858–64 are given in Proceedings of Royal Society, March 22, 1877, page 109.

them occurred at Kew (the Trevandrum observations having been discontinued) on August 15, 1867. The period is thus one of eleven years and six months.

On the other hand, the sun-spot period is that between September 15, 1855, and March 15, 1867, being likewise eleven years and six months.

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

8. In a paper on the Kew declination-range already alluded to, it was shown that the planetary periods of most frequent occurrence appear to be well indicated by the results of sixteen years' observations. Indeed, for the two periods of shortest length—that of Mercury about the sun, and that of Mercury and Jupiter, it was found that half of the observations gave a result of the same character as the whole sixteen years.

From this we might conclude that these periods will probably (if they have a real existence) be indicated by the Trevandrum observations.

It will be seen from the following tables that the Trevandrum declination-ranges give results for these two planetary periods very similar to those given by the Kew observations.

TABLE V.—Period of Mercury about the Sun.

(0° denoting Perihelion—65 sets for Kew—47 for Trevandrum.)

				Kew.	Trevandrum.
Between	0°	and	30°	+429	+263
„	30	„	60	+433	+223
„	60	„	90	+256	+237
„	90	„	120	+ 5	+300
„	120	„	150	−280	+150
„	150	„	180	−439	−433
„	180	„	210	−413	−879
„	210	„	240	−279	−740
„	240	„	270	−140	−263
„	270	„	300	+ 13	+333
„	300	„	330	+158	+680
„	330	„	360	+278	+506

TABLE VI.—Period of Conjunction of Mercury and Jupiter.
(0° denoting Conjunction—63 sets for Kew—43 sets for Trevandrum.)

				Kew.	Trevandrum.
Between	0°	and	30°	+633	+453
„	30	„	60	+759	+270
„	60	„	90	+652	+129
„	90	„	120	+328	−118
„	120	„	150	−119	−384
„	150	„	180	−504	−467
„	180	„	210	−678	−487
„	210	„	240	−677	−407
„	240	„	270	−548	−122
„	270	„	300	−322	+223
„	300	„	330	− 10	+415
„	330	„	360	+343	+503

I desire, in conclusion, to thank Mr. William Dodgson, who has given me much assistance in the calculations and diagrams of this paper.

III. "Note on the Value of Euler's Constant; likewise on the Values of the Napierian Logarithms of 2, 3, 5, 7, and 10, and of the Modulus of common Logarithms, all carried to 260 places of Decimals." By Professor J. C. ADAMS, M.A., F.R.S. Received December 6, 1877.

In the "Proceedings of the Royal Society," vol. xix, pp. 521, 522, Mr. Glaisher has given the values of the logarithms of 2, 3, 5, and 10, and of Euler's constant to 100 places of decimals, in correction of some previous results given by Mr. Shanks.

In vol. xx, pp. 28 and 31, Mr. Shanks gives the results of his re-calculation of the above-mentioned logarithms and of the modulus of common logarithms to 205 places, and of Euler's constant to 110 places of decimals.

Having calculated the value of 31 Bernoulli's numbers, in addition to the 31 previously known, I was induced to carry the approximation to Euler's constant to a much greater extent than had been before practicable. For this purpose I likewise re-calculated the values of the above-mentioned logarithms, and found the sum of the reciprocals of the first 500 and of the first 1000 integers, all to upwards of 260 places of decimals. I also found two independent relations between the logarithms just mentioned and the logarithm of 7, which furnished a test of the accuracy of the work.

I. Solar spotted Area.
II. Kew Declination-Range.
III. Trevandrum Declination-Range.
IV. Mean of (II) and (III).