

XXVII.—*Report on the Hourly Meteorological Register kept at Leith Fort in the Years 1826 and 1827.* By Sir DAVID BREWSTER, K.H., D.C.L., F.R.S.  
(Plates XXIV. and XXV.)

(Read 19th February 1866.)

Having already published in the Transactions\* a detailed report on the Hourly Meteorological Register kept at Leith Fort, at the expense of the Society, during the years 1824 and 1825, it is unnecessary to enter into any recapitulation respecting the origin and history of this class of observations.

The singular and unexpected results obtained from these Registers, and the rapid approximation to general laws which some of these results exhibited, attached a great interest to the observations of future years; and it is satisfactory to find that the results for the two following years of 1826 and 1827 are almost perfectly coincident with those for 1824 and 1825, not only in their general relations, but even in their numerical laws.

The following are the Mean Temperatures of the four years during which the hourly observations were made at Leith Fort:—

Mean Temperature of 1824,	.	.	.	.	.	.	47.588
" " of 1825,	.	.	.	.	.	.	48.911
" " of 1826,	.	.	.	.	.	.	48.436
" " of 1827,	.	.	.	.	.	.	48.407
Average Mean Temperature of four years,	.	.	.	.	.	.	48.335

The following Tables contain the mean temperatures for every day of the year, and for every hour of the day for 1826 and 1827:—

\* Vol. X. p. 362.

## MEAN RESULTS OF THE HOURLY REGISTER FOR 1826.

The Mean Temperature of the Winter Months, viz. Dec. Jan. Feb. is	40°556
„ „ of the Spring Months, viz. March, April, May,	46°135
„ „ of the Summer Months, viz. June, July, August,	58°263
„ „ of the Autumn Months, viz. Sept. Oct. Nov.	48°818

The Mean Temperature of the Year 1826, from 8760 observations, is 48°436

TABLE I.—CONTAINING THE DAILY AND MONTHLY MEAN TEMPERATURES FOR 1826.

Day.	January.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	32·94	40·40	45·49	46·48	44·65	54·09	62·04	56·77	56·46	56·44	43·54	39·29
2	37·77	43·82	41·40	46·55	49·03	49·88	61·66	52·96	58·57	52·69	43·21	40·38
3	39·42	47·92	42·28	51·29	42·57	51·33	61·96	56·50	58·35	51·78	41·67	36·38
4	37·34	43·26	42·38	49·65	43·09	52·84	60·47	56·58	57·90	47·55	43·62	35·00
5	36·54	43·21	39·15	50·21	45·75	52·69	60·94	56·20	53·25	45·06	46·41	31·51
6	36·21	47·54	41·59	50·40	43·00	58·88	62·50	56·00	53·58	47·73	39·08	32·75
7	36·16	42·77	43·22	49·33	45·55	53·97	60·58	59·97	56·82	55·53	39·08	41·99
8	30·69	46·84	44·08	53·87	44·38	54·92	62·26	58·42	54·04	48·02	39·09	44·09
9	24·36	47·34	54·57	50·27	44·26	49·00	56·31	54·86	52·68	45·96	38·37	44·31
10	30·98	43·55	59·20	46·01	48·40	50·80	57·47	54·25	54·20	48·24	44·22	46·92
11	31·26	39·08	50·57	48·17	47·49	54·33	57·77	55·86	55·15	51·27	50·29	50·01
12	29·45	43·75	43·92	47·50	48·16	60·35	55·46	56·15	56·50	51·16	41·80	48·91
13	25·49	45·60	41·26	46·31	51·72	62·35	56·47	60·40	59·02	50·41	39·11	46·76
14	20·94	43·31	39·65	49·72	53·86	57·45	52·38	62·17	54·36	49·15	37·71	44·25
15	22·03	46·26	41·18	46·97	54·38	54·88	53·85	61·96	50·82	56·05	38·72	45·15
16	24·01	46·79	39·06	46·10	49·90	51·51	55·36	60·51	56·55	54·85	35·42	44·42
17	40·79	42·04	38·88	46·99	54·78	55·14	54·42	61·58	60·25	52·37	39·15	44·05
18	43·75	37·00	43·48	47·65	57·67	56·99	56·60	69·75	53·07	48·26	37·65	43·16
19	34·94	38·75	42·36	50·67	52·54	55·34	54·34	68·23	55·01	48·55	41·09	38·86
20	40·15	39·17	44·24	53·73	49·32	57·47	51·44	62·44	54·09	52·76	39·00	39·99
21	43·30	41·55	43·22	49·80	52·27	54·63	50·42	59·72	51·99	54·71	39·70	37·46
22	39·21	48·06	39·65	49·27	53·71	52·27	50·14	57·94	52·16	54·21	42·97	45·29
23	40·32	39·65	39·44	44·45	48·90	56·52	50·16	63·74	51·21	56·11	45·38	47·66
24	37·76	43·15	39·22	43·16	49·75	65·11	53·94	63·53	52·87	56·05	38·94	47·60
25	40·95	43·67	36·92	41·17	51·31	68·79	57·60	63·28	53·90	50·91	35·87	44·96
26	38·15	41·78	36·71	42·11	46·32	69·34	58·01	60·04	60·08	45·09	34·52	40·12
27	38·37	41·35	40·60	35·91	50·28	64·11	61·80	60·26	59·05	48·12	31·48	39·17
28	40·09	47·78	44·91	35·30	51·47	67·01	64·20	59·87	55·00	47·86	38·99	42·65
29	41·16	...	37·22	37·85	50·48	64·31	62·09	64·15	58·57	47·55	42·72	45·12
30	43·72	...	38·26	41·44	50·79	64·66	62·46	61·94	61·31	45·87	43·88	47·67
31	44·42	...	41·46	...	51·13	...	61·69	57·67	...	44·26	...	47·58
Mean Temp. of each Month.	35·570	43·407	42·438	46·611	49·269	57·365	57·633	59·792	55·561	50·470	40·423	42·692

The Mean Temperature of 1826 is, by this Table, 48°436.

TABLE II.—SHOWING THE MEAN TEMPERATURE OF EACH HOUR FOR EACH MONTH IN 1826,  
AND FOR THE WHOLE YEAR.

Hour.	January.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean Temp. of each Hour for the whole Year.
1 A.M.	33·822	41·723	40·492	43·650	45·234	52·833	53·274	56·790	53·125	48·363	39·242	42·193	45·916
2 ...	33·927	41·812	40·089	42·975	44·645	51·975	52·927	56·274	52·767	47·976	39·100	42·089	45·565
3 ...	33·926	41·562	39·960	42·700	43·822	51·367	52·871	55·645	52·267	47·863	39·125	42·145	45·289
4 ...	33·880	41·822	39·855	42·433	43·710	51·225	53·008	55·427	52·242	47·960	39·142	41·976	45·240
5 ...	33·890	41·750	39·331	42·358	44·153	51·700	52·742	54·863	51·808	48·057	39·283	41·742	45·154
6 ...	33·890	41·732	39·355	42·925	44·968	52·725	53·863	55·847	51·833	47·960	39·383	41·605	45·525
7 ...	33·863	42·009	39·516	43·958	46·145	53·917	55·250	57·307	52·750	48·000	38·992	41·653	46·133
8 ...	34·169	42·281	40·468	45·358	47·661	55·358	56·685	58·307	53·750	49·129	39·550	41·935	47·075
9 ...	35·024	43·527	41·806	47·075	49·572	57·075	58·161	59·363	55·325	50·807	40·008	42·145	48·347
10 ...	35·952	44·277	43·331	48·125	50·322	58·400	59·282	60·597	56·917	52·379	40·685	42·693	49·438
11 ...	36·661	44·795	44·258	48·958	51·500	60·150	60·073	61·766	58·400	51·984	41·640	43·395	50·407
12 ...	37·557	44·973	45·290	49·985	52·274	61·150	60·806	63·057	59·167	53·863	42·433	43·670	51·214
1 P.M.	38·210	46·134	45·758	50·400	53·065	62·192	61·427	63·347	58·973	54·153	42·790	43·943	51·724
2 ...	38·274	46·295	46·169	49·917	53·581	62·425	62·185	63·726	59·333	54·162	42·907	44·161	51·958
3 ...	38·200	46·170	46·081	50·208	53·613	62·650	62·282	63·920	59·300	54·065	42·617	43·853	51·941
4 ...	37·677	45·402	45·645	50·650	53·992	63·092	62·540	64·468	59·557	53·516	42·017	43·605	51·879
5 ...	36·758	44·661	45·476	50·692	53·903	63·367	62·653	64·137	59·092	52·411	41·433	43·415	51·533
6 ...	36·202	43·920	43·935	50·475	53·879	62·858	62·428	63·912	57·807	51·121	40·717	43·307	50·915
7 ...	35·798	43·553	43·072	48·433	52·306	61·417	61·000	62·645	56·358	50·540	40·342	43·057	49·910
8 ...	35·476	43·286	42·516	47·108	50·693	59·025	58·057	60·813	55·683	50·307	40·067	42·847	48·851
9 ...	35·363	42·857	41·984	46·283	49·548	56·975	56·589	59·476	54·792	49·508	39·873	42·532	48·008
10 ...	35·226	42·678	41·540	45·675	48·540	55·908	55·726	58·670	54·323	49·097	40·000	42·379	47·504
11 ...	34·903	42·420	40·911	44·800	47·701	55·183	55·387	58·210	54·067	48·677	39·773	42·137	47·036
12 ...	34·702	42·312	41·000	44·017	47·298	54·033	54·492	57·670	53·633	48·484	39·692	42·121	46·670

The Mean Temperature obtained from the last column in the above Table is 48°·468.

It occurred at 9<sup>h</sup> 7<sup>m</sup> A.M. and 8<sup>h</sup> 27<sup>m</sup> P.M.

## HOURLY REGISTER FOR 1827.

The Mean Temperature of the Winter Months, viz. Dec. Jan. Feb. is . . . 38·945  
 " " of the Spring Months, viz. March, April, May, . . . 45·817  
 " " of the Summer Months, viz. June, July, August, . . . 57·612  
 " " of the Autumn Months, viz. Sept. Oct. Nov. . . . 51·255

The Mean Temperature of the Year 1827, is . . . 48·407

TABLE III.—CONTAINING THE DAILY AND MONTHLY MEAN TEMPERATURES FOR 1827.

Day.	January.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	43·68	37·64	41·70	48·79	47·61	54·50	56·92	61·67	56·09	56·48	41·71	45·29
2	28·22	35·60	34·63	50·99	51·25	52·36	55·58	62·69	59·35	54·43	48·31	43·25
3	20·44	33·29	33·34	50·36	53·23	49·80	57·59	61·83	57·73	55·75	49·38	46·67
4	28·26	36·27	32·86	48·53	54·84	52·34	59·47	56·80	55·79	54·71	48·30	53·14
5	27·85	41·22	33·77	51·13	52·11	50·71	59·99	59·05	56·69	52·57	48·62	50·49
6	44·88	40·05	38·50	48·34	46·39	51·91	61·62	55·41	55·51	56·58	43·60	40·73
7	48·97	37·90	32·76	46·85	44·83	53·15	59·41	58·82	56·72	54·06	43·00	45·38
8	48·95	35·98	30·34	47·87	47·14	57·37	62·71	59·31	56·50	52·51	44·27	42·48
9	38·66	35·45	32·96	49·05	47·95	61·23	59·37	61·67	58·69	54·08	50·18	43·95
10	38·75	38·72	36·46	46·12	43·42	61·23	57·75	57·43	62·89	48·11	49·26	49·56
11	32·31	37·93	41·84	44·39	45·95	61·34	56·58	55·92	63·56	50·65	43·89	46·69
12	29·38	36·26	41·99	47·58	50·93	60·87	57·17	55·14	57·01	50·52	49·25	40·91
13	40·48	35·13	40·67	47·31	54·18	57·56	57·61	56·95	55·75	48·35	55·23	40·75
14	40·97	36·13	39·58	48·53	49·19	57·63	57·09	53·76	58·62	48·37	53·33	44·96
15	35·25	32·41	37·10	47·81	48·72	56·12	60·30	52·54	62·62	56·58	43·13	45·12
16	38·92	30·36	40·27	45·74	48·58	61·45	65·01	51·35	63·91	58·01	46·29	41·85
17	35·46	31·24	42·78	44·53	51·66	57·98	65·37	53·86	62·68	55·53	44·10	45·43
18	37·21	28·35	38·72	42·08	48·53	56·66	59·78	53·38	55·61	51·98	36·44	43·19
19	37·44	28·69	47·42	42·93	54·46	54·33	56·59	55·12	49·98	53·98	38·44	46·59
20	35·32	31·58	47·15	43·01	53·37	50·88	55·46	54·42	56·53	54·04	44·42	41·98
21	35·96	35·09	47·65	42·38	59·12	52·59	56·10	57·86	56·66	53·24	33·48	43·08
22	35·37	33·30	50·71	40·69	56·89	53·23	58·33	55·87	57·46	50·05	31·58	41·34
23	33·13	35·92	51·91	35·54	54·75	53·77	59·58	58·55	57·50	50·15	33·08	40·41
24	34·01	36·21	46·14	34·65	56·76	54·95	64·58	57·57	56·22	53·26	32·35	46·47
25	36·11	35·85	38·69	37·53	50·46	57·63	61·54	55·58	57·56	54·02	38·83	45·97
26	35·77	46·05	40·17	41·39	51·03	58·16	56·64	54·87	56·50	55·12	42·71	50·88
27	30·96	40·41	45·12	45·75	51·21	58·60	59·73	59·81	55·42	52·51	47·98	45·66
28	45·73	37·36	40·61	47·49	54·66	58·53	62·72	56·96	54·95	43·96	49·98	40·72
29	48·19	...	38·12	50·25	56·35	58·02	63·53	56·21	55·86	43·46	48·45	32·67
30	45·26	...	40·55	51·25	57·02	57·98	62·67	59·61	55·61	46·69	47·33	30·62
31	43·52	...	42·15	...	57·26	...	63·97	58·15	...	42·65	...	42·69
Mean Temp. of each Month.	37·271	35·728	40·215	45·628	51·608	56·096	59·702	57·037	57·532	52·013	44·221	43·836

TABLE IV.—SHOWING THE AVERAGE MEAN TEMPERATURE OF EACH HOUR FOR EACH MONTH IN 1827, AND FOR THE WHOLE YEAR.

Hour.	January.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Mean Temp. of each Hour for the whole Year.
1 A.M.	37·121	34·982	38·508	43·275	48·718	52·091	56·056	54·379	56·050	52·597	43·550	43·282	46·717
2 ...	37·097	34·955	38·395	42·925	48·161	51·491	55·492	53·685	55·608	52·589	43·368	43·129	46·408
3 ...	36·935	35·080	38·290	42·500	47·750	51·016	54·863	52·935	55·433	52·403	43·116	43·185	46·125
4 ...	36·734	35·160	38·169	42·356	47·790	51·258	54·677	52·693	55·241	52·153	43·000	43·290	46·043
5 ...	36·508	34·768	37·855	42·508	48·072	51·850	55·201	52·976	55·550	51·903	42·808	43·282	46·107
6 ...	36·532	34·553	38·185	43·083	48·645	52·866	56·145	53·306	55·800	51·763	42·733	43·322	46·411
7 ...	36·419	34·643	38·516	43·291	49·492	54·066	57·605	54·911	56·091	51·677	42·841	43·242	46·899
8 ...	36·701	34·652	39·185	44·475	50·234	55·716	58·725	56·330	56·850	51·556	43·008	43·411	47·570
9 ...	36·911	35·134	40·379	45·608	51·218	57·075	60·105	57·355	57·516	51·580	43·491	43·548	48·327
10 ...	37·250	35·768	41·201	46·800	51·895	58·121	61·306	58·182	58·075	52·057	44·183	44·008	49·070
11 ...	37·605	36·518	42·387	48·041	53·145	58·783	62·153	59·435	58·650	52·476	45·375	44·556	49·927
12 ...	38·072	37·375	42·750	48·658	53·492	59·400	62·951	60·290	59·233	52·355	46·400	45·153	50·511
1 P.M.	38·129	37·259	43·395	49·016	54·185	59·975	63·589	60·871	59·641	52·193	46·908	45·201	50·863
2 ...	38·362	37·625	43·371	49·066	54·734	60·541	63·516	61·161	59·607	52·258	46·991	45·209	51·037
3 ...	38·282	37·419	42·927	49·183	54·879	60·725	63·806	60·814	59·966	51·968	46·600	44·943	50·959
4 ...	38·064	37·089	42·645	48·950	54·943	60·633	64·056	60·669	60·233	51·888	45·800	44·339	50·776
5 ...	37·911	36·616	41·935	48·300	54·943	60·400	63·363	60·323	60·283	51·637	45·458	44·242	50·451
6 ...	37·564	36·202	40·935	47·566	54·137	59·750	62·951	59·863	59·075	51·532	44·866	43·830	49·856
7 ...	37·218	35·785	39·958	46·541	53·709	58·191	62·387	58·967	58·558	51·516	44·616	43·766	49·268
8 ...	37·153	35·563	39·896	45·658	52·355	56·841	61·185	57·669	58·000	51·847	44·275	43·637	48·673
9 ...	36·968	35·330	39·605	45·041	51·750	55·341	59·571	56·750	57·300	52·161	44·075	43·540	48·119
10 ...	36·927	35·259	39·193	44·391	51·097	53·625	58·274	56·048	56·841	51·944	44·008	43·242	47·571
11 ...	37·008	35·321	38·887	44·050	50·314	53·541	57·532	55·427	56·891	52·201	43·900	43·484	47·379
12 ...	36·959	35·357	39·024	43·691	49·629	52·733	57·209	54·597	56·300	52·330	43·850	43·589	47·105

The Mean Temperature obtained from the last column in the above Table is 48°·423.

The Mean Temperature of 48°·423 occurs at 9<sup>h</sup> 12<sup>m</sup> A.M. and 8<sup>h</sup> 23<sup>m</sup> P.M.

The general results which may be deduced from the preceding Tables relate—

1. To the form and character of the annual and monthly daily curves, or the daily progression of temperature.
2. To the arrangement of the monthly curves in separate groups.
3. To the determination of the times of the day when the mean temperature occurs.
4. To the relation between the mean temperature of the day, and that of any single hour or pair of similar or *homonymous* hours.
5. To the parabolic form of the four branches of the annual daily curve.

I. *On the Form and Character of the Annual and Monthly Daily Curves, or the Daily Progression of Temperature.*

The mean temperature of the year 1826 was  $48^{\circ}436$ , and that of 1827  $48^{\circ}407$ , both of them intermediate between that of the two preceding years; but though in its average character the temperature of 1826 was moderate, yet it differed from both of them in a remarkable manner. Though the mean annual curves of 1824 and 1825 differ from one another, from the former representing a *cold* and the latter a *warm* year, yet they are perfectly parallel, indicating the same vicissitudes of climate. The curve of 1826, however, exhibits the character of an American climate, descending almost as low as that of 1824 in the morning branch, and rising nearly as high as 1825 in the warm period of the day.

The curve for 1827 differs remarkably from that of 1826, keeping above it from 1 o'clock in the morning till 8 o'clock in the evening, but almost touching it at the morning and evening hours of mean temperature. See Plates XXIV. and XXV.

In all the curves for these four years, the lowest temperature took place at 5 o'clock in the morning. The temperature increased, with great regularity, till 3 o'clock in the afternoon, when it descended to its minimum. The period, therefore, of its ascending is *ten* hours, and that of its descending motion *fourteen* hours.

By comparing the summer and winter curves or the mean temperatures of the six summer months, from April to September inclusive, with those of the six winter months, from October to March inclusive, as exhibited in the annexed Table, we are enabled to discover whether or not the peculiar character of 1826 is derived from the warm or the cold season.

TABLE, SHOWING THE MEAN TEMPERATURE OF EACH HOUR FOR THE SIX SUMMER MONTHS, FROM APRIL TO SEPTEMBER INCLUSIVE, AND FOR THE SIX WINTER MONTHS, FROM OCTOBER TO MARCH INCLUSIVE, FOR 1826 AND 1827.

1826.			1827.		
Hours.	Six Summer Months.	Six Winter Months.	Hours.	Six Summer Months.	Six Winter Months.
1 A.M.	50·818	40·972	1 A.M.	51·761	41·667
2	50·260	40·832	2	51·227	41·589
3	50·112	40·763	3	50·749	41·501
4	49·667	40·772	4	50·669	41·418
5	49·604	40·675	5	51·026	41·187
6	50·366	40·654	6	51·641	41·181
7	51·554	40·672	7	52·576	41·223
8	52·853	41·255	8	53·721	41·419
9	54·428	42·219	9	54·813	41·900
10	55·604	43·219	10	55·396	42·411
11	56·808	45·123	11	56·701	43·153
12	57·740	44·590	12	57·337	43·684
1 P.M.	58·234	45·165	1 P.M.	57·846	43·848
2	58·528	45·271	2	58·104	43·969
3	58·662	45·104	3	58·229	43·689
4	56·731	44·647	4	58·247	43·304
5	59·333	44·026	5	57·935	42·966
6	58·726	43·200	6	57·224	42·488
7	57·026	42·727	7	56·292	42·143
8	55·229	42·416	8	55·285	42·062
9	53·943	42·019	9	54·292	41·946
10	53·141	41·820	10	53·379	41·766
11	52·561	41·470	11	52·959	41·800
12	51·857	41·385	12	52·359	41·851
Mean,	54·324	42·541	Mean,	54·574	42·257

The summer curve of 1826 retains the same intermediate position between those of 1824 and 1825 that it did in the annual curve; but in the morning hours it descends nearly to the curve of the cold year of 1824, while in the afternoon hours it rises towards the curve of the warm year 1825, thus displaying, in the summer season, the character of an American climate.

The summer curve of 1826 bears the same relation to that of 1827, keeping below it in the morning till about 11 o'clock, when it rises high above it till 8 o'clock, when it descends till midnight.

In the winter curves, that of 1826 keeps between those of 1824 and 1825 from 1 o'clock A.M till 8 o'clock. It then rises above that of 1825, and keeps above it till 6 o'clock in the evening, when it again meets that of 1825, coinciding with it till about 3 o'clock in the morning. Hence it follows that the peculiar character of 1826 appears still more strikingly in the winter than it does in the summer season.

The winter curve of 1826 bears a different relation to that of 1827 in its morning branch, but a similar relation to it in its evening branch.

II. *On the Arrangement of the Monthly Curves into three separate Groups.*

By examining the daily curve for each month, it will be seen that it preserves the general form of the daily annual curve, occasionally deviating into salient and re-entering portions; but were we to delineate the individual daily curves, we should, in most cases, find the very form of a curve obliterated, and a capricious succession of elevations and depressions substituted in its place.

The most remarkable result, however, is the distribution of the monthly curves into three separate groups, namely, curves of high temperature, such as those of *June, July, August, and September*; curves of low temperature, such as those of *November, December, January, February, and March*; and curves of moderate temperature, such as those of *April, May, and October*.

This distinct separation of the monthly group is well seen in the Plates XV. and XVI. of Volume X., which represents them as in 1824 and 1825. In that for 1824 there is a very slight encroachment of the April curve upon that of January, but in that for 1825 the separation is complete.

In 1826 and 1827 (See Plates XXIV. and XXV.) these curves are grouped, though less distinctly, according to the same law; but, what is very remarkable, the curve for January 1826 is entirely thrown out of the cold group, and in consequence of the extraordinary cold which prevailed in that month, its curve is as far separated from those of the winter group, as any one of the groups are separated from each other.\*

III. *On the Determination of the Two Hours of the Day when the Mean Temperature occurs.*

Previous to the establishment of the hourly Register at Leith Fort, nothing was known respecting the times of the day when the mean annual temperature occurs. It was generally supposed to be about 8 o'clock in the morning, and Professor PLAYFAIR adopted this as the most probable result. With regard to the time when the annual mean occurred in the evening, I am not aware that even a conjecture had been formed.

\* The extraordinary character of the October curve in 1827 requires to be explained. When the daily schedules for that month were sent to me from Leith Fort, I was surprised to find *two* for the *same day* of October with very different numbers. Upon inquiring into the cause, I found that some of the non-commissioned officers who had voluntarily undertaken the duty of observing the thermometer, and for doing which they were liberally paid, had neglected to make the observations, and had filled up the daily schedules with false numbers. It is obvious from the curve that this fraud was committed by the person who made the afternoon and evening observations.

It is interesting to observe how little effect these erroneous observations have had upon the general results for 1827, when compared with those of other years.



	Hours of Morning and Evening Mean Temperature.	Critical Interval.
In 1824 it occurred at . . . . .	{ 9 <sup>h</sup> 13 <sup>m</sup> A.M. } { 8 26 P.M. }	11 <sup>h</sup> 13 <sup>m</sup>
In 1825, . . . . .	{ 9 13 A.M. } { 8 28 P.M. }	11 15
In 1826, . . . . .	{ 9 7 A.M. } { 8 27 P.M. }	11 20
In 1827, . . . . .	{ 9 12 A.M. } { 8 23 P.M. }	11 11
	Mean,	11 <sup>h</sup> 15 <sup>m</sup>

The mean of which is

9<sup>h</sup> 11<sup>m</sup> A.M. and 8<sup>h</sup> 26<sup>m</sup> P.M.

The interval between the morning and evening mean temperature has been called the *critical interval*, which at Leith Fort is 11<sup>h</sup> 15<sup>m</sup>, and which, there is reason to believe, is a fixed quantity. The equality of these numbers in four different years is very remarkable, the deviation of each from the mean not exceeding 4<sup>m</sup>.

Although the hours of mean temperature vary in different latitudes, and at different heights above the sea, yet the critical interval seems to be a fixed quantity everywhere, as appears from the following table:—

At Padua, . . . . .	11 <sup>h</sup> 14 <sup>m</sup>	At Philadelphia, . . . . .	11 <sup>h</sup> 20 <sup>m</sup>
At Appenrade, . . . . .	11 14	At Belleville, . . . . .	11 14
At Inverness, . . . . .	11 13	At Trincomalee, . . . . .	11 5
At Tweedsmuir, . . . . .	11 15	At Kingussie, . . . . .	10 44

The mean of which is 11<sup>h</sup> 10<sup>m</sup>, differing only 4<sup>m</sup> from the Leith result.

The determination of the times of mean annual temperature gives us the two best hours for recording the indications of the thermometer, namely, 9<sup>h</sup> 11<sup>m</sup> A.M. and 8<sup>h</sup> 26<sup>m</sup> P.M.; for if any of the observations is accidentally omitted at one of the hours, the mean of the remainder will approach nearer to the mean temperature of the year than if any other pair of hours had been taken and similar omissions made.

Another advantage of this determination is, that the mean temperature of the year may be obtained with great accuracy from a single observation made every day at one of the hours of mean temperature.

If we examine the annual, or even the monthly, curves, it will be seen that the ascending, or morning branch, is more regular in its progression than the descending, or evening branch, and therefore a single observation made at the time of the morning mean is preferable to one made at the time of the evening mean.

This regularity in the morning curve has been observed in other phenomena, but especially in atmospherical polarisation, and the cause of it has been explained by DOVE and RUBENSON.\*

\* *Memoire sur la Polarisation de la Lumiere Atmospherique*, p. 86, note.

The hours of mean temperature have a considerable range in the monthly curves, varying in the morning from half-past 8 to half-past 10, and in the evening from 7 o'clock to 9.

IV. *On the relation between the Mean Temperature of the Day, and that of any single Hour, or pair of similar or homonymous Hours.*

It was long the practice of meteorologists to observe the thermometer at *two* convenient hours, so that if the one gave a temperature greater than the mean, the other might give a temperature as much less, and in this way several registers were kept with considerable accuracy. The hours of 10<sup>h</sup> A.M. and 10<sup>h</sup> P.M., suggested by the Rev. Dr GORDON, were frequently used, and gave a result nearer to the mean of the *maximum* and *minimum* than any other pair of convenient hours.

Upon computing the mean temperature of every pair of similar or homonymous hours, I found, as shown in the following Table, that they differed very little from the mean temperature of the 24 hours :—

Hours of Observation.		Diff. from Mean Temp. of Day in Thousandths of a Degree.	
		Leith.	Inverness.
5 <sup>h</sup> A.M. and	5 <sup>h</sup> P.M.	—0·134	—0·434
6	6	—0·281	—0·543
7	7	—0·372	—0·552
8	8	—0·421	—0·396
9	9	—0·285	—0·113
10	10	—0·086	+0·174
11	11	+0·176	+0·374
12	12	+0·374	+0·555
1	1	+0·367	+0·550
2	2	+0·366	+0·389
3	3	+0·252	+0·173
4	4	+0·059	—0·175

Hence it appears that the defect or excess of the mean temperature of any pair of similar hours, when compared with that of the 24 hours, is always in the Leith observations less than *half a degree*. It appears, also, that the mean of 4<sup>h</sup> and 4<sup>h</sup> approaches nearest to the daily mean, and 10<sup>h</sup> and 10<sup>h</sup> next to it.

I have added to the above Table the results of the Inverness hourly observations. The deviations are very slightly greater, but the law is the same; and it is interesting to observe the interchange of the signs at 10<sup>h</sup> and 10<sup>h</sup>, and 4<sup>h</sup> and 4<sup>h</sup>, a proof of the singular equality between the mean temperature of the day, and half the sum of the mean temperature of these hours.

In speaking of this law, as given in the Report upon the Registers for 1824 and 1825, HUMBOLDT says,—

“We are surprised, at the first glance, by the generality of this law. The *homonymous* hours are very inequally distant from the hour of the *maximum* of the daily temperature. . . . It is a thing truly remarkable, that from the

mean of two ordinates, we may deduce the mean temperature of the whole year ; that is, the mean of all the horary ordinates."

As meteorological registers have sometimes been kept only once a day, it is desirable to ascertain the relation of the mean temperature of each hour to that of the day. In the following Table, I have given the results for 1826 and 1827, and also for 4 years, from 1824 to 1827 inclusive :—

Hour.	1826.	1827.	Mean of Four Years. 1824-1827.
1 A.M.	−2°552	−1°706	−2°131
2	−2°903	−2°015	−2°396
3	−3°179	−2°298	−2°658
4	−3°228	−2°308	−2°793
5	−3°314	−2°316	−2°844
6	−2°943	−2°011	−2°545
7	−2°335	−1°524	−1°956
8	−1°393	−0°853	−1°180
9	−0°121	−0°096	−0°760
10	+0°970	+0°647	+0°777
11	+1°939	+1°504	+1°702
12	+2°746	+2°088	+2°463
1 P.M.	+3°256	+2°440	+2°865
2	+3°490	+2°614	+3°125
3	+3°473	+2°536	+3°135
4	+3°411	+2°353	+2°927
5	+3°065	+2°028	+2°576
6	+2°447	+1°433	+1°984
7	+1°442	+0°845	+1°211
8	+0°383	+0°350	+0°362
9	−0°460	−0°304	−0°410
10	−0°964	−0°852	−0°949
11	−1°432	−1°044	−1°351
12	−1°798	−1°318	−1°713

From this Table it appears, that the mean annual temperature of any hour never differs more than  $3\frac{1}{2}^{\circ}$  from the mean temperature of the day for the whole year. The very same result was obtained from the Register of 1824 and 1825.\*

V.—On the Parabolic form of the Four Branches of the Annual Daily Curve.

In the report upon the Register for 1824 and 1825, I have shown that the four branches of the annual daily curve approach so nearly to Parabolas, that the greatest difference between the observed and calculated temperatures is only *a quarter of a degree of Fahrenheit*. The following Table contains the calculated temperatures for 1826 and 1827, and the difference between them and the observed temperatures :—

\* Edinburgh Transactions, vol. x. p. 387, 388.

	1826.	Difference.		1827.	Difference.
Mean	48.468	...		48.423	...
	48.055	0.047		48.056	-0.063
	47.375	-0.129		47.522	-0.049
	46.786	-0.250		47.070	-0.309
	46.287	-0.383		46.700	-0.405
	45.879	-0.037		46.413	-0.304
	45.562	-0.003		46.207	-0.201
	45.335	+0.046		46.084	-0.041
	45.199	-0.041		46.043	0.000
Min.	45.154	-0.000		46.131	-0.024
	45.345	-0.180		46.396	-0.015
	45.918	-0.215		46.836	-0.063
	46.874	-0.201		47.453	-0.117
	48.214	-0.133		48.247	-0.080
Mean	48.468	0.000		48.423	0.000
	49.616	+0.178		49.220	+0.150
	50.641	+0.234		50.015	+0.088
	51.373	+0.159		50.583	+0.072
	51.812	+0.088		50.923	+0.066
Max.	51.958	0.000		51.037	0.000
	51.874	-0.067		50.973	+0.014
	51.623	-0.256		50.780	+0.004
	51.203	-0.330		50.459	+0.008
	50.576	-0.339		50.010	+0.154
	49.861	-0.049		49.431	+0.163
	48.938	+0.087		48.725	+0.052
Mean	48.468	0.000		48.423	0.000

From this Table it appears, that the difference between the observed and the calculated temperatures for 1826 and 1827, is only four-tenths of a degree of Fahrenheit, a very little more than in 1824 and 1825.

I cannot conclude these observations, without directing the attention of the Society to the singular fact, that laws so regular as those we have been contemplating should have shown themselves after only four years of hourly observations. When we consider by how many disturbing causes the temperature at any particular instant is affected—by the winds which blow over surfaces differently heated,—by the showers which instantly cool the air,—by the interposition of clouds, now screening the sun, and now giving a free passage to his rays, and by many other causes, as capricious in their origin as they are irregular in their influence, it cannot but appear wonderful that all these effects should be so nicely balanced, as to produce a perfect compensation at every point of the annual daily curve. In virtue of this compensation, we may consider the mean annual daily curve as representing the mean daily progression of the solar heat, whether received directly from the sun, or returned into the atmosphere, by terrestrial radiation.

