XII.—*On the Climate of Edinburgh for Fifty-six years, from 1795 to 1850, deduced principally from Mr Adie's Observations; with an Account of other and Earlier Registers.* By JAMES D. FORBES, D.C.L., F.R.S., Sec. R.S. Ed., Professor of Natural Philosophy in the University of Edinburgh. (With two Plates, XVIII. and XIX.)

(Read 5th March 1860.)

§ 1. Early Observations.	§ 5. Succession of Seasons, 1795 to 1850.
§ 2. Mr Adie's Observations.	§ 6. On the Annual Curve.
§ 3. Annual and Monthly Mean Temperatures.	§ 7. Influence of Seasons on the Price of Corn.
§ 4. Fall of Rain.	

1. The late Mr ALEXANDER ADIE, optician, and Fellow of the Royal Society of Edinburgh,* was so generally known to be a zealous and careful observer of meteorological instruments, that an attempt to combine the results deducible from his labours carried on (though with one long break) over more than forty years, cannot be otherwise than interesting.

2. The plan of superintending the careful reduction of the thermometrical part of Mr ADIE's registers occurred to me a long time ago, but circumstances prevented the execution of it until two or three years since, when, through the kindness of Mr ADIE and his family, the whole of the manuscript observations, commencing with 1795, were put into my hands, and the Council of the Royal Society of Edinburgh provided sufficient funds for the employment of computers for reducing them.

3. The work has proceeded with frequent interruptions, but is at length complete. Before I proceed to detail the particulars of the reductions and their results, I will give a short account of the earlier observations on the climate of Edinburgh which I have been able to trace, some of which perhaps have hitherto escaped notice.

SECT. 1. *On the Earlier Recorded Observations on the Climate of Edinburgh.*

4. I have been fortunate enough to discover an old printed Register of Meteorological Observations at Edinburgh, extending from June 1731 to May 1736. It is contained in five successive volumes of "Medical Essays and Observations published by a Society in Edinburgh," which reached a third edition in 1748, and it is the one from which I quote.

5. This register appears to have been made with remarkable care, and most likely by one observer, and in the same locality, for the above-mentioned period, and probably longer, as I judge from the mention of it in MARTINE'S Essays.†

* Some account of Mr ADIE's personal history and labours will be found in the Vice-President's Address for the Session 1859–60 (Proceedings of the Royal Society of Edinburgh, vol. iv. pp. 225–27.)

† Essays and Observations on the Construction and Graduation of Thermometers by GEORGE MARTINE, M.D., 2d edit. 1772, p. 48.

The Observatory was situated in the town of Edinburgh, about 270 feet above the sea.* The thermometer was sheltered by a case well perforated with holes to admit the air.† It was filled with alcohol, and graduated, not, as now, into degrees, but into inches and tenths. But the reference to Fahrenheit's scale becomes easy, since we are told (p. 7), that "the freezing point is at 8 inches 2 tenths; and the heat of a man in health raises the spirits to 22 inches 2 tenths." The former point of course corresponds to 32° Fahr.; the latter was found by Dr MARTINE to be 97° Fahr. by actual experiment on the person who graduated the Edinburgh thermometer.‡ Hence it is easy to form a table for reducing the "Edinburgh Scale" to Fahrenheit's; but it may be sufficient to adopt a reduction which is to be found already made at page xiv. of the preliminary matter to the third volume of "Essays of the Philosophical Society in Edinburgh," published in 1771. The observations there tabulated are evidently identical with the observations already described, although these are not there directly referred to. It would also appear that blood-heat was reckoned at 96° instead of 97°, as I find by comparing the numbers in the "Medical Essays" with those of the Philosophical Society. If we assume (as is reasonable) MARTINE to be correct, the numbers in the foregoing tables ought to be slightly raised; but for the mean annual temperature the difference would be less than a quarter of a degree.

6. I regret that it is not in my power to throw any light on the name of the person by whom these records were made; but he was in all probability a medical man.

7. I ought to add that the barometer, hygrometer, wind, weather, and amount of rain, are all carefully entered. The observations were almost invariably made twice a-day, the first nearly always at 9 A.M., the second at an hour (usually between two and six) which varied with the season of the year.

8. Confining our attention to the thermometrical observations, they require a correction for the varying hour at which the afternoon observations were made at different seasons of the year. Taking a sort of average, I have applied the following tabular corrections to the reduced observations as given in the "Essays of the Philosophical Society" above referred to. The second line contains the reductions for the observations made in 1764-70, which will be immediately referred to:—

Years.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1732-35,	-0.3	-0.5	-1.0	-2.1	-1.7	-1.3	-1.9	-1.1	-1.8	-0.8	-0.5	-0.2
1764-70,	+0.9	+1.3	+1.8	+2.2	+1.4	+1.1	+1.1	+1.1	+1.5	+1.0	+1.0	+0.5

9. The *earlier* of these series of observations, it is to be observed, was adapted to the *Julian, or old style*. These tabular corrections are taken from M. DOVE's reductions of the Leith hourly observations.§

* Medical Essays, i. p. 6.—Most likely in the neighbourhood of the present Royal Exchange.

† Ibid. p. 8.

‡ MARTINE's Essays, p. 48.

§ British Association Reports for 1847.

10. The next observations we find recorded are in the same volume (the third) of the "Essays of the Philosophical Society in Edinburgh" from which I have already quoted. They embrace the years 1764 to 1770 inclusive, and consist of two sets, one made at Hawkhill, situated between Edinburgh and Leith, at 103 feet above the sea, the other at Edinburgh itself. If we assume that the latter set was made in the same locality as the observations of 1732-36, the height above the Hawkhill Observatory would be 167 feet. Both sets were made uniformly at the hour of 8 A.M., and a correction has been applied to the monthly means to reduce them to the average, to the extent indicated in Art. 8. The Hawkhill observations were continued at least until 1776 by Mr MACGOWAN, and the results are contained in the first volume of the "Edinburgh Transactions," page 333. They are also included in this Table, with the same correction for the hour of observation (8 A.M.)

EDINBURGH (<i>reduced</i>).													
	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1732	34.4	41.5	41.0	41.8	48.6	57.7	56.1	54.2	48.5	44.4	36.5	35.9	45.0
1733	38.1	39.3	38.8	45.4	50.9	58.1	59.3	53.7	48.5	43.5	43.4	43.2	46.8
1734	34.4	42.0	44.2	48.2	48.1	56.3	57.1	54.2	47.6	40.8	36.5	35.9	45.4
1735	36.3	35.1	38.8	43.6	48.1	54.9	57.5	56.5	47.6	43.1	42.0	38.2	45.1
1764	34.6	35.4	40.3	45.0	53.5	55.9	60.0	57.5	51.9	46.6	40.2	36.7	46.5
1765	40.9	34.5	40.9	45.7	49.4	53.3	57.5	56.6	54.1	47.0	41.2	37.6	46.5
1766	38.1	31.1	38.7	46.1	46.3	55.7	59.3	59.5	46.9	46.4	43.7	37.9	45.8
1767	31.2	41.3	39.2	42.6	47.1	52.9	55.7	57.8	55.2	45.5	42.5	37.6	45.7
1768	33.2	37.8	38.6	46.2	50.0	54.2	57.9	57.5	50.8	42.6	38.8	37.5	45.4
1769	33.8	35.2	40.6	45.2	49.0	53.2	59.0	55.4	53.3	45.2	39.2	37.8	45.6
1770	37.1	38.8	34.4	40.6	46.1	52.4	55.7	57.2	53.6	44.0	37.3	34.9	44.3
Mean of 11 years,													45.64
HAWKHILL (<i>reduced</i>).													
	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1764	36.6	38.6	40.0	46.3	54.3	57.5	61.4	59.0	52.6	47.3	39.2	36.2	47.4
1765	40.1	33.5	41.3	46.8	54.0	55.6	60.1	58.1	53.3	48.0	37.9	35.7	47.0
1766	35.0	35.1	39.4	48.1	47.9	55.9	60.6	60.9	53.2	47.4	43.8	37.8	47.1
1767	32.0	41.7	40.2	47.1	50.8	55.0	58.1	61.2	56.2	46.5	43.8	39.4	47.7
1768	33.5	38.8	41.5	49.0	54.6	56.4	60.0	60.1	52.6	47.8	40.9	39.2	47.9
1769	35.6	37.2	42.9	47.8	52.5	56.3	61.8	57.7	55.5	46.5	40.9	40.5	47.9
1770	39.5	41.6	37.1	43.8	50.0	55.2	58.6	59.6	56.7	46.6	39.1	37.7	47.1
1771	34.1	37.9	37.7	43.9	51.8	56.8	59.6	57.7	53.2	47.8	42.9	41.8	47.1
1772	32.4	32.2	38.8	45.1	50.5	58.3	59.8	58.5	53.0	49.8	42.7	40.1	46.8
1773	39.5	36.4	43.9	47.8	50.0	56.3	58.8	59.4	52.8	47.0	39.2	36.9	47.3
1774	30.0	37.5	38.9	45.3	48.0	56.2	58.5	58.3	53.2	49.3	39.1	37.8	46.0
1775	38.7	40.4	41.8	49.0	54.1	57.7	60.2	58.7	54.8	46.3	39.0	39.1	48.3
1776	30.1	37.0	42.7	48.1	50.7	56.6	60.5	57.8	53.3	48.0	42.0	38.3	47.1
Mean of 13 years,													47.28

11. The two sets of observations are each consistent among themselves; but the average difference of the two series, amounting to $1^{\circ}6$ in excess for the mean temperature of Hawkhill above Edinburgh, is greater than the difference of level and exposure would seem to warrant. Even after applying a correction of $+0^{\circ}25$ to the Edinburgh observations, deduced from MARTINE's estimate of blood heat (Art. 5), these averages appear to be too low, whilst those of the Hawkhill observations agree well with the modern ones contained in the sequel of this paper.*

12. Professor PLAYFAIR appears to have commenced in 1794 a register in Windmill Street (near George Square), Edinburgh, 265 feet above the level of the sea. The results are published in the Edinburgh Transactions, Vols. IV. and V., from 1794 to 1799 both inclusive. The hours of observation were nearly 8, 2, and 10 (not 8, 12, and 10, as stated by M. DOVE†), the middle observation being chosen so as to fall nearly at the moment of highest temperature.

Mean Annual Temperature of Edinburgh.

Years.	Playfair, 8 ^h , 2 ^h , and 10 ^h .	Adie, 8 ^h and 8 ^h .	Difference.
1794	50°32	° ...	° ...
1795	47°75	45°67	—2°08
1796	48°10	46°46	—1°64
1797	48°04	46°33	—1°71
1798	49°28	47°59	—1°69
1799	46°13	44°44	—1°69

The difference is striking, and nearly constant. Sir D. BREWSTER attributes it to the radiation of heat from neighbouring houses at the midday observation.‡ At all events, Professor PLAYFAIR's observations seem to be in error.

13. The only farther contribution I have to make to the older series of observations is to mention that in Mr ADIE's earliest Register Book, mentioned below, I find a memorandum that the mean temperature of the year 1787 was $46^{\circ}44$; of 1788, $46^{\circ}191$; and of 1789, $46^{\circ}573$; but the authority is not given.

SECT. 2. *On Mr Adie's Thermometrical Observations generally, and their Reduction.*

14. The observations of Mr ADIE on the temperature of Edinburgh have hitherto been known by their periodical publication for some years, commencing with 1824, in Sir D. BREWSTER's "Edinburgh Journal of Science," from whence they have been quoted by M. DOVE in his various writings.

* Farther references to Mr MACGOWAN's observations will be found in the "London Philosophical Transactions" for 1775, and in the Edinburgh Transactions, vol. iv. p. 214; but I have not been able to discover any continuation of the observations later than 1776.

† Not unnaturally, since in the Tables themselves the word "noon" is used to denote the midday observation. Compare p. 214 of the paper in vol. iv. of the Transactions.

‡ Edin. Trans. ix. p. 209.

15. The original observations were far more extensive. Stimulated probably by Professor PLAYFAIR'S example and advice, Mr ADIE commenced what appears to have been a very careful register of the thermometer, barometer, wind, and rain, on the 1st January 1795. After continuing this register with great punctuality for more than ten years, it came abruptly to a close about the middle of 1805. It seems certain that Mr ADIE then discontinued it, not from any want of interest in the subject, but because he considered that he had amassed sufficient materials for ascertaining the peculiarities of the climate of Edinburgh. For he reduced these ten years' observations with care, and not only so, but projected the whole in neat curves now in the possession of his family. These observations were made in Merchant Court, a locality now apparently extinct, but which was close to Merchant Street, near George IV. Bridge, in the old town of Edinburgh. Its elevation above the sea was, according to Mr JAMES JARDINE,* 230 feet. The distance from Windmill Street, the locality of Professor PLAYFAIR'S observations, was inconsiderable. The observations were made at 8 A.M. and 8 P.M.

16. Nearly fifteen years elapsed from 1805 without observations being made. I shall afterwards state the source whence I have attempted to supply this blank.

17. In 1821 Mr ADIE resumed his observations at his villa of Canaan Cottage, in a sheltered valley about a mile and a quarter south from his former locality. Its elevation was 260 feet above the sea.† The observations of the common thermometer and barometer were made at 10 A.M. and 10 P.M. instead of eight o'clock, as formerly. From 1822 the observations included the maximum and minimum temperature.

18. These observations were continued until 1850 inclusive, by Mr Adie or some member of his family. But it is important to observe, that from the middle of May 1831 to the middle of May 1838, the locality was removed to No. 9 Regent Terrace, on the Calton Hill, in the new town of Edinburgh, 246 feet above the sea, about five furlongs N.E. from his first station in Merchant Court, but in a far opener and more airy situation. In 1838 the old residence at Canaan Cottage was resumed.

19. Thus we have consecutive observations from 1795 to 1804 both inclusive; and again consecutive observations from 1821 to 1850 both inclusive, at two localities distinct from the former. The changes of locality and exposure are no doubt unfavourable to the perfect comparability of these observations. Nevertheless the considerable continuity of the observations in each locality enables me to affirm, after comparing the mean results, that the change of position (the

* See Sir D. BREWSTER'S Memoir on the Mean Temperature of the Globe (Edin. Trans. vol. ix. pp. 209, 210), where also the mean temperature is deduced from Mr JARDINE'S observations on the springs of the Pentland Hills to be $47^{\circ}1$.

† Edinburgh Journal of Science, vol. i. In later volumes it is stated at 300 feet, but this is certainly too high. By the Ordnance Survey Map it would appear to be about 280 feet.

height above the sea not having materially varied) has very slightly, if at all, affected the indications of the thermometer.

20. The observations are recorded in seven quarto paper books, all apparently original. My attention has been almost entirely confined to the *thermometrical* observations, though I have also used the monthly totals of the rain-fall which were first collected by Mr JOHN ADIE.

21. My first business was to obtain the mean temperature of each day of the forty years' observations. This was done with great care by Mr GRASSICK, clerk in Messrs ADIE and SON'S establishment. For the ten and a half years, 1795-1805, the mean of the eight o'clock morning and evening observations of the thermometer was taken and entered in vertical columns under each day of the year.

22. Beginning with 1822, the mean of the maximum and minimum temperature is taken to represent the mean of the day; for 1821 *only* the mean of the 10 A.M. and 10 P.M. observations was used. I have not attempted any correction for the more accurate estimation of the mean temperature than is given by these several times of observation. They are known all to coincide closely with the mean in the long-run. The degree of coincidence of the mean of the 10 A.M. and 10 P.M. observations with the mean of the maxima and minima may be appreciated by an examination of Mr ADIE'S printed registers in the Edinburgh Journal of Science. As a *general* rule, I am averse to the application of corrections to particular meteorological data, depending upon averages merely, because they fail to reproduce the very peculiarities of which we may be in search. In deducing probable results for the climate at one place from that at a neighbouring locality, the possible error arising from such corrections must be submitted to. But in most other cases I prefer using, when admissible, those observations in their pure and simple form which give most nearly the mean temperature of the day (omitting any others) to applying to individual results any considerable correction or factor derived from long averages merely. Such corrections may, if wished, be easily applied to the *final average* of a long course of observations, to which alone they are strictly applicable.

23. The sums and means of each column (Art. 21) of daily mean temperature were taken for four periods of ten years each, into which the whole of Mr ADIE'S observations were divided; viz., for the periods 1795-1804, 1821-30, 1831-40, 1841-50. The total averages were then taken.

24. In like manner, the monthly averages for each year were taken, and the whole combined in the usual way. The mean temperature of the month, for each period of ten years, was first taken by the mean of the averages for each day of the month (or means of the vertical columns), and again, by the mean of averages of the months for each year separately.

25. Another check on the accuracy of the computer was obtained by the circumstance that Mr ADIE had already, in by far the majority of instances, taken the means himself. Mr GRASSICK'S calculations were made independently of these

determinations, and where any discrepancy appeared, the cause was carefully sought out.

26. Farther, the accuracy of the copy from the original registers, and of each part of the calculations, was tested in a great many instances (taken at random) by Mr BALFOUR STEWART (now of Kew Observatory), in whose exactness I have the utmost confidence. Although some errors were thus detected, they were not sufficiently numerous or important to shake my confidence in the care with which the reductions had been made, but rather indeed confirmed it.

27. I ought to add, that the observations were all made with instruments manufactured by Mr ADIE himself, and certainly equal in accuracy to any then constructed. I have not been able to ascertain when or how often the thermometers were renewed. We must therefore rely on their general exactness, without attempting a correction for index error.

28. The thermometers were commonly read to whole degrees merely. Consequently, in taking the mean temperature of the day from two observations, we have not usually to do with any fractions differing from $0^{\circ}5$. To save room, I have adopted, in the MS. calculations, a plan which may be usefully employed in all such cases. I have written such a temperature as 52.5 thus, 52° , and have allowed for these half degrees in making the summations. Where *quarter degrees* occurred, the nearest *whole* degree was written, and this little error is evidently self-compensatory in the long-run.

SECT. 3. *On the Annual and Monthly Mean Temperatures of Edinburgh for Fifty-six years.*

29. A peculiar interest attaches to long-continued series of thermometrical observations in one locality. When made by one observer, and with comparable instruments, the interest is greatly heightened. We then see clearly the great extent of what M. DOVE calls the "Non-periodic fluctuations" of temperature, and the great length of time required to attain any certainty, even as to the precise mean temperature of a place, still more the peculiarities of the inflection of the diurnal and annual curves of temperature.

30. A slight inspection of M. DOVE's large collection of monthly average temperatures,* will show in how few instances anything like fifty years of continuous thermometrical observations can be depended on. The interesting deductions by M. QUETELET from his own perfectly comparable observations at Brussels for only twenty years, show how much may be done to reduce the apparently lawless changes of climate to order, by the judicious combination of long averages.† I have kept M. QUETELET's reductions in view, in the course of those which follow.

* See his *Memoirs* in the *Berlin Transactions*. In the *Index* to these which I have made and printed in the *Edinburgh Transactions*, vol. xxii. p. 75, I have indicated by an asterisk the stations where the observations have been most continuous.

† *Mem. de l'Acad. de Bruxelles*, tom. xxviii. Paper read June 1853.

31. The unfortunate blank in Mr ADIE's observations from 1805 to 1820 inclusive, detracted considerably from their interest, and I used every effort to discover some other register which might be used to supply the defect. None from the immediate neighbourhood of Edinburgh, however, appeared. But my attention was directed by M. DOVE's summaries to a register of twenty years' continuance, kept at Dunfermline by the Rev. Mr FERGUS, which extended over the missing years, and which farther indicated a climate remarkably agreeing with that of Edinburgh, not only in the annual mean, but in the partition of temperature throughout the seasons.

32. The town of Dunfermline lies thirteen miles in a right line to the N.W. of Edinburgh. It is little more than three miles distant from the estuary of the Forth, and about 300 feet above its level. I shall detail in a short paper on the climate of Dunfermline, following the present one, the fortunate circumstances which put me in possession of Mr FERGUS's original registers, extending over a period nearly equal to those of Mr ADIE.

33. In order to reduce the Dunfermline temperatures to those of Edinburgh, I selected the ten years 1821–30, during which observations were made contemporaneously at both places; and taking the monthly means, and averaging the differences for each month of the year, I obtained the following numbers for the reduction of the Dunfermline monthly mean temperatures at 9 A.M., to those of Edinburgh (mean of maxima and minima):—

January,	− 0·61	July,	+ 0·32
February,	+ 0·19	August,	+ 0·67
March,	+ 1·46	September,	+ 1·20
April,	+ 1·08	October,	+ 0·71
May,	+ 0·66	November,	+ 0·11
June,	0·00	December,	− 0·29

If these corrections be projected, an annual curve passes very fairly through them, indicating two maxima in March and September, and two minima in June and December.

34. The corrections derived from the table above were employed to reduce the Dunfermline observations of the years 1805–20 (deficient in Mr ADIE's series) to Edinburgh. It is to be observed, that these corrections are irrespective of the error of either thermometer, and merely reduce the readings of the one to those of the other. I have distinguished the derived observations in the following table by the letter D. While I neither claim for them the original worth and precision of Mr ADIE's observations, nor rely too much on the universal application of the reductions from one locality to another, I believe that they will be found to indicate in a trustworthy manner the specific characters of those seasons which would otherwise have been defective in the series.

TABLE I.—MEAN MONTHLY TEMPERATURE AT EDINBURGH FOR 56 YEARS.

N.B.—The numbers followed by D are deduced from the Dunfermline Observations.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Annual Means.
1795,	30.03	30.43	37.26	44.20	48.88	52.30	57.32	59.19	56.98	50.21	37.80	43.40	45.67
1796,	44.11	40.03	38.27	48.43	48.17	55.35	56.67	59.17	54.30	43.75	38.26	31.03	46.46
1797,	39.58	42.26	38.93	43.68	50.62	53.08	58.88	57.04	51.03	43.58	38.50	38.74	46.33
1798,	37.09	37.50	39.35	48.13	53.40	61.36	59.79	58.70	53.45	47.41	39.13	35.72	47.59
1799,	36.20	34.87	36.82	39.65	47.3*	54.18	57.05	55.43	52.63	44.51	40.30	34.30	44.44
1800,	34.53	34.69	36.79	45.00	49.06	54.48	60.72	59.31	53.68	46.32	38.70	35.12	45.70
1801,	37.77	38.21	39.90	43.95	50.61	56.58	56.95	60.21	55.75	48.61	39.01	32.53	46.67
1802,	37.12	36.57	40.66	45.90	48.45	55.83	55.93	59.72	54.73	49.14	41.10	37.16	46.86
1803,	35.19	36.82	41.05	46.20	49.89	55.26	62.74	58.32	51.06	46.66	38.48	37.91	46.63
1804,	39.77	35.22	37.17	41.82	53.98	59.26	58.87	57.93	57.10	49.26	41.65	35.68	47.31
1805,	37.08	37.10	42.53	46.08	48.00	54.60	60.4 D	60.32	56.5 D	46.5 D	43.5 D	36.3 D	47.41 D
1806,	35.0 D	37.8 D	41.6 D	45.9 D	52.7 D	57.8 D	58.7 D	58.9 D	55.1 D	50.4 D	44.5 D	40.7 D	48.26 D
1807,	37.1 D	36.8 D	36.8 D	44.6 D	50.0 D	54.9 D	61.9 D	59.5 D	48.5 D	49.0 D	34.1 D	36.7 D	45.82 D
1808,	35.8 D	36.2 D	40.8 D	42.4 D	53.6 D	57.9 D	62.8 D	59.6 D	54.0 D	43.8 D	40.0 D	36.1 D	46.91 D
1809,	31.1 D	38.9 D	43.4 D	41.3 D	53.4 D	54.7 D	57.7 D	56.8 D	54.1 D	52.3 D	41.0 D	36.8 D	46.80 D
1810,	37.1 D	36.1 D	37.9 D	45.1 D	46.6 D	57.1 D	56.8 D	58.3 D	55.2 D	49.7 D	39.5 D	35.8 D	46.26 D
1811,	34.1 D	37.5 D	43.7 D	45.4 D	51.2 D	54.2 D	58.2 D	55.8 D	53.9 D	50.8 D	42.9 D	36.2 D	47.00 D
1812,	35.5 D	39.5 D	37.1 D	40.5 D	49.1 D	54.4 D	55.6 D	56.1 D	53.9 D	47.3 D	39.6 D	35.3 D	45.32 D
1813,	35.9 D	40.0 D	44.2 D	43.9 D	48.3 D	55.7 D	58.0 D	56.9 D	53.8 D	44.7 D	38.8 D	37.6 D	46.48 D
1814,	27.7 D	35.8 D	39.4 D	48.3 D	48.6 D	52.6 D	58.4 D	56.8 D	54.5 D	45.6 D	39.1 D	35.7 D	45.21 D
1815,	33.4 D	41.1 D	43.0 D	46.0 D	50.9 D	55.1 D	57.6 D	57.0 D	53.5 D	47.9 D	37.2 D	34.1 D	46.40 D
1816,	35.2 D	35.3 D	38.2 D	41.0 D	49.4 D	53.4 D	54.8 D	54.5 D	51.3 D	46.6 D	38.5 D	35.4 D	44.46 D
1817,	38.0 D	39.5 D	39.7 D	44.7 D	45.9 D	54.1 D	56.3 D	54.1 D	53.8 D	42.6 D	44.2 D	35.4 D	45.69 D
1818,	36.9 D	36.5 D	38.2 D	40.7 D	50.0 D	59.0 D	59.7 D	56.2 D	52.9 D	52.4 D	46.9 D	39.7 D	47.42 D
1819,	37.6 D	36.6 D	42.2 D	45.1 D	49.3 D	54.0 D	57.9 D	61.7 D	53.5 D	46.1 D	37.3 D	34.0 D	46.27 D
1820,	31.6 D	40.0 D	40.7 D	46.8 D	50.2 D	54.0 D	57.3 D	55.9 D	51.8 D	44.3 D	42.1 D	38.7 D	46.11 D
1821,	38.29	39.21	41.40	47.58	46.50	52.15	56.87	57.55	56.46	49.89	42.60	40.80	47.44
1822,	39.05	40.58	43.74	45.53	52.45	59.22	58.05	57.00	50.31	47.79	44.05	36.11	47.82
1823,	31.06	34.41	40.52	42.40	51.34	53.27	56.40	55.58	51.92	44.85	44.56	37.32	45.30
1824,	39.89	39.03	39.64	45.22	50.08	56.65	59.89	57.22	54.56	45.76	40.73	38.42	47.26
1825,	39.09	38.96	41.19	46.58	50.72	56.70	61.40	60.06	56.91	50.14	38.51	37.97	48.19
1826,	33.19	41.75	41.84	46.76	51.79	61.28	61.98	60.98	54.63	49.92	38.75	41.06	48.66
1827,	35.42	33.98	40.06	45.05	50.77	56.15	58.45	55.24	54.98	50.13	42.80	42.24	47.11
1828,	39.45	40.09	42.87	45.23	51.22	56.86	57.63	56.98	54.51	48.47	44.88	43.34	48.46
1829,	32.08	38.77	39.68	41.90	51.64	56.35	56.55	54.05	50.30	45.93	39.53	35.97	45.23
1830,	34.32	36.03	44.21	46.63	49.74	51.98	57.72	52.68	52.15	48.51	42.35	35.45	45.98
1831,	34.69	38.68	42.29	45.01	48.80	50.30	59.39	60.10	55.28	52.97	40.38	41.85	47.48
1832,	39.13	40.55	41.82	45.80	48.68	55.88	57.71	57.36	54.05	49.74	41.43	40.55	47.72
1833,	34.69	39.52	38.87	44.41	55.82	55.55	58.87	54.55	52.96	48.93	41.76	40.30	47.19
1834,	41.42	40.50	42.89	45.05	52.26	56.88	59.26	58.37	54.02	48.85	43.18	42.22	48.74
1835,	37.88	39.62	40.56	44.63	48.96	54.31	57.55	59.09	52.21	45.63	42.40	38.80	46.80
1836,	38.09	37.15	39.64	42.78	50.87	55.93	56.00	54.93	49.55	45.08	39.76	38.93	45.73
1837,	34.97	38.88	34.78	38.93	47.98	56.00	59.61	55.59	51.70	49.22	40.07	40.97	45.72
1838,	30.63	29.82	39.13	41.14	46.04	54.53	59.15	56.87	53.53	47.39	37.93	40.53	44.72
1839,	35.50	37.85	38.24	43.50	49.13	55.75	58.63	56.56	53.41	47.37	42.31	38.08	46.36
1840,	39.23	37.47	41.13	48.36	48.32	55.11	55.93	59.14	51.40	46.29	41.65	36.58	46.72
1841,	33.43	37.87	46.48	45.35	52.03	53.86	56.35	57.30	54.41	44.56	38.98	38.92	46.63
1842,	34.98	40.02	42.51	46.00	51.68	57.08	56.25	59.93	55.10	45.42	40.93	45.59	47.96
1843,	39.42	34.28	42.32	45.63	47.13	52.20	58.78	57.90	57.10	44.89	44.13	47.70	47.62
1844,	41.16	35.77	41.40	49.66	48.82	55.05	56.89	55.55	53.15	47.08	43.26	32.98	46.72
1845,	36.56	35.21	36.80	45.11	48.13	56.81	55.09	55.82	54.25	49.37	43.38	38.77	46.27
1846,	42.06	44.85	42.68	44.73	53.18	61.60	59.43	59.90	59.30	48.19	44.85	34.39	49.60
1847,	35.95	35.84	42.03	43.35	50.59	55.86	61.77	57.56	51.48	48.95	45.56	39.72	47.39
1848,	33.64	40.07	41.56	44.06	55.48	54.93	59.18	54.06	53.75	46.61	40.23	40.45	47.00
1849,	37.09	42.41	42.58	42.71	51.03	52.91	56.75	57.01	52.11	44.85	41.78	36.64	46.51
1850,	31.50	41.75	42.37	46.36	48.29	58.45	59.11	56.82	52.36	47.49†	41.17†	38.57†	47.02
Mean of the whole,	36.15	37.90	40.55	44.65	50.18	55.55	58.28	57.41	53.66	47.50	41.00	37.98	46.75
Mean of the Edinburgh Observations only, }	36.64	37.92	40.58	44.84	50.26	55.65	58.29	57.49	53.72	47.49	41.17	38.57	46.88

† Supplied from the Means.

35. With a view to trace more intelligibly the specific characters of the different seasons, and in the hope of perhaps distinguishing in them something of a periodic or recurring character, I had the whole of these monthly temperatures projected in the form of fifty-six annual curves of temperature. The result, however, does not seem at present to warrant the labour and expense of reducing and engraving them. Looking, however, in a general way at these curves, or at the numbers in the preceding table, we note three leading characteristics of any year. I. The mean temperature of the year, or the position of the line of abscissæ of the curve for that year. II. The annual range due to season. III. The earliness or lateness of the season, or the period of culmination of the curve for the year.* We shall consider these elements of climate more particularly.

36. I. *Mean Temperature of the Year*.—The mean of the whole period, deduced from nearly 35,000 observations, is $46^{\circ}\cdot75$, or if we exclude the Dunfermline observations, $46^{\circ}\cdot88$.†

The highest annual mean was that of 1846, amounting to,	. . .	49°60
The lowest was that of 1799,	. . .	44°44
The range,		5·16

The higher limit was nearly touched in 1826 and 1834; the lower limit in 1816 and 1838.‡ The following table contains the order of the years, taken with respect to mean temperature, beginning with the highest:—

TABLE II.—THE SEASONS ARRANGED ACCORDING TO THE MEAN TEMPERATURE, BEGINNING WITH THE HIGHEST.

1. 1846	8. 1822	15. 1805	22. {1811	29. 1840	36. 1815	43. 1830	50. 1812
2. 1834	9. 1832	16. 1847	23. {1848	30. 1801	37. 1839	44. 1807	51. 1823
3. 1826	10. 1843	17. 1804	24. 1808	31. {1803	38. 1797	45. 1836	52. 1829
4. 1828	11. 1798	18. 1824	25. 1802	32. {1841	39. {1819	46. 1837	53. 1814
5. 1806	12. 1831	19. 1833	26. {1809	33. 1849	40. {1845	47. 1800	54. 1838
6. 1825	13. 1821	20. 1827	27. {1835	34. 1813	41. 1810	48. 1817	55. 1816
7. 1842	14. 1818	21. 1850	28. 1844	35. 1796	42. 1820	49. 1795	56. 1799

* In the usual approximate expression for the annual curve of temperature represented by the curve of sines, where t is the temperature of any day of the year, x the time reckoned from the commencement of the year, then, $t = A + B \sin(x + u_1)$. The three constants, A , B , and u_1 , refer to the three particulars specified in the text. The equation to the annual curve will be more fully considered farther on (in § 6).

† It will be seen how nearly this coincides with Mr JARDINE'S deductions from the temperature of springs, viz., $47^{\circ}\cdot08$. (Art. 15, note).

‡ The mean temperature of Greenwich for seventy-nine years (1771–1849) is estimated by Mr GLAISHER at $48^{\circ}\cdot29$, or only $1^{\circ}\cdot54$ above that of Edinburgh. The fluctuation of the mean annual temperature at Greenwich was $6^{\circ}\cdot2$, or within the period of the Edinburgh observations (1795–1850) $5^{\circ}\cdot6$. (Phil. Trans., 1850.)

37. II. *The Annual Range*, as roughly represented by the difference of the hottest and coldest months, varied from $30^{\circ}7$ in 1814 to $17^{\circ}9$ in 1836. The mean is $24^{\circ}1$.* The importance of this element in estimating the character of any year with respect to temperature, is well illustrated by comparing the years 1826 and 1828, which stand third and fourth on the list of mean annual temperature; but whereas the former was the hottest summer recollected in Scotland, the last was remarkably the reverse, the annual mean being kept up by the mildness of both the preceding and following winter. Table III. contains the years arranged according to the amount of the Annual Range, where it will be seen that 1826 stands *fourth* in order, and 1828 *fifty-fifth*.

TABLE III.—THE SEASONS ARRANGED ACCORDING TO THE DIFFERENCE OF HOTTEST AND COLDEST MONTHS, BEGINNING WITH THE GREATEST DIFFERENCE.†

1. 1814	8. 1801	15. 1847	22. 1837	29. 1811	36. 1818	43. 1813	50. 1849
2. 1838	9. 1850	16. 1820	23. 1843	30. 1804	37. 1802	44. 1845	51. 1816
3. 1795	10. 1803	17. 1798	24. {1827	31. 1844	38. 1839	45. 1824	52. 1821
4. 1826	11. 1846	18. 1848	25. {1829	32. 1806	39. 1822	46. 1835	53. 1834
5. 1796	12. 1808	19. 1831	26. 1815	33. 1841	40. 1799	47. 1817	54. 1832
6. 1807	13. 1809	20. 1823	27. 1833	34. 1825	41. 1840	48. 1812	55. 1828
7. 1819	14. 1800	21. 1842	28. {1805	35. 1830	42. 1810	49. 1797	56. 1836

38. It may be interesting to classify the years in the order of the mean temperature of the *hottest month*, distinguishing which month that is, as in the following Table :—

TABLE IV.—CONTAINING THE MEAN TEMPERATURE OF THE HOTTEST MONTH IN EACH YEAR.

1808	$62^{\circ}8$	July	1824	$59^{\circ}89$	July
1803	$62^{\circ}74$	July	1802	$59^{\circ}72$	August
1826	$61^{\circ}98$	July	1818	$59^{\circ}7$	July
1807	$61^{\circ}9$	July	1837	$59^{\circ}61$	July
1847	$61^{\circ}77$	July	{ 1804	$59^{\circ}26$	June
1819	$61^{\circ}7$	August	{ 1834	$59^{\circ}26$	July
1846	$61^{\circ}60$	June	1822	$59^{\circ}22$	June
1825	$61^{\circ}40$	July	1795	$59^{\circ}19$	August
1798	$61^{\circ}36$	June	1848	$59^{\circ}18$	July
1800	$60^{\circ}72$	July	1796	$59^{\circ}17$	August
1805	$60^{\circ}4$	July	1838	$59^{\circ}15$	July
1801	$60^{\circ}21$	August	1840	$59^{\circ}14$	August
1831	$60^{\circ}10$	August	1850	$59^{\circ}11$	July
1842	$59^{\circ}93$	August	1835	$59^{\circ}09$	August

* According to Mr GLAISHER, the mean difference of the hottest and coldest months at Greenwich for 79 years (1771–1849) is $28^{\circ}5$, varying from $37^{\circ}1$ to $21^{\circ}3$. The climate of Greenwich is therefore more extreme than that of Edinburgh. The mean temperature of January is nearly a degree higher at Edinburgh than at Greenwich.

† In this Table the months in all cases belonged to the same Calendar Year.

TABLE IV. (*continued.*)

1806	58.9	August	1821	57.55	August
1797	58.88	July	{ 1820	57.3	July
1833	58.87	July	{ 1841	57.30	August
1843	58.78	July	1799	57.05	July
1839	58.63	July	1849	57.01	August
1827	58.45	July	1844	56.89	July
1814	58.4	July	1845	56.81	June
1810	58.3	August	1829	56.55	July
1811	58.2	July	1823	56.40	July
1813	58.0	July	1817	56.3	July
1830	57.72	July	1812	56.1	August
1832	57.71	July	1836	56.00	July
1809	57.7	July	1816	54.8	July
1828	57.63	July			
1815	57.6	July	Mean of the whole, 58°.91		

From whence it appears, that in 56 years June was five times the hottest month, July thirty-six times, and August fifteen times.*

39. If we make a similar comparison for the coldest month of the year, we shall find it to range over no less than five calendar months from November to March. In the following Table it is to be observed, that when November or December is set down as the coldest month, it means that it was colder than the immediately *succeeding* January, February, or March. [In Tables III. and IX. the monthly ranges are those strictly included within the year.]

TABLE V.—CONTAINING THE MEAN TEMPERATURE OF THE COLDEST MONTHS OF EACH WINTER.

1814	27.7	January	1843	34.28	February
1838	29.82	February	1799–1800	34.30	December
1795	30.03	January	1830	34.32	January
1796–7	31.03	December	1846–7	34.39	December
1823	31.06	January	{ 1831	34.69	January
1809	31.1	January	{ 1833	34.69	January
1850	31.50	January	1837	34.78	March
1820	31.6	January	1799	34.87	February
1829	32.08	January	1842	34.98	January
1801–2	32.53	December	1806	35.0	January
1844–5	32.98	December	1800–1	35.12	December
1826	33.19	January	1803	35.19	January
1815	33.4	January	1804	35.22	February
1841	33.43	January	1812–13	35.3	December
1848	33.64	January	{ 1816–17	35.4	December
1827	33.98	February	{ 1817–18	35.4	December
{ 1807–8	34.1	November	{ 1812	35.5	January
{ 1811	34.1	January	{ 1839	35.50	January
{ 1815–6	34.1	December	1804–5	35.68	December

* Reducing Mr GLAISHER's numbers for Greenwich in proportion to the number of years, they would give—June $3\frac{1}{2}$, July 33, August $17\frac{1}{2}$, September 2. The maximum occurs, therefore, later at Greenwich than at Edinburgh.

TABLE V. (*continued.*)

1844	35·77	February	1795-6	37·80	November
1810	36·1	February	1835	37·88	January
1819	36·6	February	1821	38·29	January
1807	36·8	Feb. and March	1824-5	38·42	December
{ 1798	37·09	January	1845-6	38·77	December
{ 1849	37·09	January	1822	39·05	January
1836	37·15	February	1832	39·13	January
1823-4	37·32	December	1828	39·45	January
1840	37·47	February	1833-4	40·30	December

40. Thus it appears that out of fifty-six winters, the lowest monthly mean temperature occurred twenty-seven times in January, fifteen times in December, ten and a half times* in February, twice in November (in 1795 and 1807), and one and a half times in March (in 1807 and 1837).†

41. III. *The Epoch of Highest Temperature* mainly determines the earliness or lateness of the season. It is well known that in these latitudes the mean epochs of greatest heat and cold are, on a long average of years, nearly six months apart.‡ But in any given year, the fluctuations of temperature in winter are so irregular, as to make it very difficult to define the inferior culmination of the curve of temperature. I employ, therefore, the position of the maximum, as deciding the character of the season with respect to earliness or lateness. This has been approximately determined by a very simple process of approximation, which I used in my paper on the Temperature of the Earth at Different Depths.§ The rule is as follows:—" Calling A the excess of the mean temperature of the hottest month above the *preceding* month, B the excess of the mean temperature of the hottest above the *following* month; Then $15 \times \frac{A-B}{A+B}$ is the number of days $\pm$ that the hottest day of the year $\begin{cases} \text{follows} \\ \text{precedes} \end{cases}$ the 15th day of the hottest month."

42. The results of this (merely approximate) estimate will be given in a future table (see Table IX. col. 5, below). In the meantime, the following is the classification of the seasons, as early or late. The earliest date was June 22d in 1845, the latest August 14th in 1795.

* When the temperature of February and March was the same, as in 1807, then one-half is the proportion for each.

† Mr GLAISHER's numbers for Greenwich would give for a like number of years, January 30, December 15, February 10, March 1, November 0.

‡ See QUETELET on the Climate of Brussels, and § 6 of the present paper.

§ Edin. Trans., vol. xvi. p. 216.

TABLE VI.—THE SEASONS ARRANGED AS EARLY OR LATE BY THE DATE OF SUMMER MAXIMUM.

1. 1845*	8. 1818	15. 1817	22. 1808	29. 1797	36. 1815†	43. 1849	50. 1796
2. 1846*	9. 1850	16. 1824	23. {1799	30. 1807	37. {1816	44. 1831	51. 1810
3. 1798	10. {1826	17. 1828	24. {1803	31. 1834	38. {1823	45. {1812	52. 1821
4. 1822	11. {1827	18. 1830	25. {1811	32. {1809	39. {1832	46. {1835	53. {1801
5. 1804	12. 1833	19. 1839	26. {1813	33. {1814	40. 1843	47. 1841	54. {1802
6. 1836	13. {1837	20. 1844	27. {1838	34. {1825	41. 1805	48. {1819	55. {1842
7. 1829	14. {1848	21. 1847	28. 1820	35. {1800	42. 1806	49. {1840	56. 1795

SECT. 4. *On the Annual and Monthly Fall of Rain at Edinburgh for Thirty-eight years.*

43. Mr ADIE appears always to have paid great attention to the amount of rain.

44. The rain-gauge used by him was a metal funnel, about $6\frac{1}{2}$ feet above the ground, with a glass tube connected with it, and a stop-cock, by means of which the depth of rain was at once indicated.†

45. The following Table contains the monthly results for thirty-eight complete years, and part of two others. I have been unable to find a comparable register for the years omitted; but even had one existed for a neighbouring locality, the seemingly capricious variations of this element of climate would make it hazardous to attempt any arbitrary reduction from one spot to another:—

* In these two years, and also in 1810, there is some ambiguity owing to a double maximum occurring in June and August. In 1845 and 1846, at least, the effective maxima must be held to have occurred in July.

† Mr ALEXANDER J. ADIE has favoured me with the following information about his father's rain-gauges:—"Linlithgow, 14th March 1859.—My belief is, that there were but two gauges used in all the time the register was kept, and that the one still standing in the garden at Canaan Cottage was the only one used after that at Merchant Court was broken up. The second gauge is about $6\frac{1}{2}$ feet above the ground, and of the ordinary form of the funnel mouth, with the glass tube and scale at the side. Falls of snow were taken by pushing down a cylinder through the snow in an open place, melting it, and measuring the depth of water for the fall had it been in rain."

TABLE VII.—MONTHLY FALL OF RAIN AT EDINBURGH.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Year.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1795	2.81	3.87	1.37	3.01	1.20	3.92	2.12	3.62	1.12	4.87	4.58	3.81	36.60
1796	3.28	1.40	.43	1.09	1.43	1.03	2.77	.45	2.21	1.19	1.31	1.06	17.65
1797	1.32	.67	1.20	1.47	1.96	2.18	5.19	4.50	2.99	3.24	1.20	1.26	27.18
1798	1.80	.55	1.52	1.56	1.62	2.53	2.10	2.99	2.28	2.15	2.07	1.41	22.58
1799	.89	1.57	.47	2.15	3.27	.87	2.60	5.66	4.02	1.99	1.79	1.23	26.51
1800	3.26	.49	1.34	2.05	2.50	.53	.40	1.26	2.53	3.33	.98	2.91	21.58
1801	1.75	1.44	.82	.60	1.99	.20	5.25	.88	2.66	1.59	1.06	2.17	20.41
1802	.71	1.87	.69	.73	.86	2.21	4.19	2.13	2.37	2.43	2.09	1.02	21.30
1803	.80	1.56	.74	1.16	1.13	1.35	.86	2.00	1.82	1.00	2.26	1.13	15.81
1804	3.72	.57	2.58	2.04	1.58	1.32	1.86	3.91	.71	2.37	1.92	1.96	24.57
1805	.65	1.58	.....	.64	1.01	1.38	.....	2.83	.....	.....	.....	.....	.....
1822	1.23	2.50	3.57	1.41	1.80	1.36	4.53	2.36	1.27	2.39	2.12	1.60	26.14
1823	2.23	3.85	.66	1.68	2.35	1.	4.25	3.87	1.82	3.10	1.07	4.38	30.26
1824	.87	1.70	1.34	.57	.63	2.01	1.58	1.50	1.62	4.73	4.38	3.88	24.81
1825	1.31	.69	.43	1.41	3.25	2.05	.15	1.89	2.85	2.19	3.91	1.99	22.12
1826	.55	1.77	1.33	1.52	1.25	.30	2.31	1.83	1.01	1.38	.76	1.26	15.27
1827	3.33	1.58	4.84	2.74	1.28	1.62	2.27	4.89	1.15	4.97	1.02	2.90	32.59
1828	1.70	.98	1.18	1.42	1.85	.81	4.57	3.43	2.31	.86	3.94	2.18	25.23
1829	2.49	1.61	.32	3.35	.77	2.03	4.48	6.80	1.77	2.53	2.48	1.33	29.96
1830	.95	1.21	1.78	2.28	1.96	2.54	6.57	6.69	3.63	.16	3.13	2.35	33.25
1831	.66	3.88	1.97	1.54	.69	1.41	2.44	4.03	1.55	2.15	2.95	1.26	24.53
1832	.61	1.42	1.29	1.21	1.35	2.89	1.14	3.64	.92	5.53	.95	2.28	23.23
1833	.57	2.53	1.43	1.34	.79	3.48	1.53	1.16	2.37	1.13	.71	3.84	20.88
1834	3.28	.86	1.65	.44	.51	1.45	3.20	1.18	4.50	1.23	1.22	1.52	21.04
1835	1.08	2.48	2.28	.79	2.04	1.02	1.37	1.99	5.43	2.09	2.76	1.89	25.22
1836	4.06	1.62	3.79	1.54	.56	2.50	6.53	2.45	2.81	1.66	3.05	2.46	33.03
1837	1.23	2.14	1.28	1.61	1.53	2.86	4.54	4.13	1.73	2.02	2.03	1.67	26.77
1838	2.47	1.21	2.76	1.78	2.90	5.16	2.45	2.97	4.00	1.55	3.06	.73	31.04
1839	1.76	1.45	1.47	.33	.47	3.91	3.51	1.77	3.09	2.38	1.65	1.66	23.45
1840	3.72	1.58	.43	.19	3.97	2.75	3.46	1.99	2.39	2.01	2.33	.68	25.50
1841	1.23	1.64	.60	1.14	1.14	1.56	3.87	3.64	2.63	4.53	2.28	1.96	26.22
1842	1.01	1.11	3.44	.15	1.45	.97	1.53	1.36	1.45	.98	1.63	1.79	16.87
1843	1.69	1.38	.99	1.87	2.99	2.26	3.59	1.40	.89	4.20	2.20	.34	23.80
1844	1.23	1.72	2.42	.40	.15	2.71	2.39	2.11	2.70	.82	3.92	.37	20.94
1845	1.77	.61	1.67	.40	2.24	3.08	1.72	3.48	1.77	6.14	1.70	2.04	26.62
1846	2.64	1.60	.97	2.88	1.27	3.59	4.17	5.01	3.35	3.60	1.74	.72	31.54
1847	.51	.79	.13	1.25	4.77	1.79	1.37	.91	1.25	3.48	1.64	4.88	22.77
1848	1.26	5.21	2.80	1.06	.60	6.04	1.36	2.00	1.45	4.56	2.42	1.84	30.60
1849	2.84	.97	1.05	1.64	1.66	2.45	2.58	2.31	2.02	1.74	1.50	1.45	22.21
1850	1.62	2.84	.14	.88	3.14	1.18	1.63	2.20	1.83	.....	.....	.....	.....
Means,	1.77	1.71	1.51	1.38	1.69	2.10	2.89	2.83	2.26	2.58	2.15	1.92	25.00*
TOTAL, 24.79.													

* For 38 complete years.

46. The average rain-fall at Edinburgh is therefore exactly 25 inches, ranging from 36·60 in 1795 to 15·27 in 1826. The order of the seasons from Wet to Dry is shown in the following Table for the years which are complete :—

TABLE VIII.—THE SEASONS ARRANGED FROM WET TO DRY.

1.	1795	8.	1823	15.	1822	22.	1843	29.	1800	36.	1842	The years are from 1795–1804, and from 1822–1849 inclusive.
2.	1830	9.	1829	16.	1840	23.	1839	30.	1802	37.	1803	
3.	1836	10.	1797	17.	1828	24.	1832	31.	1834	38.	1826	
4.	1827	11.	1837	18.	1835	25.	1847	32.	1844	...	...	
5.	1846	12.	1845	19.	1824	26.	1798	33.	1833	...	...	
6.	1838	13.	1799	20.	1804	27.	1849	34.	1801	...	...	
7.	1848	14.	1841	21.	1831	28.	1825	35.	1796	...	...	

47. The means of the columns of Table VII. show the following averages of rain-fall according to the season :—

WINTER.			SPRING.			SUMMER.			AUTUMN.		
	Inch.	Inch.		Inch.	Inch.		Inch.	Inch.		Inch.	Inch.
Dec.	1·92	5·40, or	Mar.	1·51	4·58, or	June,	2·10	7·82, or	Sept.	2·26	6·99, or
Jan.	1·77	21·8 per	April,	1·38	18·4 per	July,	2·89	31·6 per	Oct.	2·58	28·2 per
Feb.	1·71	cent.	May,	1·69	cent.	Aug.	2·83	cent.	Nov.	2·15	cent.*

48. It thus appears that at Edinburgh spring is decidedly the driest, and summer decidedly the wettest, quarter of the year. If we project the monthly results, we obtain a pretty regular curve, showing a minimum about the middle of April, and a maximum about the end of July, but October has a slight maximum of its own. Of individual rainfalls, Mr ADIE noted, on the 18th November 1795, 2·89 inches within 24 hours; on the 30th July 1797, 2·63 inches; and on the 18th August 1797, 2·56 inches, nearly the whole of which fell within 6 hours from 2 to 8 P.M.

SECT. 5. *General Remarks on the Succession of the Seasons for the period 1796–1850 and their Extremes.*

49. The following Table contains a concise view of the succession of the seasons from 1795 to 1850. It is difficult to trace any periodic recurrence of good and bad seasons, although it is very plain that they happen for the most part in groups of usually from seven to ten or twelve years' duration.† This is well seen by the third column of Table IX., showing the annual deviations of the

* The sum total at all seasons is 24·79 inches, which is slightly below the average of 38 complete years given above. This arises from the partial observations of 1805 and 1850 (which are below the average) being included in the monthly means.

† There is a slight appearance (from Table IX. column 2) of alternate ten-year periods below and above the mean, commencing in 1793 or 1794, and terminating in 1852 or 1853,—

The maxima would be 1809, 1829, 1849.

The minima would be 1799, 1819, 1839.

mean temperature from the average of fifty-six years. The succeeding columns show, *First*, the range of the monthly means within one and the same year. *Secondly*, the approximate date of the maximum temperature of summer, deduced from the monthly means, on which some remarks have already been made in Art. 41. *Thirdly*, the highest and lowest *mean temperature of any day* in each year, with the dates (the Dunfermline observations not included). *Fourthly*, the *extreme* temperatures occurring in any year, with the dates (confined to the period for which self-registering instruments were used). The highest individual temperature noted in the twenty-eight years 1822–1850, was 87° , on the 24th and 26th June 1826, and on the 17th June 1839; and the lowest, 5° , occurred on the 31st January 1845 and the 29th January 1848.

50. It will easily be seen that the second, fourth, and fifth columns afford the means of supplying the approximate constants for the curve of each year denoted by A, B, and u_1 , in the note to Art. 35, and in § 6, below. It might be wished that these constants were compared in several moderately distant localities (for example over Europe), to see how far the characteristic features of any season may be held to extend. By this means it might even be possible, after ascertaining the proportional constants for each season, to infer the characters of the climate of any locality from a few years' observation only. Even were this method applicable to so limited an area as that of Great Britain, it might be of great use in generalizing meteorological results.

TABLE IX.—SHOWING THE GENERAL AND EXTREME CHARACTERS OF EACH SEASON.

Year.	Mean Temp.	Deviation from the Mean.	Highest and Coldest Months.	Calculated Time of greatest Heat.†	Highest Mean Daily Temp.	Date.	Lowest Mean Temp.	Date.	Difference or Range.	Extreme Heat.	Date.	Extreme Cold.	Date.	Extreme Range.
1795	45.67	-1.08	29.16	Aug. 14	68.5	Aug. 12	16.5	Jan. 29	52.	...	.....	...	.....	...
1796	46.46	-0.29	28.14	Aug. 10	68.	June 30	18.5	Dec. 24	49.5	...	.....	...	.....	...
1797	46.33	-0.42	20.38	July 22	67.5	July 14	24.	Nov. 29	43.5	...	.....	...	.....	...
1798	47.59	+0.84	25.64	June 25	69.	June 28	21.5	Dec. 28	47.5	...	.....	...	.....	...
1799	44.44	-2.31	22.75	July 19	67.	June 21, 22	20.	Dec. 31	47.	...	.....	...	.....	...
1800	45.70	-1.05	26.19	July 24	70.	July 24	23.	Dec. 30	47.	...	.....	...	.....	...
1801	46.67	-0.08	27.68	Aug. 13	69.	Aug. 19	25.	Dec. 19	44.	...	.....	...	.....	...
1802	46.86	+0.09	23.15	Aug. 13	67.	Aug. 17	24.5	Jan. 1, 6, 7	42.5	...	.....	...	.....	...
1803	46.63	-0.12	27.55	July 19	77.	July 18	19.5	Jan. 13	57.5	...	.....	...	.....	...
1804	47.31	+0.56	24.04	June 28	66.	Sept. 14	21.	Feb. 7, D ^c 31	45.	...	.....	...	.....	...
1805	47.41	+0.66	24.1	July 30	.....	.....	.....	.....	.....	...	.....	...	.....	...
1806	48.26	+1.51	23.9	Aug. 1	.....	.....	.....	.....	.....	...	.....	...	.....	...
1807	45.82	-0.93	27.8	July 22	.....	.....	.....	.....	.....	...	.....	...	.....	...
1808	46.91	+0.16	27.0	July 18	.....	.....	.....	.....	.....	...	.....	...	.....	...
1809	46.80	+0.05	26.6	July 23	.....	.....	.....	.....	.....	...	.....	...	.....	...
1810	46.26	-0.49	22.5	Aug. 10	.....	.....	.....	.....	.....	...	.....	...	.....	...
1811	47.00	+0.25	24.1	July 19	.....	.....	.....	.....	.....	...	.....	...	.....	...
1812	45.32	-1.43	20.8	Aug. 6	.....	.....	.....	.....	.....	...	.....	...	.....	...
1813	46.48	-0.27	22.1	July 20	.....	.....	.....	.....	.....	...	.....	...	.....	...
1814	45.21	-1.54	30.7	July 23	.....	.....	.....	.....	.....	...	.....	...	.....	...
1815	46.40	-0.35	24.2	July 24	.....	.....	.....	.....	.....	...	.....	...	.....	...
1816	44.46	-2.29	19.6	July 25	.....	.....	.....	.....	.....	...	.....	...	.....	...
1817	45.69	-1.06	20.9	July 15	.....	.....	.....	.....	.....	...	.....	...	.....	...
1818	47.42	+0.67	23.2	July 5	.....	.....	.....	.....	.....	...	.....	...	.....	...
1819	46.27	-0.48	27.7	Aug. 9	.....	.....	.....	.....	.....	...	.....	...	.....	...
1820	46.11	-0.64	25.7	July 21	.....	.....	.....	.....	.....	...	.....	...	.....	...
1821	47.44	+0.69	19.26	Aug. 11	67.5	July 19	17.	Jan. 3	50.5	...	.....	...	.....	...
1822	47.82	+1.07	23.11	June 26	65.5	June 5	25.	Dec. 28, 29	40.5	80	June 13	18	Dec. 28	62
1823	45.30	-1.45	25.34	July 25	66.	Aug. 11	19.	Feb. 5	47.	75	Aug. 11	11	Feb. 5	64
1824	47.26	+0.51	21.47	July 16	72.	Sept. 2	22.5	Dec. 5	49.5	85	Sept. 2	16	Dec. 5	69
1825	48.19	+1.44	23.43	July 23	70.5	July 14	27.	Jan. 5, F ^b 4	43.5	83	July 30, 31	19	Nov. 10	64
1826	48.66	+1.91	28.79	July 12	74.	June 28	18.	Jan. 16	56.	87	June 24, 26	10	Jan. 16	77
1827	47.11	+0.36	24.47	July 12	63.5	Jy 16, S ^b 16	19.	Jan. 3	44.5	77	July 16	14	Jan. 3	63
1828	48.46	+1.71	18.18	July 16	66.	June 27	23.	Jan. 11	43.	76	Aug. 27	15	Jan. 11	61
1829	45.23	-1.52	24.47	July 3	65.	Aug. 8	22.5	Jan. 22	42.5	75	July 13	15	Jan. 22, 25	60
1830	45.98	-0.77	23.40	July 16	68.	July 26	22.	Dec. 24	46.	81	July 28	15	Dec. 25, 26	66
1831	47.48	+0.73	25.41	Aug. 3	67.	July 29, 31	26.	Feb. 4	41.	76	July 31	19	Feb. 4	57
1832	47.72	+0.97	18.58	July 25	65.	Aug. 10	29.5	Jan. 3, 27	35.5	75	Aug. 10	24	Jan. 27	51
1833	47.19	+0.44	24.18	July 13	67.5	July 28	27.	Jan. 15	40.5	75	July 17, 29	23	Jan. 16	52
1834	48.71	+1.99	18.76	July 22	68.5	Aug. 12	31.	F ^b 21, N ^v 24	37.5	77	Aug. 12	20	Mar. 24	57
1835	46.80	+0.05	21.21	Aug. 6	66.5	Aug. 11	28.	Jan. 20	38.5	77	Aug. 4, 10	22	Jan. 21	55
1836	45.73	-1.02	17.91	July 2	65.	June 15	28.	Dec. 26	37.	76	June 15	24	Jan. 19	52
1837	45.72	-1.03	24.61	July 14	64.	July 6	23.	Jan. 11	41.	73	July 10	16	Jan. 12	57
1838	44.72	-2.03	29.33	July 20	68.5	July 12	18.	Jan. 21	50.5	84	Sept. 9	13	Feb. 13	71
1839	46.36	-0.39	23.13	July 17	66.5	June 17	21.	Feb. 21	42.5	87	June 17	13	Jan. 30	74
1840	46.72	-0.03	22.56	Aug. 9	67.5	Aug. 21	27.5	Dec. 24	40.	78	Aug. 9	21	J ⁿ 30, F ^b 27	57
1841	46.63	-0.12	23.87	Aug. 7	67.	Aug. 20	21.5	Jan. 9	45.5	79	June 10	8	Jan. 9	71
1842	47.96	+1.21	24.95	Aug. 13	68.?	Aug. 13?	26.5	Jan. 16	41.5	79	July 23	18	Jan. 16, 17	61
1843	47.62	+0.87	24.50	July 26	67.	July 14	24.	Feb. 15	43.	77	July 14	16	Feb. 15, 17	61
1844	46.73	-0.02	23.91	July 17	66.	July 22, 25	24.5	Feb. 21	41.5	77	Sept. 1	13	Feb. 27	64
1845	46.27	-0.48	21.60	June 22†	69.	June 12	18.	Jan. 31	51.	79	June 12, 13	5	Jan. 31	71
1846	49.60	+2.85	27.21	June 21†	71.5	June 5	25.5	Dec. 25	46.	84	June 5	16	Dec. 18	68
1847	47.39	+0.64	25.93	July 17	75.5	July 12	25.5	F ^b 8, 9, D ^c 31	50.	83	July 14	17	Feb. 8, 9	66
1848	47.00	+0.25	25.54	July 14	68.5	July 13	17.5	Jan. 29	51.	82	July 13	5	Jan. 29	77
1849	46.51	-0.24	20.37	Aug. 2	65.5?	July 10?	20.	Jan. 2	45.5?	78	June 5	19	Jan. 4, 6	59
1850	47.02*	+0.27	27.61?	July 7	68.5	June 24	19.5	Jan. 17	49.	78	July 23	12	Jan. 18	66
Mean,	46.75	.....	24.08		68.0	July 19.5	22.8	Jan. 11.9	45.2					

* Three months of 1850 are supplied from the general average of those months.

† Calculated by Formula of Art. 41.

‡ See Note to Table VI.

51. Table X. shows the succession of the seasons in a somewhat different form; the seasons being indicated as *Hot or Cold*, *Extreme or not*, *Summer Hot or Cold*, *Early or Late*, *Rainy or Dry*. The numbers affixed to any year, denote its Rank in those respects amongst all the years for which the observations were made. They are in fact the numbers in the Tables II., III., IV., VI., and VIII., arranged chronologically instead of quantitatively. The seventh column refers to the Price of Grain, which is considered in the concluding section of the present paper.

TABLE X.—SHOWING THE RELATIVE CHARACTERS OF FIFTY-SIX SUCCESSIVE SEASONS IN CHRONOLOGICAL ORDER.

	Hot or Cold.	Summer, Hot or Cold.	Extreme or not.	Early or Late.	Rainy or Dry.	Oats, Cheap or Dear.		Hot or Cold.	Summer, Hot or Cold.	Extreme or not.	Early or Late.	Rainy or Dry.	Oats, Cheap or Dear.
1795	49	22	3	56	1	36	1823	51	52	20	38	8	38·5
1796	35	24	5	50	35	10	1824	18	15	45	16	19	28
1797	38	30	49	29	10	3	1825	6	8	34	33	28	32
1798	11	9	17	3	26	5	1826	3	3	4	10·5	38	48
1799	56	47	40	24	13	52	1827	20	34	24·5	10·5	4	24
1800	47	10	14	35·5	29	55	1828	4	42	55	17	17	34
1801	30	12	8	54	34	23	1829	52	51	24·5	7	9	21·5
1802	25	16	37	54	30	17	1830	43	39	35	18	2	38·5
1803	31·5*	2	10	24	37	26	1831	12	13	19	44	21	26
1804	17	19·5	30	5	20	34	1832	9	40	54	38	24	6
1805	15	11	28·5	41	...	...	1833	19	31	27	12	33	3
1806	5	29	32	42	...	38·5	1834	2	19·5	53	31	31	14
1807	44	4	6	30	...	51	1835	26·5	28	46	45·5	18	14
1808	24	1	12	22	...	47	1836	45	56	56	6	3	41
1809	26·5	41	13	33	...	53	1837	46	18	22	13·5	11	18
1810	41	36	42	51	...	29	1838	54	25	8	26·5	6	42
1811	22·5	37	28·5	24	...	45	1839	37	33	38	19	23	34
1812	50	54	48	45·5	...	54	1840	29	26	41	48·5	16	11·5
1813	34	38	43	26·5	...	43	1841	31·5	45·5	33	47	14	11·5
1814	53	35	1	33	...	31	1842	7	14	21	54	36	8
1815	36	43	26	35·5	...	7	1843	10	32	23	40	22	19
1816	55	56	51	38	...	49	1844	28	49	31	20	32	21·5
1817	48	53	47	15	...	45	1845	39·5	50	44	1†	12	38·5
1818	14	17	36	8	...	45	1846	1	7	11	2†	5	50
1819	39·5	6	7	48·5	...	26	1847	16	5	15	21	25	30
1820	42	45·5	16	28	...	20	1848	22·5	23	18	13·5	7	9
1821	13	44	52	52	...	16	1849	33	48	50	43	27	1
1822	8	21	39	4	15	14	1850	21	27	9	9	...	3

* When in this and the following columns two years are designated by the same number (whether whole or fractional), it indicates that they were *equally* hot, or extreme, or rainy (as the case may be), and the mean of the numbers is assigned to them which they would have had if there had been an inequality.

† These positions are not the true ones, for the reason assigned in the Note to Table VI. In both years, however, the actual highest temperature, both in the extremes and in the mean of the day and of the month, occurred in June.

SECTION 6. *On the Form of the Annual Curve of Temperature at Edinburgh, and on its Accidental Fluctuations.*

52. The method usually employed to represent the annual curve of temperature, is to take the mean temperature of the twelve separate months (each month being represented in extent by 30° or one-twelfth of an entire circumference), and to express them by a series of the form—

$$y_n = A + B \sin (30^\circ \times n + u_1) + C \sin (30^\circ \times 2n + u_2) + D (30^\circ \times 3n + u_3) + \&c.$$

Where y_n is the temperature of any month whose number is n (reckoning January=0, February=1, &c.) Eliminating the constants (by the method given, for example, in DOVE's *Repertorium*, vol. ii. p. 275, or "Encyclopædia Britannica" (8th Edition), Art. *Meteorology*, p. 665, we obtain the following numerical formula:—

$$y_n = 46^\circ.88 - 10^\circ.83 \sin (30n + 83^\circ.28') + 0^\circ.963 (60n + 52^\circ.8'), + \&c.$$

(the fourth term is negligible, its greatest value being only $0^\circ.104$).

53. A comparison of this calculation with the observations collected in Table I. gives the following results:—

TABLE XI.

Month.	Temperature.		Excess of Calculation.	Month.	Temperature.		Excess of Calculation.
	Observed.	Calculated.			Observed.	Calculated.	
January,.....	36°64	36°88	+ 0°24	July,.....	58°29	58°40	+ 0°11
February,....	37°92	37°84	— 0°08	August,.....	57°49	57°70	+ 0°21
March,.....	40°58	40°53	— 0°05	September, ..	53°72	53°46	— 0°26
April,.....	44°84	44°89	+ 0°05	October,.....	47°49	47°35	— 0°14
May,.....	50°26	50°30	+ 0°04	November,...	41°17	41°68	+ 0°51
June,.....	55°65	55°45	— 0°20	December,...	38°57	38°05	— 0°52

54. Consequently, the mean temperatures of the months are satisfactorily represented by the formula. It is evident, however, that the annual curve drawn through the mean temperatures of the months will lie somewhat too low during the hotter part of the year, and too high in winter; in other words, the inflection of the curve will be too small. This arises from the fact that the mean elevation of a given number of points, which all coincide with the arc of a curve, will necessarily fall *within* the concavity of the curve, and the true curve will be external to the curve of the means, especially if the period embraced in the means be so considerable as thirty days.

55. The correction for this (which, I think, has not usually been made) is easily found, with sufficient approximation, as shown in the subjoined note.*

* Let A B C D be four points in the *true* annual curve which is sought, and which is assumed to be symmetrical on either side. It will be sufficient for a first approximation to assume that these points, so far as they are considered at one time, are situated in a parabolic arc, formed by daily temperatures horizontally equidistant from one another. The mean temperature of the month B C (for example) will lie at β , and not at b in the parabolic arc. In like manner α and γ are the tabular averages for the preceding and following months. We want to find the quantity βb , by

56. The greatest value of this correction of the numbers in the preceding table, in order to obtain the curve of daily mean temperature, is about $0^{\circ}\cdot 15$. As it will only be sensible in the second term of the equation of the annual curve, and as it tends to increase its co-efficient, this latter, instead of $10^{\circ}\cdot 83$, becomes $10^{\circ}\cdot 98$; and if we farther modify the angular constants of Art. 52, so as to adapt them to the beginning of the year as an origin, instead of the middle of January, the formula becomes (x being the distance of any day of the year from the beginning, in angular measure)—

$$y = 46^{\circ}\cdot 88 - 10^{\circ}\cdot 98 \sin (x + 68^{\circ} 28') + 0^{\circ}\cdot 96 \sin (2x + 22^{\circ}).$$

57. If we consider the two first terms only of this formula, the hottest day will be the 23d July; if all three terms, it will be the 27th July. The coldest day in the former case would be the 22d January, or in the latter, the 17th January. The effect of the third term is therefore to shorten the period of declining temperature by about six days, and to increase the period of rise by the same quantity. The days corresponding to the mean temperature of the year shown by the geometric curve are the 28th April and the 18th October. The temperature is therefore above the mean for 173 days, and below it for 182 days.

58. We next proceed to compare this equation with the annual curve in detail, as derived from Mr ADIE's forty years' observations.

which the monthly mean is to be increased, in order to make it coincide with the temperature of the middle day of the month. β is the centre of gravity of the daily temperatures lying in the arc BC. Considering these daily temperatures as equally heavy points distributed uniformly with respect to a double ordinate BC parallel to the tangent at b , we have by the properties of the centre of gravity

$$\beta b = \frac{\int p \cdot \frac{y^2}{2a} dy}{\int p \cdot dy}; \text{ where the equation to the parabola is } y^2 = 2ax, \text{ and where the weight of an indi-}$$

vidual observation is p . Hence we have $\beta b = \frac{y^2}{6a} = \frac{x}{3}$, where x is the abscissa $b b'$ intercepted by the chord or double ordinate BC. In like manner $aa' = \frac{1}{3}aa'$ and $yc = \frac{1}{3}cc'$. But a, c , the points representing the middle of the preceding and following months, are 60 days apart, while B and C are only 30 days apart. Therefore $bD = 4bb'$ and $\beta b = \frac{1}{4}bD$, which is equal (neglecting small quantities) to very nearly $\frac{1}{12}\beta D'$. So that the required correction is found by *increasing* the co-ordinate of temperature expressed by the periodic part of the equation in the text (+ or - as the case may be) at the middle day of each month by $\frac{1}{12}$ of the difference between the mean temperature of the month and the average of the temperatures of the preceding and following months.

TABLE XII.—SHOWING THE MEAN TEMPERATURE FOR EVERY DAY OF THE YEAR AT EDINBURGH, DERIVED FROM FORTY YEARS' OBSERVATIONS;
ALSO FOR EACH OF FOUR DECENNIAL PERIODS; ALSO THE FLUCTUATION IN THE MEAN TEMPERATURE OF EACH DAY IN FORTY YEARS.

JANUARY.																															
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	
1785—1805.....	34.0	34.9	36.4	39.2	38.5	37.0	36.0	35.7	36.5	35.2	34.7	35.2	37.4	37.1	37.2	39.8	39.6	39.1	39.7	39.7	38.4	37.9	38.0	37.4	36.7	38.2	36.0	36.3	35.7	37.8	35.0
1821—1840.....	36.1	34.4	33.1	35.2	33.7	35.8	36.7	35.9	35.5	36.1	34.2	35.3	35.9	35.6	32.7	34.0	34.2	38.1	37.3	38.8	35.3	35.1	36.3	36.2	37.0	36.8	37.9	39.0	41.1	40.9	
1831—1840.....	37.5	37.6	38.6	38.4	37.4	36.6	36.4	36.9	36.1	34.4	35.0	35.8	36.4	34.6	35.5	35.7	37.3	36.8	36.2	36.0	37.5	39.7	39.1	37.9	36.7	36.1	36.3	34.6	34.1	35.5	
1841—1850.....	36.6	33.9	35.7	36.9	37.2	36.0	36.5	36.3	36.3	35.3	35.4	34.7	35.0	34.0	33.1	35.1	35.1	36.3	36.8	35.4	36.1	37.3	39.6	39.7	40.3	38.7	39.2	36.9	37.7	36.2	
MEAN.....	36.10	35.24	35.99	37.46	36.72	36.37	36.17	35.96	35.42	35.26	34.80	35.46	36.06	37.15	36.14	36.15	37.91	38.05	37.34	37.01	38.12	38.15	37.64	38.07	37.45	36.57	37.69	36.94			
Highest M. T. in 40 yrs.....	40.0	41.5	46.0	47.5	47.0	48.0	47.5	48.0	49.0	49.5	47.5	48.0	49.0	52.0	47.0	50.0	50.5	49.0	49.5	50.0	50.5	49.0	48.5	49.5	49.0	48.0	50.0	48.5	50.5	51.0	
Lowest.....	25.0	20.0	17.0	23.0	22.0	26.5	25.0	24.0	21.5	26.0	23.0	24.5	19.5	20.0	19.0	19.5	22.0	22.0	18.5	18.0	18.5	21.5	23.5	24.0	22.5	25.5	24.5	16.5	24.0	18.0	
Fluctuation.....	20.0	21.5	29.0	24.5	24.0	21.5	22.5	26.0	26.5	23.5	23.5	23.5	32.0	27.0	31.0	31.0	27.0	27.5	31.5	32.5	30.5	27.0	26.0	25.0	26.5	22.5	25.5	32.0	26.5	33.0	
FEBRUARY.																															
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.		
1785—1805.....	36.4	37.7	36.7	35.2	35.1	34.1	33.5	37.6	38.9	39.0	37.0	35.2	34.6	35.3	35.4	35.3	34.0	35.0	37.9	38.0	37.9	39.9	39.7	39.3	38.1	37.6	37.6	35.8	35.8		
1821—1840.....	39.8	38.8	36.3	35.8	38.2	40.4	39.4	39.0	39.1	39.4	39.7	38.8	37.9	36.4	37.1	37.5	39.3	38.2	36.8	37.5	38.3	37.3	39.9	40.4	40.3	41.0	39.3	40.0			
1831—1840.....	39.8	36.0	37.0	37.3	39.3	38.9	40.0	40.5	39.5	39.5	39.2	38.0	39.6	40.1	40.8	38.9	39.3	38.9	38.9	38.9	38.4	36.4	38.1	37.4	36.3	35.0	36.2	37.6			
1841—1850.....	36.8	37.4	39.3	38.7	38.5	35.1	34.8	35.4	35.6	36.7	39.1	38.9	39.3	41.2	41.0	39.7	40.9	41.2	41.4	40.8	39.5	40.7	40.3	39.2	37.8	38.0	40.9	40.0			
MEAN.....	37.22	37.25	37.40	36.89	37.20	35.59	37.21	38.21	38.52	38.61	38.51	38.30	37.07	38.51	38.26	38.31	37.86	37.39	37.90	37.97	37.10	38.85	38.57	38.07	37.81	38.24	38.30	39.37			
Highest M. T. in 40 yrs.....	52.5	50.0	51.0	50.5	51.0	50.0	47.0	49.0	51.5	49.5	48.0	48.0	49.5	49.5	50.5	47.5	48.5	54.0	54.0	54.0	53.5	53.0	52.5	52.5	52.5	55.0	51.5				
Lowest.....	22.0	26.0	25.0	24.0	19.0	23.0	28.0	23.5	25.5	28.5	25.5	23.5	19.5	19.0	24.5	24.5	24.0	25.0	26.0	28.0	24.0	25.0	27.0	32.0	29.0	27.5	31.0	31.0			
Fluctuation.....	30.5	24.0	26.0	26.5	32.0	27.0	24.5	25.5	24.0	24.0	24.0	24.5	28.5	30.5	25.5	26.0	23.5	28.0	19.5	24.0	25.0	26.5	21.0	22.5	23.5	25.0	34.0	20.5			
MARCH.																															
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	
1785—1805.....	37.1	36.3	37.6	36.8	35.8	35.7	35.9	38.9	38.8	37.9	37.5	37.1	38.9	38.7	38.2	38.9	39.8	38.8	38.3	38.0	39.2	40.3	41.0	41.9	42.3	42.1	42.0	41.3	40.5	39.7	43.2
1821—1840.....	41.0	39.4	40.2	38.9	37.2	37.3	39.1	39.8	42.3	42.6	42.4	42.7	41.4	41.0	40.6	40.9	41.9	42.7	41.6	41.8	44.0	41.4	41.5	41.3	41.1	41.3	44.5	43.7	43.2	41.3	40.1
1831—1840.....	38.4	39.7	40.4	41.1	39.8	38.6	37.9	37.5	38.9	39.9	40.2	39.4	40.6	40.7	40.4	40.0	39.0	40.5	41.4	42.0	42.2	40.4	39.4	39.5	38.1	37.9	42.2	40.9	40.3	40.8	41.9
1841—1850.....	39.7	41.3	41.6	38.6	40.5	41.9	39.9	41.4	41.2	41.5	41.2	41.8	41.6	43.0	45.6	42.7	42.8	43.6	41.4	40.6	41.4	41.1	42.8	42.9	42.1	41.9	42.4	42.1	42.0	44.5	
MEAN.....	39.09	39.19	39.97	38.86	38.36	38.41	38.96	39.42	40.34	40.37	40.34	40.22	40.65	40.87	41.24	40.66	40.92	41.41	41.49	41.37	41.72	41.60	40.94	40.65	41.00	40.87	42.09	41.52	40.96	42.46	
Highest M. T. in 40 yrs.....	51.0	50.0	51.0	52.5	51.0	50.5	51.0	53.5	52.0	51.0	51.0	51.0	52.0	53.0	56.0	53.0	55.0	55.0	52.5	52.0	51.0	50.5	51.0	51.5	53.0	54.0	55.0	51.0	48.5	52.0	
Lowest.....	26.0	26.0	31.0	29.0	27.5	28.0	27.5	27.0	28.0	31.0	31.0	28.0	28.5	28.5	29.0	27.0	29.5	29.5	29.0	32.5	32.5	32.0	31.5	32.0	30.5	30.5	30.5	29.0	30.5		
Fluctuation.....	25.0	24.0	20.0	23.0	23.5	19.5	23.5	26.0	24.0	20.0	20.0	23.0	24.5	24.5	27.0	28.5	26.5	26.5	22.5	22.5	22.0	18.5	17.5	19.5	21.0	23.5	21.5	20.5	28.0	19.5	
APRIL.																															
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.		
1785—1805.....	42.9	43.2	41.3	41.9	40.9	41.7	43.9	44.4	43.6	43.7	43.0	43.4	44.5	46.7	47.3	45.9	45.8	45.9	45.8	45.1	45.3	46.0	45.7	45.1	46.2	47.2	47.5	46.7	45.7	47.7	
1821—1840.....	46.7	42.1	42.4	43.0	44.4	45.1	43.7	45.0	45.0	45.3	43.1	44.7	44.9	46.1	45.9	46.5	45.3	45.7	45.0	47.3	45.8	45.9	44.4	43.5	44.7	46.8	46.5	50.2	51.1	50.1	
1831—1840.....	40.8	42.0	40.1	42.1	44.3	43.4	42.5	41.7	42.1	43.1	42.0	43.4	43.2	44.2	45.2	42.4	42.3	43.9	44.9	44.8	44.6	46.2	45.4	46.4	47.2	46.9	46.4	45.0	45.5		
1841—1850.....	45.1	45.8	43.0	44.1	45.5	43.6	44.6	44.7	43.0	44.3	43.5	44.4	44.4	46.0	45.4	46.0	45.4	45.3	45.3	44.8	45.0	46.2	46.2	46.4	47.2	46.9	46.4	46.1	45.2	49.0	
MEAN.....	42.50	43.14	42.42	42.51	43.51	43.47	43.20	44.19	43.95	43.96	43.92	44.20	45.40	45.71	45.32	44.76	44.97	45.62	45.71	45.30	45.80	45.95	45.07	45.95	47.01	46.85	47.35	47.51	48.09		
Highest M. T. in 40 yrs.....	51.0	52.0	54.5	53.0	52.0	52.0	53.0	53.5	57.0	59.0	57.5	56.0	52.5	54.0	56.0	53.0	52.0	53.5	55.5	57.0	58.0	57.5	56.5	56.0	57.0	58.5	58.5	59.0	58.5		
Lowest.....	31.5	26.5	31.5	31.0	30.5	33.5	34.5	34.5	34.0	33.5	30.0	35.5	36.0	37.5	33.5	33.5	33.0	36.5	34.5	33.0	34.0	34.0	37.0	39.0	37.0	38.0	37.5	38.0	37.5		
Fluctuation.....	19.5	25.5	23.0	22.0	21.5	18.5	18.5	19.0	23.0	26.0	27.0	21.0	17.0	18.0	18.5	19.5	23.5	23.5	23.0	24.0	24.0	24.5	19.5	17.0	20.0	20.5	21.5	20.0			
MAY.																															
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	
1785—1805.....	48.2	46.6	45.0	47.5	48.5	47.0	47.4	47.9	47.1	47.7	46.6	46.2	45.4	46.7	47.0	49.3	48.8	50.8	51.1	53.1	54.1	55.3	54.6	54.5	53.5	53.6	53.0	53.4	50.7	52.4	
1821—1840.....	50.1	50.0	48.0	49.0	50.3	49.7	49.6	50.0	48.3	48.5	48.2	48.2	49.4	48.8	51.2	51.3	52.6	51.9	50.7	49.6	50.5	50.4	52.3	51.1	51.6	50.3	52.2	51.9	52.7	54.9	
1831—1840.....	45.9	46.9	47.8	48.2	47.1	47.2	47.8	48.1	47.4	48.9	49.4	47.2	47.7	46.9	50.9	51.0	49.8	50.5	51.8	51.0	49.8	50.5	50.5	51.5	51.6	53.0	53.1	53.7	53.5	54.3	
1841—1850.....	49.7	48.1	49.4	47.6	47.6	49.2	47.8	48.2	47.6	49.0	49.7	49.0	52.6	51.9	51.2	51.3	49.6	51.2	49.1	50.6	50.7	52.1	51.8	51.6	53.9	52.6	52.1	53.1	52.1	53.5	
MEAN.....	48.50																														

JULY.																														
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
1795-1804,	57.1	58.0	56.7	57.3	57.4	58.4	57.4	57.4	57.0	58.2	58.2	58.4	60.4	58.3	59.9	59.3	59.5	58.2	59.1	59.7	60.1	58.7	58.8	57.8	58.8	59.2	58.9	58.0	58.3	59.7
1821-1830,	56.4	56.9	56.9	58.0	58.6	56.4	56.8	57.4	57.7	56.5	58.6	57.1	59.4	59.2	59.4	59.5	59.4	60.1	59.6	57.6	60.3	58.9	58.3	59.5	57.7	59.5	60.0	59.5	58.7	58.6
1831-1840,	58.1	57.1	58.2	59.1	61.0	59.3	57.5	58.9	58.5	59.0	57.9	57.0	57.9	58.1	57.9	59.8	56.7	56.8	56.3	56.1	56.7	57.7	58.4	59.1	59.7	61.1	58.6	58.6	59.0	59.0
1841-1850,	56.7	56.6	57.4	58.3	56.1	56.8	56.7	57.3	55.9	59.3	58.0	60.6	60.3	59.4	58.9	58.3	57.7	58.3	58.3	57.8	57.9	58.7	58.5	59.1	59.1	59.3	57.7	56.9	58.8	58.8
MEAN,	57.12	57.17	57.30	58.20	58.31	57.75	57.36	57.79	57.19	58.19	58.35	58.71	59.02	59.04	58.62	58.99	58.00	58.44	58.35	57.90	57.86	58.39	58.26	57.60	58.50	58.72	59.41	59.84	58.45	59.04
Highest M. T. in 40 yrs.,	67.0	68.5	66.0	69.0	69.5	68.0	65.0	69.0	64.5	69.5	68.5	70.5	68.5	68.5	68.5	68.5	72.0	77.0	67.5	65.5	66.5	66.5	67.5	67.5	68.0	68.0	68.0	68.5	70.5	
Lowest,	50.5	48.5	50.0	53.0	50.5	51.0	52.0	51.0	50.5	50.0	50.5	50.5	50.5	50.5	50.5	49.5	48.0	49.0	51.5	53.0	51.5	51.5	51.5	51.5	51.5	53.0	54.0	50.5	51.0	51.5
Fluctuation,	16.5	17.0	16.0	16.0	19.0	17.0	14.0	17.0	13.5	15.0	19.5	25.0	18.0	19.0	15.0	19.0	24.0	23.0	16.0	14.0	12.5	15.0	16.5	18.5	16.0	16.5	14.0	17.5	17.5	19.0

AUGUST.																														
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
1795-1805,	60.1	59.3	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0	58.0
1821-1830,	56.8	58.9	58.5	57.9	57.5	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2	58.2
1831-1840,	57.8	57.3	57.2	58.9	58.0	58.6	59.2	59.4	58.4	60.0	60.1	59.6	57.7	56.8	57.9	58.1	57.0	58.3	57.8	58.1	57.4	57.6	58.0	58.3	58.5	58.9	58.6	58.8	58.5	58.9
1841-1850,	58.9	57.8	56.7	57.2	56.8	58.6	57.5	58.1	57.5	56.5	56.9	58.0	58.9	57.0	56.7	56.5	56.6	57.6	56.7	57.6	56.0	54.8	55.2	54.7	55.0	56.6	57.2	56.4	58.4	57.1
MEAN,	58.42	58.35	57.61	58.02	57.62	58.20	58.36	59.20	58.46	58.19	58.57	58.36	57.76	57.16	57.52	58.30	57.44	58.13	57.56	56.91	55.69	56.96	56.22	56.49	56.07	56.49	55.99	56.85	56.57	55.95
Highest M. T. in 40 yrs.,	65.5	68.0	67.0	64.0	64.5	64.5	65.5	67.5	68.5	66.5	68.5	67.0	66.0	66.0	66.0	66.0	67.0	70.5	68.0	67.5	65.0	64.5	63.0	64.5	63.0	64.5	63.0	66.5	64.5	60.5
Lowest,	50.0	51.5	52.0	51.5	51.0	50.5	52.0	52.5	51.0	52.0	51.0	50.0	46.5	46.5	47.0	48.0	49.0	48.0	48.0	48.5	49.0	48.0	50.0	51.0	50.0	46.5	46.0	47.5	49.0	47.5
Fluctuation,	15.5	16.5	15.0	12.5	13.5	14.0	12.5	15.0	17.5	14.5	15.5	18.5	20.5	19.5	19.0	15.5	18.0	21.5	22.5	20.0	19.0	16.0	18.5	13.0	13.0	18.0	17.0	19.0	15.5	19.0

SEPTEMBER.																														
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
1795-1804,	56.2	56.4	56.2	55.4	55.6	56.1	55.4	55.3	55.3	55.3	54.4	52.5	53.1	56.4	57.2	56.8	55.8	55.5	54.3	52.8	51.4	51.4	50.3	50.1	51.2	52.3	51.0	52.4	52.8	51.3
1821-1830,	56.3	58.1	56.6	56.7	54.6	54.1	54.3	54.2	54.2	54.2	56.3	54.6	53.2	52.2	52.0	56.6	56.2	54.0	53.6	52.4	52.1	50.7	52.6	53.1	52.8	52.3	50.2	49.3	51.4	51.4
1831-1840,	54.4	53.4	52.9	53.9	54.5	54.8	54.9	53.0	54.3	52.5	51.6	52.0	51.8	51.2	53.8	51.8	52.3	52.8	52.4	51.7	52.6	53.2	52.2	52.8	53.2	52.8	51.4	51.6	50.7	50.7
1841-1850,	57.0	59.8	57.4	54.6	51.2	53.2	53.2	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3
MEAN,	56.00	56.20	55.50	55.19	54.71	55.07	55.09	54.47	54.94	54.61	54.57	53.67	54.16	54.07	54.00	55.60	55.12	53.50	53.22	52.19	51.62	52.02	52.52	52.45	52.47	52.19	51.35	50.65	50.09	50.09
Highest M. T. in 40 yrs.,	65.0	72.0	67.5	65.0	64.5	65.5	63.0	62.5	64.0	66.0	66.0	66.0	64.5	66.0	66.0	66.0	67.0	70.5	68.0	67.5	65.0	64.5	63.0	64.5	63.0	64.5	63.0	66.5	64.5	60.5
Lowest,	48.0	48.0	47.0	47.0	47.0	47.5	45.0	47.5	47.0	46.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5	45.5
Fluctuation,	17.0	24.0	20.5	18.0	17.5	18.0	21.5	15.5	17.5	19.5	20.5	25.5	22.0	22.0	19.5	19.0	19.5	19.0	16.0	16.5	20.5	21.0	18.5	21.5	20.0	21.0	22.5	25.5	17.5	17.5

OCTOBER.																														
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
1795-1804,	50.5	52.1	51.5	51.2	49.0	48.1	48.7	47.0	46.0	45.7	45.1	46.0	46.3	48.5	47.1	46.3	46.6	46.8	47.7	47.4	45.4	44.0	43.1	45.1	45.8	44.0	43.2	44.0	45.6	44.7
1821-1830,	44.8	45.8	45.8	42.3	43.0	42.3	41.0	40.2	41.1	41.8	42.8	44.6	43.7	41.6	40.3	41.9	38.8	39.9	42.7	44.0	40.4	38.8	41.7	39.7	41.1	41.1	41.1	41.1	41.1	41.1
1831-1840,	41.6	41.2	41.3	43.9	43.8	43.1	40.3	50.1	49.9	50.2	50.4	47.6	47.7	48.2	49.1	49.1	50.4	48.8	47.7	48.7	48.0	49.4	47.2	45.9	44.4	45.0	45.9	43.0	43.0	43.8
1841-1849,	51.5	50.9	48.6	40.1	49.5	49.6	48.5	49.8	49.4	49.9	47.6	46.1	46.1	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3	46.3
MEAN,	51.22	50.91	51.07	48.41	49.82	49.61	49.15	48.63	48.74	48.67	47.04	46.82	47.77	47.41	47.47	47.51	46.50	47.12	47.72	46.50	46.76	46.82	46.04	45.54	44.20	45.05	44.09	43.83	44.86	44.76
Highest M. T. in 40 yrs.,	60.0	59.0	60.0	61.5	60.0	60.5	62.0	58.0	55.5	60.5	60.0	58.5	58.5	62.0	58.0	58.0	58.0	57.0	59.5	56.5	56.5	56.0	56.0	56.0	56.0	56.0	56.0	56.5	55.5	54.0
Lowest,	43.0	41.0	39.5	41.0	38.5	38.0	40.0	38.0	39.0	39.0	38.5	38.0	38.0	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5
Fluctuation,	17.0	18.0	20.5	20.5	21.5	22.5	22.0	20.0	16.5	15.5	21.5	20.5	23.5	22.5	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0

NOVEMBER.																														
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
1795-1804,	44.4	44.3	41.0	40.0	40.6	41.8	43.1	40.6	39.9	39.4	40.3	40.8	41.5	40.3	40.1	40.7	38.9	37.5	37.4	37.1	37.8	36.8	36.6	35.2	36.4	36.5	35.2	36.9	36.3	36.3
1821-1830,	44.8	45.8	45.8	42.3	43.0	42.3	41.0	40.2	41.1	41.8	42.8	44.6	43.7	41.6	40.3	41.9	38.8	39.9	42.7	44.0	40.4	38.8	41.7	39.7	41.1	41.1	41.1	41.1	41.1	41.1
1831-1840,	41.6	41.2	41.3	43.9	43.8	43.1	40.3	50.1	49.9	50.2	50.4	47.6																		

59. The preceding table (pp. 348–49) contains the synopsis of the whole thermometric observations described in Section 2, arranged under each day of the year, and divided into four decennial periods. From these partial results, the great length of period required to determine the mean temperature of any given day may be estimated. I have farther added the extremes of the observed mean temperature of the day during forty years, and the difference of these, which I call the “fluctuation.” This uncertainty as to the mean temperature of a given day amounts occasionally in winter and spring to 30° Fahr. or more.

60. The mean daily temperatures in the preceding Table are projected on a large scale in Plate XVIII. Notwithstanding the casual sinuosities of the curve of temperature from day to day, the interpolating curve derived from the formula obtained in Art. 56 evidently represents the course of temperature with general exactness, and the temperature of a given day may be estimated from it with far more accuracy than by the observed mean of that day only, even if derived from forty years’ observations.

61. Nevertheless, it is interesting and important to ascertain whether there are not *partial inflections* of the annual curve, subject to recur, and which cannot be satisfactorily represented by the usual periodic series. These are fitly termed by M. QUETELET “periodic anomalies.” *

62. With this object in view, as well as to facilitate a comparison of the Edinburgh temperatures with observations made elsewhere, I caused the *five-day means* to be taken from one end of the year to the other (derived from the collective observations of 40 years), in the same way that was done by the earlier meteorologists, and more lately by M. DOVE, who has published a considerable collection of such results.† By this process the sinuosities of the larger curve are very much reduced, and anything like a systematic deviation from symmetry is more clearly shown.

63. The results are contained in the following table, and are represented in Plate XIX.

* Memoire, &c., p. 4.

† Dove, Fünftägige Mittel, &c. Folio, Berlin : and in the Tables of the Prussian Statistical Bureau. Folio, 1858.

TABLE XIII.—SHOWING THE FIVE-DAY MEANS OF TEMPERATURE FOR FORTY YEARS, AS OBSERVED AND AS COMPUTED FROM THE FORMULA; ALSO THE FLUCTUATION OF DAILY TEMPERATURE IN FORTY YEARS, AND THE MEAN DAILY RANGE (TWENTY-NINE YEARS' AVERAGE).

	Temperature.		Diff.	Daily Fluctuation in 40 Years.	Mean Daily Range.		Temperature.		Diff.	Daily Fluctuation in 40 Years.	Mean Daily Range.
	Cal- culated.	Ob- served.					Cal- culated.	Ob- served.			
Jan. 1-5	36°92	36°30	-0°62	24°4	9°4	July 5-9	58°00	57°68	-0°32	16°1	16°9
6-10	36°76	35°84	-°92	24°4	9°5	10-14	58°30	58°67	+°37	19°3	16°5
11-15	36°74	35°97	-°77	27°5	9°4	15-19	58°54	58°60	+°06	20°4	16°1
16-20	36°72	37°06	+°34	29°6	9°6	20-24	58°71	58°00	-°71	15°3	15°8
21-25	36°78	37°65	+°87	28°2	10°3	25-29	58°78	58°98	+°20	15°8	17°0
26-30	36°82	37°34	+°52	26°6	10°5	30-3	58°69	58°32	-°37	16°7	16°5
Feb. 31-4	37°06	37°16	+°10	28°0	10°6	Aug. 4-8	58°52	58°32	-°20	13°5	16°5
5-9	37°27	37°55	+°28	26°8	10°6	9-13	58°24	58°27	+°03	17°3	16°5
10-14	37°54	38°33	+°79	26°1	11°1	14-18	57°81	57°44	-°37	18°7	15°7
15-19	37°80	37°94	+°14	25°3	11°2	19-23	57°37	57°05	-°32	18°8	15°7
20-24	38°21	38°35	+°14	23°2	10°8	24-28	56°80	56°25	-°55	14°9	16°0
25-1	38°60	38°32	-°28	26°0	11°3	29-2	56°12	56°46	+°34	18°9	16°1
Mar. 2-6	39°08	38°96	-°12	21°5	12°5	Sept. 3-7	55°36	55°13	-°23	19°1	15°4
7-11	39°53	39°91	+°38	24°7	13°9	8-12	54°54	54°45	-°09	18°9	16°0
12-16	40°11	40°74	+°63	25°3	13°3	13-17	53°62	54°73	+1°11	20°4	15°7
17-21	40°66	41°38	+°72	21°4	14°0	18-22	52°71	52°55	-0°16	18°6	15°1
22-26	41°35	41°01	-°34	21°0	13°7	23-27	51°72	52°33	+°61	20°4	14°2
27-31	42°03	41°94	-°09	22°2	14°3	28-2	50°70	51°03	+°33	20°1	14°9
April 1-5	42°75	42°82	+°07	22°3	14°6	Oct. 3-7	49°57	50°21	+°64	21°4	13°5
6-10	43°44	43°73	+°29	20°7	14°9	8-12	48°61	48°44	-°17	20°0	12°6
11-15	44°30	44°37	+°07	20°7	15°7	13-17	47°55	47°40	-°15	22°6	13°1
16-20	45°08	45°28	+°20	21°0	16°1	18-22	46°53	46°92	+°39	22°7	13°1
21-25	46°01	45°49	-°52	22°9	15°5	23-27	45°44	45°43	-°01	21°0	12°0
26-30	46°92	47°37	+°45	19°8	16°3	28-1	44°54	44°54	-°00	23°2	12°2
May 1-5	47°79	48°21	+°42	19°0	17°1	Nov. 2-6	43°55	42°90	-°65	19°9	11°1
6-10	48°70	48°14	-°56	20°5	16°5	7-11	42°69	42°22	-°47	22°2	10°6
11-15	49°64	48°60	-1°04	20°3	17°6	12-16	41°79	41°26	-°53	21°2	10°9
16-20	50°55	50°69	+0°14	21°5	17°5	17-21	41°05	40°74	-°31	23°1	11°2
21-25	51°49	52°34	+°85	20°2	16°7	22-26	40°35	39°55	-°80	23°8	10°6
26-30	52°38	52°99	+°61	23°3	17°5	27-1	39°64	39°48	-°16	25°2	10°0
31-4	53°27	54°03	+°76	20°1	18°0	Dec. 2-6	39°01	38°99	-°02	25°8	9°8
June 5-9	54°08	54°41	+°33	22°9	17°5	7-11	38°53	39°87	+1°34	24°7	9°7
10-14	54°93	55°68	+°75	21°5	17°9	12-16	38°00	39°89	+1°89	24°9	9°9
15-19	55°64	56°00	+°36	19°5	17°9	17-21	37°69	38°76	+1°07	22°2	9°7
20-24	56°36	56°39	+°03	18°8	17°7	22-26	37°32	37°32	0°00	30°1	9°7
25-29	56°96	56°81	-°15	21°7	17°7	27-31	37°11	36°62	-°49	26°7	9°7
30-4	57°50	57°39	-°11	17°0	17°6						

64. In this Table I have included the five-day means of the "fluctuation" of temperature for forty years for a given day, deduced as above; also the "mean

daily range," deduced from the average of all the daily extremes for twenty-nine years (1822-1850), during which self-registering thermometers were in use.* I shall make a few observations under each of these heads.

(1.) *On the inflections, or "periodic anomalies" of the annual curve, compared with the standard or computed values.*

65. Of these the most marked, indicated by the Curve and the Table last referred to, is an excess of temperature above the calculated or normal amount in the latter part of January and earlier part of February. This is a well-known and long recognised anomaly. In most European instances it affects materially the mean temperature of February, which is very commonly far too high, when contrasted with the general sweep of the annual curve. At Brussels, for example, M. Quetelet finds an excess in the temperature of February above the general curve of at least $1^{\circ}5$ Fahr. The same peculiarity may be noticed in the annual curves of London, Prague, St Petersburg, Vienna, and many other places, including even the Great St Bernard. If it is nearly insensible in the monthly means of Table XI. p. 346, this apparently arises from the anomaly occurring rather sooner at Edinburgh than in most other places, and therefore affecting the temperature of January fully as much as that of February.

66. In connection with this anomaly, I may observe that it is apparently connected with an anomalous depression of the thermometer in the early part of January, of which it may be said to be the reaction. Although we have seen (Art. 57), that in the equalized curve of temperature the minimum is attained on the 17th January (and if two terms of the equation alone were used, it would be on the 22d), the average coldest day is very decidedly earlier in the month. This is well shown in both the detailed curve and the curve of five-day means. The 11th January is the average coldest day (Table IX.), and it is also the central point of an abnormal depression of temperature. The same thing is well marked in M. Quetelet's curves, which coincide almost to a day with the preceding results.†

67. Of the other periodic inequalities of the annual curve we cannot speak with much confidence. Even after forty years' observations, the casual fluctuations of daily temperature are far from being eliminated; and for a period of ten, or even twenty years, very great uncertainty still remains, as may easily be concluded from a comparison of the numbers under each day in Table XII. for the four decennial periods. Perhaps the general depression of temperature in the month of November, which is also traceable in the curves of Greenwich and Brussels, may be considered as a true periodic anomaly, at least in this part of the world.

* The reductions of the daily range have been less scrupulously verified than most of the other computations contained in this paper, but any residual errors are hardly likely to affect sensibly the mean results.

† Since writing the above, I notice that M. Quetelet, at page 39 of his Memoir, expresses himself as to this anomaly in almost the same terms that I have used.

A sort of reaction appears in a comparatively limited yet marked excess of temperature, during the middle fortnight of December. This excess is clearly indicated in every one of the four decennial periods. About the 12th May there is also a brief depression of temperature, which, so far, appears to confirm the existence of the three cold days (11th, 12th, and 13th May) mentioned by Humboldt,* which likewise seem to be indicated at Greenwich; but these deductions are of a description not much to be relied on, and, after all, they most likely depend on causes more or less local.

(2 and 3). *On the "fluctuation" of daily mean temperature, and on the diurnal range.*

68. If we project, in the form of a curve, the fluctuation of the daily mean temperature for forty years included in Mr ADIE'S observations (as shown in column 5 of Table XIII.), we find a very remarkable variation with the season of the year. There appears to be the least casual fluctuation about the end of July, when it amounts to about 16° or 17° , and the maximum occurs nearly six months later, or about the middle of January, when it may be reckoned at between 28° and 29° . These periods coincide, it will be observed, nearly with the hottest and coldest seasons. It may be accidental, but I cannot help remarking, that for some days together these values of "fluctuation" range remarkably low, and then for another short period as uniformly high. An example of this may be noticed in Table XII. for the latter part of December.

69. The other element, the diurnal range, or mean daily difference of maximum and minimum readings for twenty-nine years, gives us a curve of a nearly opposite form to the preceding, and much more regular. The minimum range of 9.5 occurs in the end of December or beginning of January; the maximum of nearly 18° between the middle and end of June.

SECT. 7. *Remarks on the Price of Corn during Fifty-six years, as compared with Meteorological Data.*

70. It will be recollected that Sir William Herschel, when investigating the connection of the solar spots with terrestrial temperature, employed (though not without some reserve, and only in the absence of better data) the price of wheat as an indication of the heat or cold of different years.

71. I thought it might be worth while to test roughly the applicability of such a scale of climate; and I even considered that it might be practicable to express the relation of the abundance of corn to the meteorological elements which might be expected chiefly to influence it. These expectations signally failed. But I think it may be instructive to record the failure, at a time when agriculturists are directing their attention to meteorology.

* Cosmos, vol. i. note §6.

72. I decided to use the price of oats in the Edinburgh market as the fairest test of the state of the harvest, being at once the most abundant crop, and the one least likely to be affected by foreign importations and by fiscal enactments. In this view I was confirmed by two eminent agricultural authorities.

73. To Mr Charles Lawson I am indebted for a table of the average price of oats of first and second quality, in the Edinburgh market for each year from 1795 to 1850 inclusive (with the exception of the year 1805). The following Table contains the prices of the first quality, in chronological order, and the differences + or - (neglecting fractions of a penny) from the mean of the whole, which is 18s. 11d. per boll of six bushels:—

TABLE XIV.—SHOWING THE PRICE OF OATS (FIRST QUALITY) IN THE EDINBURGH MARKET, PER BOLL OF SIX BUSHELS, FROM 1795 TO 1850 INCLUSIVE.

			Difference from Mean.				Difference from Mean.				Difference from Mean.
	s.	d.	s. d.		s.	d.	s. d.		s.	d.	s. d.
1795	19	6	+ 0·7	1814	18	3	— 0·8	1833	13	6	— 5·5
1796	14	4	— 4·7	1815	14	3	— 3·8	1834	15	0	— 3·11
1797	13	6	— 5·5	1816	25	11	+ 7·0	1835	15	0	— 3·11
1798	14	0	— 4·11	1817	23	0	+ 4·1	1836	20	9	+ 1·10
1799	29	4	+ 10·5	1818	23	0	+ 4·1	1837	15	7½	— 3·4
1800	33	2	+ 14·3	1819	17	6	— 1·5	1838	21	0	+ 2·1
1801	16	6	— 2·5	1820	16	0	— 2·11	1839	18	6	— 0·5
1802	15	6	— 3·5	1821	15	4	— 3·7	1840	14	7½	— 4·4
1803	17	6	— 1·5	1822	15	0	— 3·11	1841	14	7½	— 4·4
1804	18	6	— 0·5	1823	20	0	+ 1·1	1842	14	3	— 4·8
1805	...	...	...	1824	17	10	— 1·1	1843	15	9	— 3·2
1806	20	0	+ 1·1	1825	18	4	— 0·7	1844	16	3	— 2·8
1807	27	0	+ 8·1	1826	25	9	+ 6·10	1845	20	0	+ 1·1
1808	24	0	+ 5·1	1827	17	6	— 1·11	1846	26	3	+ 7·4
1809	29	9	+ 10·10	1828	18	6	— 0·5	1847	18	1½	— 0·10
1810	18	0	— 0·11	1829	16	3	— 2·8	1848	14	3	— 4·8
1811	23	0	+ 4·1	1830	20	0	+ 1·1	1849	12	3	— 6·8
1812	31	6	+ 12·7	1831	17	6	— 1·5	1850	13	6	— 5·5
1813	21	6	+ 2·7	1832	14	1½	— 4·10				
								Average,	18	11	

74. The next Table shows the seasons arranged according to the dearness of oats, or the reverse.

TABLE XV.—CONTAINING THE SEASONS ARRANGED ACCORDING TO THE PRICE OF OATS, BEGINNING WITH THE CHEAPEST.

1.	1849	9.	1848	17.	1802	25.	{ 1803	33.	{ 1804	41.	1836	49.	1816
2.	{ 1797	10.	1796	18.	1837	26.	{ 1819	34.	{ 1828	42.	1838	50.	1846
3.	{ 1833	11.	{ 1840	19.	1843	27.	{ 1831	35.	{ 1839	43.	1813	51.	1807
4.	{ 1850	12.	{ 1841	20.	1820	28.	1824	36.	1795	44.	{ 1811	52.	1799
5.	1798	13.	{ 1822	21.	{ 1829	29.	1810	37.	{ 1806	45.	{ 1817	53.	1809
6.	1832	14.	{ 1834	22.	{ 1844	30.	1847	38.	{ 1823	46.	{ 1818	54.	1812
7.	1816	15.	{ 1835	23.	1801	31.	1814	39.	{ 1830	47.	1808	55.	1800
8.	1842	16.	1821	24.	1827	32.	1825	40.	{ 1845	48.	1826	...	...

75. If this Table be compared with similar ones of the different meteorological data in the earlier part of this paper, the complete discordance from all or any of these will be perceived. It is true that the cold years of 1799, 1800, and 1812, certainly coincide with periods of dear corn; but, on the other hand, we find them in close proximity with 1826 and 1846, the two hottest summers of the record. On the other hand, the cheapest years of the whole, 1849 and 1797, will be seen from Table X. to have been cold, late, and rainy. I have in that Table included the character of the season as one of cheapness or of scarcity, in anticipation of this comparison.

76. It might be suggested that the abundance, or the contrary, of the crop of any year might be expected rather to influence the prices of the next than of that season; but this supposition does not seem to reconcile the anomaly. Thus, the cold years 1797 and 1849 were not only cheap years, but were succeeded by cheap years; and the hot summers of 1826 and 1846 produced not only high prices, but were succeeded by years of only average prices.

77. With a view to test impartially the possible connection between prices and these elements of climate, I assumed that it might be possible to represent the price of oats in any year by a linear function of the following variables—viz., the mean temperature of the year, the temperature of the hottest month, and the fall of rain. I accordingly wrote out (without selection) those data for the following years of those for which I possessed complete records—viz., the three dearest, the three cheapest, the three years having the highest mean temperature, the three having the lowest mean, the three having the hottest summer months, and the three wettest years. I took the mean of the three years of the same description, and thus obtained six equations of a linear form, each containing three factors as multipliers of the meteorological elements, which factors were to be determined. It will show the extreme anomaly of the results that the mean of the three years of most rain showed a price of oats rather *below* the average, that the three hottest years were *above* the average. The six equations being solved separately

in two groups of three, each give constant factors of the meteorological elements so extravagantly wide of one another as not to be worth reporting.

78. It may of course be said that the meteorological data affecting the harvest are mainly confined to one critical period of the year. It is also true that *extremes*, whether of heat or cold, drought or wet, are not favourable to abundant harvests.* Making all allowances, however, the results are exceedingly anomalous, and seem to show that the price of corn cannot be used to afford the slightest clue to the temperature or meteorological character of a given season.

Postscript.

I have already acknowledged the assistance which I have derived from Mr GRASSICK, and especially from Mr BALFOUR STEWART, in the preparation of this paper. I have farther to add, that I am indebted to Mr STEWART for the projection of the curves of Plates XVIII. and XIX., and to Mr ROBERT CRAM for the calculation of several of the Tables.

* The same remark is made in page 39 of Mr JENYNS' "Observations on Meteorology," a very carefully compiled work. It might be possible to include this view of the case by considering the prices to vary with the *square* of the departures of the meteorological elements from a certain amount most favourable to cultivation, but I find no encouragement to make a fresh calculation on this more complex system.

Curve showing the Course of the mean daily Temperature at Edinburgh for 40 years deduced from M^r Adie's observations & compared with the Formula $y = 46^{\circ} 88' - 10^{\circ} 98 \text{ Sine } (x + 68^{\circ} 28') + 0^{\circ} 96 \text{ Sine } (2x + 22^{\circ})$

Jan^r | Feb^r | March | April | May | June | July | Aug^t | Sept^r | Oct^r | Nov^r | Dec^r
 Comparison of the Mean Temperature of Edinburgh for 40 years, taken for 5 day intervals, with the Formula.