

XVIII.—*Account of some Experiments on the Temperature of the Earth at different Depths, and in different Soils, near Edinburgh.* By JAMES D. FORBES, Esq., F.R.S., Sec. R.S. Ed., &c. Corresponding Member of the Institute of France, and Professor of Natural Philosophy in the University of Edinburgh.

### I. *History of the Observations.*

THE proper temperature of our globe is a question which, formerly abandoned to speculation and hypothesis, has only lately been made the subject of direct experiment. Preliminary to it, and intimately connected with it, is another inquiry of great interest, namely, What is the thermometric effect of the whole solar heat which falls in a year on the surface of the globe? How much is transmitted to the interior? How much dissipated at the surface? To what depth does the influence of the seasons extend, and in what manner is that influence modified at different depths? It is impossible to say to how many curious and important inquiries a solution of these preliminary questions may lead the way; and it is to them that our attention is at present to be confined. We shall not speak, except incidentally, of the absolute heat of the interior of the globe; we shall only discuss the modifications of the solar heating influence near its surface.

This inquiry was perhaps first agitated by the illustrious LAMBERT, a mathematical philosopher of Germany, who yields, in originality, in comprehensiveness of mind, and in the successful application of mathematics to a wide range of important physical subjects, to very few of his contemporaries or successors. His experiments were made by M. OTT, a merchant at Zurich, who had a convenient garden for introducing the thermometers.\*

Having claimed for LAMBERT the first systematic inquiry on this subject (for the previous essays of MARIOTTE and HALES could not lead to any exact conclusions), I shall not trace the subsequent history of the problem, which is fully stated in M. QUETELET'S papers, in the Transactions of the Brussels Academy for 1836 and 1840, and in the *Annales de l'Observatoire de Bruxelles*, tome iv. (1845). Such observations were made by HERRENSCHNEIDER, at Strasbourg; MUNCKE, at Heidelberg; by LESLIE, at Raith, near Edinburgh; by ARAGO, at Paris; by QUETELET, at Brussels; and by RUDBERG, at Upsala. As it does not appear, that, in making or discussing these observations, regard has been had to the influence of

\* LAMBERT, *Pyrometrie*, 4to, 1779, page 356.

a peculiar character of the soil or rock whose temperature was observed, it occurred to me, several years ago, to make several series of observations, under circumstances as exactly similar as possible, with the exception of the nature of the soil or rock. The neighbourhood of Edinburgh, from its variety of geological character, offered peculiar facilities for this purpose; and the British Association, at my request, undertook the expense of providing and inserting thermometers in three different positions, at depths corresponding to those already employed at Brussels, namely, 3, 6, 12, and 24 French feet below the surface. The results have already been partly published in the Proceedings of the British Association, and of the Royal Society of Edinburgh. Deeming it advisable that the curves containing the details of the observations should be published at large, I requested permission from the Committee of Recommendations of the British Association, in 1845, to communicate them, for this purpose, to one of the Royal Societies; and the Council of the Royal Society of Edinburgh having agreed to be at the necessary expense of the plates, I am enabled to present the results in their present complete form, and founded upon five years' observations.

## II. LESLIE'S *Observations at Abbotshall, in Fife.*

I shall here reproduce the particulars of the observations of the temperature of the ground at Abbotshall, in Fifeshire, on the property of Raith, close to the town of Kirkcaldy. The distance from Edinburgh is sufficiently small (11 miles in a right line) to render these observations comparable with ours; but I quote them more particularly, because those who have hitherto made use of them, being unaware of the original account published by Sir JOHN LESLIE,\* have made almost every possible mistake as to the locality, circumstances, and depths of these observations. It will be seen that they were made by Mr FERGUSON of Raith's gardener. The following extract contains all the important details.

“ In order to throw distinct light on a subject so curious and important, ROBERT FERGUSON, Esq. of Raith, a gentleman whose elegant mind is imbued with the love of science, caused, lately, a series of large mercurial thermometers, with stems of unusual length, to be planted in his spacious garden at Abbotshall, about 50 feet above the level of the sea, and nearly a mile from the shore of Kirkcaldy, in latitude  $56^{\circ} 10'$ . The main part of each stem having a very narrow bore, had a piece of wider tube joined above it; and, to support the internal pressure of the column of mercury, the bulbs were formed of thick cylinders. The instruments, inclosed for protection in wooden cases, were then sunk beside each other to the depths of one, two, four, and eight feet below the surface, in a soft gravelly soil, which turns, at four feet, into quicksand, or a bed of sand and water. These thermometers were carefully observed from time to time by Mr CHARLES NORVAL,

\* Supplement to the 6th edition of the *Encyclopedia Britannica*, article CLIMATE, incorporated in the 7th edition.

the very intelligent gardener at Raith; and we have now before us a register of their variations for nearly three years. It thence appears, that, in this climate, and on naked soil, the frost seldom or never penetrates one foot into the ground.”

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“ These observations are quite satisfactory, and exhibit very clearly the slow progress by which the impressions of heat or cold penetrate into the ground. It will not be far from the truth to estimate the rate of this penetration at an inch every day. The thermometers hence attained their maximum at different periods, though in a tolerably regular succession. The mean temperature of the ground, however, seemed rather to increase with the depth; but this anomaly has evidently proceeded from the coldness of the two last summers, and particularly that of 1816, which occasioned such late harvests and scanty crops. Thus, the thermometer of one foot indicated the medium heat of only  $43^{\circ}8$  during the whole of the year 1816. But it will be satisfactory to exhibit the leading facts in a tabular form. The following are the mean results for each month, only those for December 1817 are supplied from the corresponding month in 1815.

TABLE I. LESLIE'S OBSERVATIONS.

	1816.				1817.			
	1 Foot.	2 Feet.	4 Feet.	8 Feet.	1 Foot.	2 Feet.	4 Feet.	8 Feet.
January .....	33°0	36°3	40°7	43°0	35°6	38°7	40°5	45°1
February .....	33°7	36°0	39°0	42°0	37°0	40°0	41°6	42°7
March .....	35°0	36°7	39°6	42°3	39°4	40°2	41°7	42°5
April .....	39°7	38°4	41°4	43°8	45°0	42°4	42°6	42°6
May .....	44°0	43°3	43°4	44°0	46°8	44°7	44°6	44°2
June .....	51°6	50°0	47°1	45°8	51°1	49°4	47°6	47°8
July .....	54°0	52°5	50°4	47°7	55°2	55°0	51°4	49°6
August .....	50°0	52°5	50°6	49°4	53°4	53°9	52°0	50°0
September .....	51°6	51°3	51°8	50°0	53°0	52°7	52°0	50°7
October .....	47°0	49°3	49°7	49°6	45°7	49°4	49°4	49°8
November .....	40°8	43°8	46°3	45°6	41°0	44°7	47°0	47°6
December .....	35°7	40°0	43°0	46°0	37°9	40°8	44°9	46°4
Mean of whole Year	43°8	44°1	45°1	46°0	44°9	45°9	46°2	46°6

“ If the thermometers had been sunk considerably deeper, they would, no doubt, have indicated a mean temperature of  $47^{\circ}7$ . Such is the permanent temperature of a copious spring which flows at a short distance, and about the same elevation, from the side of a basaltic or greenstone rock.”

I had intended to have engraved the curves of the course of temperature from

1816 to 1821, which I find preserved in the Natural Philosophy Collection; but my inquiries led me to discover that most of these curves had already appeared in the 4th volume of CONSTABLE's Edinburgh Magazine for 1819, where they have remained apparently quite unknown to scientific men, together with the *details* of the observations on which they were founded, from May 1815 to March 1819, and an explanatory article, which I understand was written by Mr GEORGE BUCHANAN, civil-engineer. These observations, particularly at the commencement, were not made with great regularity, sometimes only a single observation being made in a month, at other times as many as eight. Indeed, they have not appeared to me to be worth reprinting at length; but I have condensed into the following Table the information which they contain, shewing the mean monthly temperature, at different depths, for nearly four complete years.

TABLE II. MEAN RESULTS OF LESLIE'S OBSERVATIONS.

1815-19.				
	1 Foot.	2 Feet.	4 Feet.	8 Feet.
January .....	36°·0	38°·9	41°·0	43°·8
February .....	35·3	36·3	40·6	42·5
March .....	38·1	38·6	41·0	42·1
April .....	38·6	40·2	41·8	42·2
May .....	45·5	45·3	45·3	44·4
June .....	54·5	52·4	49·1	46·9
July .....	57·2	54·8	51·9	48·2
August .....	54·9	54·8	52·3	50·3
September .....	53·3	53·0	52·1	51·0
October .....	47·7	49·5	50·0	50·0
November .....	42·9	45·3	47·5	48·5
December .....	37·5	40·8	43·8	46·3

### III. *Construction of the Instruments.*

In commencing the observations at Edinburgh, it was determined that the thermometers should consist of three sets of four each, the lengths increasing in geometrical progression, and the localities being fixed so as to embrace within a small radius, as great a variety of soil as possible. As the deepest thermometers were to be sunk to a depth of 24 French feet (25·6 English), and the portion of the tube, including a column sufficiently long to register the variations of temperature of the fluid which filled the ball (alcohol), must project a foot or two above the surface, the construction, graduation, and depositing of such unwieldy instruments, were attended with no small practical difficulty. The execution of the



whole was entrusted to Mr ADIE, to whose experience and skill I am greatly indebted for the completion of the whole without any material accident.

For the larger thermometers it is of great consequence that as little liquid as possible should be contained in the stem of the instruments, otherwise the apparent expansion of the column will depend greatly upon the variable temperature of the different parts of the stem, as well as on that of the level. This correction being difficult to apply with mathematical exactness, it was desirable to make it as small as possible (although it would be unwise to overlook the correction altogether, as most observers have done). I accordingly had twelve tubes drawn, each of about 26 feet in length; of the external thickness nearly of a common barometer tube (about half-an-inch), but whose internal diameter was nearly capillary. These were carefully examined throughout, by means of a column of mercury passed through them.

The proportional numbers, representing the calibre of the tubes, were entered in a table now before me, corresponding to every foot of their length; and the tubes were numbered, so that the degree of uniformity of any portion could at any time be ascertained. From these tubes twelve lengths were cut from the most uniform parts, amounting altogether to about 144 feet, for the construction of the three sets of thermometers.

It is to be understood that the capillary tube now spoken of was made with a view to reach the surface of the ground, above which the tube should expand into one having degrees of a convenient length. So small, indeed, was the stem compared to the bulb, that a degree of Fahrenheit in the capillary tube would have occupied, in one case, a space not less than 51 inches long. The wide tube to which the scale was attached, had a bore of about  $\frac{1}{16}$  inch, and was made long enough to include the expected range of temperature at their respective depths. These ranges were, however, in some cases rather under-rated.

The bulbs were cylindrical, and varied in size from about 6 to 8 inches long, and  $1\frac{1}{2}$  or  $2\frac{1}{2}$  wide. They were blown at the glass-house separately from the tubes. The deepest thermometers had the largest bulbs and longest degrees, because the required range was less.

From the length and fineness of the tubes much trouble would have been experienced in filling the thermometers in the usual way. The lower end of the cylindric bulb was, therefore, drawn out into a tube, by which the liquid (freshly boiled alcohol, slightly coloured) was admitted, and it was drawn in by the action of a syringe fixed at the extremity of the long stem. Both ends were then closed in the usual way, an expansion being left at the top as in common alcohol thermometers, but most necessary in this case, in order to allow for the changes of temperature to which the instruments were exposed before sinking them in the ground.

The graduation was one of the most delicate parts of the construction. The

instruments were suspended during winter in a staircase, with their bulbs in water, and the temperature of the air surrounding the stems was carefully noted, and a correction applied for any difference between it and that of the water. The staircase was artificially heated through a few degrees, and after being left for a night, a second point was fixed. The temperatures of the water were determined by the mean of three standard thermometers, which agreed extremely closely indeed, when the error of their freezing points was corrected. The first was a standard by TROUGHTON and SIMMS, belonging to and corrected by myself.\* The second was a standard constructed by Mr ADIE for the Royal Society of Edinburgh; and the third a standard having very long degrees, constructed by Mr ADIE for his own use. The first pair of observations were made by Mr ADIE *senior* alone, and scratches marked on the tubes at temperatures corresponding to  $41^{\circ}73$  and  $50^{\circ}77$  by the mean of the standard thermometers. To verify these results I made two additional comparisons with the assistance of Mr ALEXANDER ADIE *junior*, at temperatures  $41^{\circ}97$  and  $46^{\circ}42$ , which agreed by interpolation remarkably closely with those of the first experiment, considering the difficulties of the observation. In only one case (the 13 feet thermometer for the Experimental Garden), was the difference at all considerable. A mean result was adopted. The length of  $1^{\circ}$  in the 24 and 12 feet thermometers being from 1 to 2 inches, and divided into 20ths,  $\frac{1}{100}$  can be easily read by estimation. In the others the approximation is less.†

#### IV. *Localities—Sinking of Thermometers.*

Whilst the preparation of the thermometers was going forward, I had holes prepared for inserting them in the positions already fixed on with reference to the geological peculiarities of the soil. These were—

1. In the Observatory enclosure on the Calton Hill, at a height of 350 feet above the sea. The rock is a porphyritic trap, with a somewhat earthy basis, dull and tough fracture. The exact position is a few yards east of the little transit-house. There are also other buildings in the neighbourhood. The ground rises slightly to the east, and falls abruptly to the west at a distance of about 15 yards. The immediate surface is flat, partly covered with grass, partly with gravel.

\* Philosophical Transactions, 1836, p. 577.

† More lately Mr ADIE has constructed two sets of thermometers resembling these, one, extending to 24 French feet for Greenwich Observatory; the other, including only the 12 feet thermometer, for Mr CALDECOTT of Trevandrum in India. Both of these sets of instruments were fortunately transported to their destinations without any accident. The graduation of the Greenwich instruments was performed by myself, and a much larger number of points fixed than above described. The result was examined, and the scale determined, by a simple method of graphical projection and interpolation, which led to the most satisfactory results; I should, therefore, recommend this method to others undertaking the same tedious and difficult operation.

2. In the Experimental Garden, adjoining the Royal Botanic Garden at Inverleith, almost exactly 1 mile NW. of the Observatory, and 280 feet lower, being about 70 feet above the sea. The soil here is a remarkably pure sand, resembling sea-sand, extending to a great depth, and including few pebbles of any size. The precise locality was the flat summit of the rising ground, immediately to the south of the large building or show-room in the Garden. The perforation of the sand was exceedingly easy, owing to the uniformity and dryness of the strata. The four thermometers were inserted in three boxes, near to one another, the two shortest thermometers being placed together in the same hole. The *surface* is garden mould, whereas, at the Observatory and Craigleith, it is covered with vegetation (in the former case interrupted by buildings and gravel walks). This circumstance may not be without some effect. Sir JOHN LESLIE has observed\* that cold penetrates deeper through bare soil, or compact pavement, than through turf.

3. At Craigleith quarry,  $2\frac{1}{4}$  miles west from the Observatory, in a mass of coal formation sandstone, which has for many years afforded an abundant and durable building material for the city of Edinburgh. The spot chosen was situated in a field 50 yards north of the house called Craigleith Hill, immediately to the east of the quarry, and about 75 yards distant from its north escarpment. The field was under grass during the first two or three years of the observations, afterwards under crop. The height above the sea is about 150 feet. The thermometers were inserted here, as at the Observatory, in one hole, six or seven inches in diameter at the top, and three at the bottom, which it required several weeks to form with boring-irons in the usual manner. When the hole was empty some water always flowed into it, and stood at a certain height, however often removed.

The insertion of the thermometers into the holes required the greatest precaution ; the length and flexibility of the stems of the longest exposing them to great risk of casualty. The operation was managed in the following manner. A strong tripod, 12 or 15 feet high, was erected over the hole, and a ladder still longer attached it, so that a man ascending it could command completely the upper part of the instrument. The tube lay in the angle formed by two united pieces of wood, similar to a roof gutter, where it was secured by loops of string. Being raised, with this defence, into an erect position directly over the hole, the loops were successively cut, and the thermometer allowed to slip from the wooden shield, and to sink to the required depth. Dry sand was then poured in to half the depth of the hole. The second thermometer was then similarly planted, and so of the others ; the aperture being well closed round the tubes with clay puddle.†

\* Encyc. Brit., Article CLIMATE.

† Subsequently (May 1838), a quantity of Roman cement was employed to secure completely the opening of the holes.

Strong wooden boxes painted green, having doors open to the north side, were then firmly fixed over the projecting stems, which boxes were afterwards pierced with holes, in order to secure a free ventilation. Small thermometers graduated to whole degrees were hung in air within the boxes ; and afterwards (May 1838) other thermometers were placed with their bulbs just covered by the soil within the boxes. These last thermometers are referred to in the tables as  $t_g$ . After the instruments were finally placed, slight metal scales were attached to the respective tubes with fine copper wire. I should add that, for the defence of the bulbs and the capillary tubes, at their inferior extremities, before mentioned, they were half inserted into tin cylindrical boxes filled up with plaster of Paris.

I had hoped to have commenced the observations with 1st January 1837 ; the unexpected difficulty experienced in boring the holes, and subsequently the severe weather, prevented the insertion of the thermometers before the 18th January in the Experimental Garden, the 20th on the Calton Hill, and the 21st at Craigleith Quarry ; the whole was happily accomplished without the slightest accident. In all my arrangements, I was aided by the civility of the Directors of the Astronomical Institution and of the Experimental Garden, by the astronomer Mr HENDERSON, and other official persons.

#### V. *Observations and Observers.*

Not the least of the difficulties of carrying on such observations as the present has ever been found to be, that of getting perfectly trustworthy and zealous observers. In this matter I esteem myself particularly fortunate. Professor HENDERSON undertook, in the kindest manner, the personal superintendence of the thermometer placed on the Calton Hill in the Observatory grounds. At the Experimental Garden I received the services of Mr JAMES M<sup>C</sup>NAB, the superintendent ; and at Craigleith, those of Mr MACKINTOSH, whose official connection with the quarry ensures his constant residence. The observations were made weekly, and were registered in degrees and hundredths of Fahrenheit's scale (by approximation). The general superintendence which I have been able to give, assured me that all the observations were made, not only with fidelity, but without any sensible error arising from want of familiarity of two of the observers with instruments so minutely divided. And, were other proofs wanting, fortunately the ultimate projection and comparison of the three sets of observations affords the most perfect check upon any considerable inaccuracy, either in the observations or computations.

With a view to check any permanent change in the reading of the instruments, such as might arise from a permanent displacement of the freezing point, I had a spirit thermometer constructed with a bulb similar to those buried, with

a view to its occasional verification ; the freezing point being accurately ascertained. Nine years after (January 1846), this instrument being re-examined, shewed no appreciable change in the position of the zero point. It could not have amounted to  $\frac{1}{10}$  of a degree. A common thermometer would have altered appreciably under similar circumstances. Is not this owing to the strength of the glass bulb ?

The permanent influence of the pressure of sand in the holes was suggested to me as a possible source of a change of figure of the instruments ; but the conclusive experiments lately made in America and France on the pressure of sand, convinced me that this could have no appreciable influence.

The observations were made weekly ; generally on Mondays. As it was commonly supposed that the diurnal variations of the temperature disappear at the depth of three feet, I did not take particular precautions to have all the observations made at the same hour. I find, however, that, at the Observatory, the readings were taken immediately after noon, at the Experimental Garden, about 2 o'clock, at Craigleith Quarry, regularly between 11 and 12 o'clock. The later hour of the second series may account for some irregularities observable. The observations, at all the stations, were made regularly from February 1837 down to May 1842, about which time, the thermometers at Craigleith were maliciously destroyed ; but these five years of complete observations have yielded all the results which were looked for in commencing them. The boxes covering the thermometers, in the Experimental Garden, were blown over in the winter 1844-5, crushing the thermometers. Those at the Observatory still remain in good order, and are regularly observed. The numbers, from the original registers, are exactly given in the table at end of this paper, together with the corrections applied to them, in the manner to be described in the next section. It is not to be supposed that the registers are without some errors, at least, in the case of the two less experienced observers (at Experimental Garden and Craigleith) ; but they are only oversights of the eye or hand, which can affect none of the conclusions, as the admirable coincidence of the three independent series, in Plate VII., sufficiently proves.

The following table contains the data necessary to be known, respecting the scales and dimensions of the thermometers, for correcting the temperature of the stems and exposed columns in the manner which we shall next proceed to investigate.

TABLE III. THERMOMETRIC CONSTANTS.

No.	Range of Wide Tube.	Length of 1° in inches.	Inches of Fine Tube above ground.	Inches of Wide Tube in Fine Tube.	Degrees in Fine Tube.	Length of Fine Tube in inches.	Length of 1° in inches of Fine Tube.	Degrees of Fine Tube sunk below ground.	Degree from which the column exposed to external temperature is reckoned.*
OBSERVATORY.									
1	41°·6—51°·0	1·79	9	24·5	13°·7	316	23	13°·3	41
2	41°·0—51°·0	1·57	9	7·0	4·5	162	36	4·2	40·5
3	36°·0—54°·0	0·88	9½	4·2	4·8	86	18	4·3	35
4	30°·5—55°·0	0·63	9½	3·6	5·7	48	8·4	4·6	28·5
EXPERIMENTAL GARDEN.									
1	39°·5—52°·9	1·225	8	30·0	24·5	315	12·8	23·9	38
2	38°·5—53°·2	1·09	6½	9·2	8·4	160	19	8·1	38
3	35°·0—55°·9	0·68	10	4·2	6·2	87	14	5·5	33·5
4	26°·5—60°·0	0·475	10	1·8	3·8	48	12·6	3·0	25
CRAIGLEITH.									
1	40°·5—51°·5	1·575	9	19·7	12·5	316	25·2	12·1	40
2	40°·7—50°·7	1·52	8½	4·9	3·2	162	51	3·0	40
3	37°·0—53°·6	0·98	10	6·4	6·5	87	13·4	5·7	35·5
4	31°·5—55°·4	0·67	10	1·4	2·1	48	22·8	1·7	31
<p>* This supposes the Atmospheric Temperature to penetrate 9 inches. The tubes at the surface would have the following readings :—</p> <p>41·2 40·7 35·5 29·4   38·9 38·2 34·3 25·7   40·1 40·5 36·2 31·1</p>									
<p>May 14. 1834. No. 4. Observatory was lowered 3°·12, by withdrawing alcohol. May 15, No. 4. Craigleith lowered by 1°·95. Corrected scales were immediately applied.</p> <p>In the above Table, No. 1 is the <i>longest</i>, No. 4 the <i>shortest</i>, Thermometer.</p>									

VI. *Corrections of the Observations.*

It is very evident that the readings of the thermometers cannot indicate exactly the temperature of the point corresponding to the centre of the bulb, because the stem between that point and the surface of the ground never has a uniform temperature throughout; and the portion of the column above ground is affected by the temperature of the air at the moment. Of these two corrections in *our* thermometers, the latter is by much the most important, which is fortunate, because it is also determined with the greatest accuracy.

These corrections, however obvious, have, according to M. QUETELET, been

overlooked by all observers previous to himself and M. ARAGO. It seems that M. ARAGO ascertains the expansion of the buried column of spirit by sinking, alongside of each thermometer, a stem similar to its own, having a scale above ground, but no bulb: the variations of bulk of the contained spirit being thus directly shewn are eliminable from the readings of the adjacent thermometer. As far as regards the correction due to the portion of the stem buried in the earth, this mode of correction is ingenious and satisfactory; but, when the tubes are capillary, the reduction is so small that it may readily be obtained otherwise, with sufficient accuracy. It does not, however, apply to the portion of the scale above ground, since the quantity of alcohol, so exposed, varies with the degree shewn by the thermometer. And this correction, as has been said, is, in our observations, the more important of the two. The method which I propose to employ is the following:—

The distribution of the thermometers, in geometrical progression, enables us to employ the temperatures indicated by the thermometers, Nos. 2, 3, and 4, for the correction of the reading of No. 1 (that is, to reduce the temperature of the column *ab* to the temperature of the bulb); the temperature of Nos. 3 and 4 to correct No. 2; and of No. 4 to correct No. 3. It was matter of consideration (1.), how this might be most correctly done; and (2.), to select a formula of sufficient (not superfluous) accuracy, and adapted to calculation.

The mode of doing this was partly arbitrary, and justified by application to cases where the variation of temperature in the stems was a maximum selected from the journals of observation. Thus, the depth of the successive thermometers being—

$$0, \quad a, \quad 2a, \quad 2^2 a, \quad 2^3 a, \quad \&c.$$

The intervals of depth are—

$$a \quad a \quad 2a \quad 2^2 a \quad \&c.$$

And the product of the temperature and depth must lie between two series, one of which supposes the temperature of any interval equal to the temperature of the thermometer at its superior limit, the other supposes the mean temperature equal to that at its inferior limit. It is evident that the truth must lie between these suppositions, or that denoting by *T*, the superficial temperature; and *t*<sub>4</sub>, *t*<sub>3</sub>, *t*<sub>2</sub>, *t*<sub>1</sub>, the indications of each thermometer successively in descending, we must

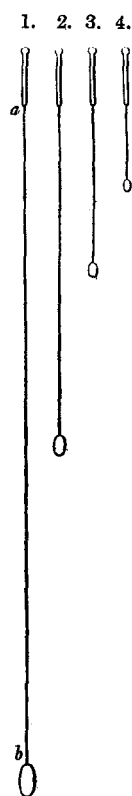
have the product of the temperature and depth between the values of the two series,

$$T \cdot a + t_4 a + 2 t_3 a + 2^2 t_2 a$$

and

$$t_4 a + t_3 a + 2 t_2 a + 2^2 t_1 a$$

Farther, it will be nearer the latter result than the former, since the variation of temperature diminishes as we descend.



Until after May 1838, no superficial thermometer (or one in the uppermost stratum of soil) was used. There was simply a thermometer suspended beside the scales in the box, to indicate the temperature of the part of the column exposed to the air. Fortunately, however, the correction for the temperature of the first interval  $a$ , or 3 feet, is very small indeed. The extreme excess of temperature of the air in the box above the highest thermometer, or  $(T - t_4)$  during 1837, was  $20^\circ$  Fahr. In the most capacious of the tubes employed, supposing that the temperature of  $20^\circ$  had been applied through the whole depth of 3 feet, an expansion would have been produced, which would have raised the alcohol on the scale of that thermometer by  $0.07$ ; but the expansion could not possibly amount to half of this, seeing that the mean temperature of the 3 feet of soil would more nearly approach to that of the inferior limit of it, than to that of the air in contact with its surface. We can hardly err  $.01$  (a quantity in this particular case much less than the errors of reading), by assuming that  $\frac{1}{4}$  of the column of 3 feet had the temperature of the air, and the remainder that of the thermometer bulb itself.\* In both the other three-feet thermometers, the error, owing to the smaller capacity of the three-feet capillary tube, would be but about half as great.

Now, by reasoning by the method of limits as above, and applying the above correction to the upper 9 inches of all the tubes, I find the following formula to be a more than sufficient approximation in every case. For the deepest thermometer, No. 1, whose temperature is  $t_1$

$$\text{Mean temperature of stem} = \frac{\Sigma \text{Temperatures} \times \text{depths}}{\text{depth}}.$$

$$\text{making } 3.2 \text{ feet} = \text{unit of depth,}$$

$$\text{mean temperature} = \frac{1 \cdot t_4 + 2 \cdot t_3 + 4 \cdot t_2 + 8 \cdot t_1}{8}. \quad . \quad . \quad . \quad (1.)$$

And as the reduction of the temperature of the stem to that of the bulb depends on the excess of the former above the latter, we have

$$\text{Mean excess of temperature} = \frac{(t_4 - t_1) + 2(t_3 - t_1) + 4(t_2 - t_1)}{8}. \quad . \quad (2.)$$

Farther, to adapt this to calculation, let the successive intervals of temperature of the series of thermometers be taken, and make

$$t_2 - t_1 = a$$

$$t_3 - t_2 = b$$

$$t_4 - t_3 = c$$

the above expression becomes

$$\begin{aligned} & \frac{1}{8} \{ (a + b + c) + 2(a + b) + 4a \} \\ & = \frac{1}{8} \{ 7a + 3b + c \} \text{ for thermometer No. 1, } \quad . \quad . \quad (3.) \end{aligned}$$

\* The application of this correction becomes exceedingly easy, by considering the correction for air temperature to apply, not only to the exposed part of the tube, but also to the first 9 inches of the buried stem.



For the other thermometers, we have only to make  $a$  and  $b$  successively = 0, and substitute 4 and 2 for the depths, which give

$$\frac{1}{4}\{3b+c\} \text{ for No. 2.}$$

$$\frac{1}{2}c \text{ for No. 3.}$$

And the correction for No. 4 will be exclusively that derived from the observation of the thermometer in air  $T$ , and has for its argument

$$\frac{1}{4}\{T-t_4\} \dots \dots \dots (4.)$$

I should have observed, that, in order to ascertain that these formulæ represented the state of the instruments with sufficient accuracy, I first calculated how nearly the mean temperature of the whole column of each thermometer must be known, in order to entail no greater error than that of the reading, say of  $\cdot 01$  degree. This, in the case of the deepest (26 feet) thermometer, with the widest bore, amounts to  $1^\circ$  of temperature, and in the three-feet thermometer to  $3^\circ$ .

For the second or Air Temperature correction, the quantity of alcohol to be expanded, depends on the height at which the liquid stands in the tube, and the amount of expansion on the temperature to which it is subjected.

Let us suppose, that in any thermometer the degree of temperature is known at which the surface of the column would just contract below the level of the soil. The number of degrees above this, which the thermometer at any time marks, points out the quantity to be corrected for expansion. If this correction is also to be applied to a part of the tube 9 inches lower, we have only to start from a degree of the scale corresponding to that point instead of to the surface. The number of degrees for which it is to be corrected, is the excess of the temperature of the air above that of the bulb, or  $T-t_n$ ,  $t_n$  denoting the temperature shewn by the  $n^{\text{th}}$ . thermometer in an ascending order. Table III. in page 198, gives the point on the scale of each thermometer, corresponding to a position 9 inches below the level of the soil; let that point be  $l_1, l_2, l_3, l_4$ , for each thermometer in succession, then the number of degrees of temperature to be corrected for, will be  $T-l_1, T-l_2$ , &c.

Thus, both the corrections required to reduce the observed readings amount to finding by a table, the increased (or diminished) length of a given column of alcohol (measured in degrees), for a given excess (or defect) of temperature, assigned in degrees. Such a table I have constructed, and I have thought it advisable to employ the correct value of the expansion of alcohol at atmospheric temperatures, instead of its *mean* amount between the freezing and boiling points. This latter quantity as given by DALTON, and commonly employed, is  $\cdot 11$  of the volume, from  $32^\circ$  to  $212^\circ$ , or  $\cdot 000611$  for  $1^\circ$  Fahr. Now, it appears from MUNCKE'S elaborate experiments, that alcohol, of density  $\cdot 808$ , expands at common atmospheric temperatures (viz. between  $0^\circ$  and  $20^\circ$  cent.), almost precisely  $\cdot 001$  of its volume

at freezing for  $1^{\circ}$  cent.,\* or  $\cdot 000555$  for  $1^{\circ}$  Fahr., a quantity *one-tenth* greater than its mean dilatation usually adopted. I accordingly had a Table constructed on this basis, with a double entry, one for the number of degrees, or space in the tube filled with the expanded liquid, and the other for the excess of temperature to which it is exposed. The arguments used for the two corrections, with this Table, were the following :—

	1st Argument. Capacity in Degrees to be corrected.	2d Argument. Degrees of Temperature to be corrected for
1st Correction (for Temperature of Stem),	Table, p. 198.	$\frac{7a + 3b + c}{8}$
2d Correction (for Temperature of Air),	$T - t_1$	$T - t_1$

The sign of the correction is always *opposite to that of the second argument*.

\* FECHNER's Repertorium, II. 430. The expansion of absolute alcohol is somewhat greater as given by MUNCKE, in a paper in the Petersburg Transactions, read 5th September 1834.

DEGREES OF TUBE TO BE CORRECTED.

DEGREES OF TUBE TO BE CORRECTED.																															
Excess of Temp.	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°	
1°	00	00	00	00	00	00	00	00	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	01	
2°	00	00	00	00	01	01	01	01	01	01	01	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
3°	00	00	01	01	01	01	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
4°	00	01	01	01	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
5°	00	01	01	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
6°	00	01	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
7°	00	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
8°	00	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
9°	00	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
10°	01	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
11°	01	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
12°	01	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
13°	01	01	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
14°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
15°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
16°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
17°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
18°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
19°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
20°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
21°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
22°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
23°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
24°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
25°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
26°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
27°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
28°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
29°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
30°	01	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
31°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
32°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
33°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
34°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
35°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
36°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
37°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
38°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
39°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	
40°	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	

VII. *Results of the Observations.*A. *Mean Temperature at different depths.*

It has been observed at Brussels and elsewhere,\* that, even at depths less than 25 feet, the mean annual temperature indicated by the lower thermometers is *greater* than that of those nearer the surface. This appears to be also clearly established by the observations at the three stations near Edinburgh, as contained in the following Table.

TABLE V. MEAN TEMPERATURE FOR FIVE YEARS.

	3 French Feet, (No. 4).			6 French Feet, (No. 3).			12 French Feet, (No. 2).			24 French Feet, (No. 1).		
	Observa- tory.	Experi- mental Garden.	Craig- leith.	Observa- tory.	Experi- mental Garden.	Craig- leith.	Observa- tory.	Experi- mental Garden.	Craig- leith.	Observa- tory.	Experi- mental Garden.	Craig- leith.
1837-1838	45°94	46°54	46°26	46°23	46°70	46°50	46°65	46°90	46°30	47°22	47°28	46°46
1838-1839	44°81	45°44	45°22	45°35	45°90	45°35	46°12	46°44	45°47	46°89	47°05	45°97
1839-1840	45°48	46°14	45°83	45°75	46°43	45°73	46°18	46°67	45°70	46°68	46°96	45°87
1840-1841	45°56	46°26	45°97	45°99	46°58	46°01	46°43	46°91	46°08	46°77	47°04	46°18
1841-1842	45°66	46°29	46°13	45°99	46°51	46°01	46°44	46°89	46°07	46°79	47°08	45°87
Means	45°49	46°13	45°88	45°86	46°42	45°92	46°36	46°76	45°92	46°87	47°09	46°07
Mean of Observatory, . . . . .							46°14	Elevation, . . . . .				
— Experimental Garden, . . . . .							46°60	, . . . .				
— Craigleith, . . . . .							45°95	, . . . .				
Mean Temperature of Air from Mr Adie's Observations,							45°28	, . . . .				

Mean of 3 Feet Thermometers, . . . . .	45°83
„ 6 „ . . . . .	46°07
„ 12 „ . . . . .	46°36
„ 24 „ . . . . .	46°68

The cause of the increased mean temperature below, is by no means clear. From its irregularity, it is most probably due to several causes, of which the central heat of the earth is perhaps one; its effect at 25 feet need not be insignificant, since the average rate of increase at great depths is 1° Fahr. for from 40 to 50 English feet. In the present case, the increase is not uniform, and it is also decidedly different in the different soils, and will appear by the sequel to be intimately connected with the conducting power of the strata. The order of magnitude of the increase is this, 1. Observatory, 2. Experimental Garden, 3. Craigleith; —or, Trap, Sand, Sandstone, which is also the order of the conducting power. The following table shews that, in every instance but one (from 6 feet to 12 feet at Craigleith), the increase was apparent.

\* QUETELET, Annales de l'Observatoire Royale de Bruxelles, iv. 150.

TABLE VI. SHEWING THE RATE OF INCREASE OF TEMPERATURE WITH DEPTH.

	Observatory.	Experimental Garden.	Craigleith.
From 3 to 6 feet,	+ 0°37	+ 0°29	+ 0°04
... 3 to 12 ...	+ 0°87	+ 0°63	+ 0°04
... 3 to 24 ...	+ 0°38	+ 0°96	+ 0°19

To complete the comparison of Meteorological data, I subjoin Mr ADIE's observations on the mean temperature of the air and the quantity of rain fallen during the same period, at Canaan Cottage, near Edinburgh, 240 feet above the sea, excepting the months previous to May 1838, which were observed on the Regent Terrace, Calton Hill, at about the same elevation above the sea.

TABLE VII. MEAN TEMPERATURE AND QUANTITY OF RAIN FOR THE YEARS 1837-38-39-40-41-42, OBSERVED AT EDINBURGH BY MR ADIE.

	1837.			1838.			1839.	
	Thermometer.	Rain.		Thermometer.	Rain.		Thermometer.	Rain.
January	36.33	1.23	January	31.73	2.47	January	33.05	1.76
February	37.23	2.14	February	30.06	1.21	February	38.53	1.45
March	35.24	1.28	March	38.12	2.76	March	36.98	1.47
April	39.65	1.61	April	40.25	1.78	April	42.53	0.33
May	48.37	1.53	May	44.87	2.90	May	46.82	0.47
June	57.30	2.86	June	53.98	5.16	June	53.42	3.91
July	60.42	4.54	July	58.94	2.45	July	57.77	3.51
August	51.77	4.13	August	56.88	2.99	August	55.51	1.77
September	53.18	1.73	September	52.04	4.00	September	52.13	3.09
October	50.17	2.02	October	46.27	1.15	October	46.50	2.38
November	40.45	2.03	November	38.38	3.06	November	43.13	1.65
December	42.68	1.67	December	38.17	0.73	December	37.46	1.66
Sums	552.79	26.77		529.69	30.86		543.83	23.45
Mean	46.07			44.14			45.32	

	1840.			1841.			1842.	
	Thermometer.	Rain.		Thermometer.	Rain.		Thermometer.	Rain.
January	38.74	3.72	January	33.00	1.23	January	35.45	1.01
February	36.55	1.58	February	38.39	1.66	February	39.55	1.11
March	42.74	0.43	March	45.62	0.60	March	42.04	3.44
April	48.16	0.19	April	44.26	1.14	April	45.03	0.15
May	47.13	3.99	May	51.74	1.14	May	51.22	1.45
June	52.53	2.51	June	52.43	1.36	June	57.53	0.97
July	52.75	3.46	July	53.58	3.87	July		
August	44.51	1.99	August	53.88	3.64	August		
September	48.57	2.39	September	54.36	2.63	September		
October	44.32	2.01	October	43.48	4.53	October		
November	48.66	2.33	November	39.10	2.28	November		
December	37.31	0.68	December	39.65	1.96	December		
Sums	541.97	25.28		549.53	26.04		270.82	8.13
Mean	45.16			45.79			45.14	

B. *General Observations on the Thermometric Curves.*

Some of the most important results depend upon the annual ranges of temperature at different depths. But the determination of the extremes is no easy matter. I will first direct attention to the curves in Plate VII., which convey a great deal of valuable information, which can here be only slightly touched upon. They are reduced to *one-sixth* of the size of the original projections, in which one degree occupied two-thirds of an inch vertically, and one day occupied one-tenth of an inch horizontally. The *corrected* temperatures are those which have been projected.

The curves extend over five years; and are placed in the order of depths (vertically) to which they belong: the uppermost undulating curves shewing the variations at the three stations 3 French feet below the surface, the lowest set shewing the variations 24 French feet below the surface.

The most obvious results are the following:—

1. In the upper set of curves, though the irregularities are greatest, yet the three curves follow one another with singular fidelity throughout these irregularities. The curves separate a little in summer, and regularly in the same direction every summer, shewing the influence of exposure, the Experimental Garden being most heated, then Craigleith, and lastly the Observatory, which is also the order of the elevations of the stations above the sea. It may also be added, that the diurnal change may possibly have some slight influence upon the Experimental Garden, where the observations were made fully two hours later than at the other stations. (See Section V.)

2. As the local irregularities diminish at increasing depths, the range diminishes, and the times of maxima and minima are continually retarded.

3. At increasing depths, the curves, which followed one another so closely and exactly amidst the irregularities of temperature near the surface, *systematically separate from one another*, both owing to a variation in the range or degree of undulation of the curve, and owing to a greater or less degree of retardation in the maxima or minima of the different curves.

4. The effect last described is least sensible in comparing the observations at the Observatory and Experimental Garden, but *most* sensible if either of these be compared with the Craigleith observations, for which last the range diminishes more slowly, so that, at 24 French feet, it is about double that of either of the others, and the retardation of the maxima and minima is much less.

5. In the trap and loose sand, the range is diminished to *one-tenth part* in descending from 3 feet to 24 feet; but in the sandstone it is not quite diminished to a *fifth part*. The epoch of maximum temperature is retarded in the two former cases nearly five months, in the latter only three.

From these statements it is easy to see that the influence of the CONDUCTING

POWER OF THE DIFFERENT SOILS OR ROCKS FOR HEAT is very palpable. But to submit it to numerical calculation, a more elaborate analysis is necessary. Each year has been first considered by itself, and then the whole united.

*C. Thermometric Ranges.*

To ascertain the range for each year, the maximum and minimum points of the curves of each thermometer were ascertained graphically by the aid of an elastic wire, bent so as to represent a curve which should pass through the zig-zags of the temperature curve, and connect the observed points with tolerable accuracy. The points of greatest and least temperature in each year were thus represented with a certain degree of approximation, and the results are shewn in the following table.

TABLE VIII. SHEWING THE MAXIMUM AND MINIMUM TEMPERATURE AND RANGE FOR EACH OF FIVE YEARS.

		Observatory, Trap.			Experimental Garden, Sand.			Craigleith, Sandstone.		
		Maxi- mum.	Mini- mum.	Range, Fahren- heit.	Maxi- mum.	Mini- mum.	Range, Fahren- heit.	Maxi- mum.	Mini- mum.	Range, Fahren- heit.
3 FEET.	1837-38	56°25	37°30	18°95	57°20	37°55	19°65	55°90	37°65	17°25
	1838-39	53°40	35°70	17°70	55°45	35°12	20°33	53°90	35°38	18°52
	1839-40	53°05	38°10	15°55	56°50	37°50	19°00	54°30	37°85	16°45
	1840-41	53°87	38°95	14°92	56°35	38°10	18°25	55°10	38°95	16°15
	1841-42	52°85	38°88	13°97	54°50	37°85	17°65	53°15	38°25	14°90
6 FEET.	1837-38	52°30	40°40	11°90	54°65	39°70	14°95	53°80	39°90	13°09
	1838-39	50°90	39°70	11°20	53°20	38°63	14°57	52°35	38°10	14°25
	1839-40	50°97	40°65	10°32	53°67	39°70	13°97	52°53	39°20	13°33
	1840-41	51°35	41°10	10°25	53°75	40°52	13°23	53°15	40°05	13°10
	1841-42	51°07	40°78	10°29	52°95	39°55	13°40	51°90	38°95	12°95
12 FEET.	1837-38	49°40	43°90	5°50	50°65	43°10	7°55	51°10	41°70	9°40
	1838-39	48°65	43°60	5°05	49°95	42°85	7°10	50°05	40°75	9°30
	1839-40	48°57	43°73	4°84	50°19	43°08	7°11	49°80	41°45	8°35
	1840-41	48°80	44°30	4°50	50°30	43°60	6°70	50°45	42°12	8°33
	1841-42	49°00	44°20	4°80	50°40	43°50	6°90	50°30	41°60	8°70
24 FEET.	1837-38	47°85	46°40	1°45	48°25	46°15	2°10	48°50	44°40	4°10
	1838-39	47°45	46°20	1°25	47°88	46°00	1°88	47°88	44°05	3°83
	1839-40	47°35	45°97	1°38	47°40	45°97	1°43	47°82	43°87	3°95
	1840-41	47°38	46°15	1°23	48°00	46°10	1°90	48°12	44°40	3°72
	1841-42	47°50	46°12	1°38	48°10	46°10	2°00	48°25	44°35	3°90

Theory shews, that the annual range ought to decrease in geometrical progression, as the depths increase uniformly. In other words, the ranges may be represented by the ordinates of a logarithmic curve. And that such is the case may be seen from the curves in Plates IX. and X., where the logarithmic curves are drawn through points so as to represent, as well as is practicable, the law of decreasing range at the different stations. These diagrams were constructed without any reference to one another; and their general coincidence is highly satisfactory.

To express the results geometrically,

$$\text{Log. } \Delta = A + Bp$$

Where  $\Delta$  is the thermometric range at a depth  $p$  in French feet;  $A$  and  $B$  are constants, the second of which is always negative. These constants are important, and their determination may be considered as the *primary* object of this investigation.  $A$  is manifestly equal to the logarithm of the thermometric range at the surface, or when  $p=0$ ;  $B$  is a constant which determines the rate of diminution of the range in the interior of the earth, being smaller in proportion as the heat penetrates more readily, or as the conductivity of the soil is greater. It was shewn by FOURIER to be directly proportional to the square root of the specific heat of the soil, and inversely as the square root of the conductivity.\*

These quantities  $A$  and  $B$  have reference to the thermometric scale employed, and therefore it is convenient, in order to obtain comparable results, to use the same unit as MM. POISSON and QUETELET have done in their comparison of theory with observation, that is, the centigrade scale. For this purpose, the ranges are expressed in the following table in centigrade degrees.

TABLE IX. RANGES IN CENTIGRADE DEGREES.

	3 Feet.			6 Feet.			12 Feet.			24 Feet.		
	Observa- tory.	Experi- mental Garden.	Craig- leith.	Observa- tory.	Experi- mental Garden.	Craig- leith.	Observa- tory.	Experi- mental Garden.	Craig- leith.	Observa- tory.	Experi- mental Garden.	Craig- leith.
1837	10 <sup>o</sup> 53	11 <sup>o</sup> 23	9 <sup>o</sup> 58	6 <sup>o</sup> 61	8 <sup>o</sup> 30	7 <sup>o</sup> 72	3 <sup>o</sup> 05	4 <sup>o</sup> 19	5 <sup>o</sup> 22	0 <sup>o</sup> 80	1 <sup>o</sup> 16	2 <sup>o</sup> 28
1838	9 <sup>o</sup> 83	11 <sup>o</sup> 30	10 <sup>o</sup> 29	6 <sup>o</sup> 22	8 <sup>o</sup> 10	7 <sup>o</sup> 91	2 <sup>o</sup> 80	3 <sup>o</sup> 94	5 <sup>o</sup> 16	0 <sup>o</sup> 70	1 <sup>o</sup> 05	2 <sup>o</sup> 13
1839	8 <sup>o</sup> 64	10 <sup>o</sup> 55	9 <sup>o</sup> 14	5 <sup>o</sup> 73	7 <sup>o</sup> 76	7 <sup>o</sup> 40	2 <sup>o</sup> 69	3 <sup>o</sup> 95	4 <sup>o</sup> 64	0 <sup>o</sup> 76	0 <sup>o</sup> 79	2 <sup>o</sup> 20
1840	8 <sup>o</sup> 29	10 <sup>o</sup> 14	8 <sup>o</sup> 98	5 <sup>o</sup> 70	7 <sup>o</sup> 35	7 <sup>o</sup> 28	2 <sup>o</sup> 50	3 <sup>o</sup> 72	4 <sup>o</sup> 63	0 <sup>o</sup> 89	1 <sup>o</sup> 06	2 <sup>o</sup> 07
1841	7 <sup>o</sup> 79	9 <sup>o</sup> 80	8 <sup>o</sup> 28	5 <sup>o</sup> 71	7 <sup>o</sup> 45	7 <sup>o</sup> 20	2 <sup>o</sup> 66	3 <sup>o</sup> 83	4 <sup>o</sup> 83	0 <sup>o</sup> 76	1 <sup>o</sup> 11	2 <sup>o</sup> 16
Means,	9 <sup>o</sup> 02	10 <sup>o</sup> 30	9 <sup>o</sup> 25	5 <sup>o</sup> 99	7 <sup>o</sup> 79	7 <sup>o</sup> 50	2 <sup>o</sup> 74	3 <sup>o</sup> 93	4 <sup>o</sup> 89	0 <sup>o</sup> 78	1 <sup>o</sup> 03	2 <sup>o</sup> 17

Two results are sufficient for eliminating the constants  $A$  and  $B$  at each station, and the most probable combination may be had by the method of least squares. I have preferred, however, the graphical method already referred to for finding, by means of a diagram and a pair of proportional compasses, the logarithmic curve which best represents the observations. This being done as shewn in Plates IX. and X., the values of  $A$  and  $B$  may be deduced thus.  $A$ , as already observed, is the logarithmic range at the surface. Taking a space equal to 10° Cent. (or 18° Fahr.) in the compasses, find the depth at which the curve has this quantity for an ordinate, let  $p_{10}$  be this depth. Then, since  $\text{Log. } \Delta = \text{Log. } 10 = 1$ , the equation above becomes

$$1 = A + Bp_{10}$$

$$\text{and } B = \frac{1 - A}{p_{10}}.$$

\* For farther particulars, see the Appendix at the end of this memoir, and also Sub-Section F.



Also  $p_1$ ,  $p_{0.1}$ ,  $p_{0.01}$  denoting the depths corresponding to a range of  $1^\circ$ ,  $0.1^\circ$ ,  $0.01^\circ$  Cent., we have

$$p_1 = -\frac{A}{B} \quad p_{0.1} = -\frac{1+A}{B} \quad p_{0.01} = -\frac{2+A}{B}.$$

*Numerical Example.* By the projection for 1837, Plate IX., we find

	Observatory.	Experimental Garden.	Craigleith.
The superficial range . . . . .	$14.6^\circ$ Cent.	$15.0^\circ$ Cent.	$11.9^\circ$ Cent.
$p_{10}$ =depth where range= $10^\circ$ Cent. . .	3.0 F. ft.	4.0 F. ft.	2.4 F. ft.
Whence A . . . . .	1.164	1.176	1.076
B . . . . .	-0.0547	-0.0440	-0.0317
$p_1$ . . . . .	21.4 F. ft.	26.7 F. ft.	34.1 F. ft.
$p_{0.1}$ . . . . .	39.7 ...	49.5 ...	65.7 ...
$p_{0.01}$ . . . . .	58.1 ...	72.2 ...	97.3 ...

The numbers in the last line may be taken (arbitrarily) as a limit of comparison for the point at which the annual variation sensibly vanishes, and its difference in the three stations shews the marked influence of the conducting soil or rock. The following tables contain a summary of these results for five years.

TABLE X. SHEWING THE VALUES OF A AND B.\*

VALUES OF A.				VALUES OF B.			
	Observatory.	Experimental Garden.	Craigleith.		Observatory.	Experimental Garden.	Craigleith.
1837	1.164	1.176	1.076	1837	—0.0545	—0.0440	—0.0316
1838	1.173	1.217	1.114	1838	—0.0641	—0.0517	—0.0345
1839	1.086	1.182	1.049	1839	—0.0516	—0.0498	—0.0305
1840	1.073	1.155	1.044	1840	—0.0550	—0.0470	—0.0308
1841	1.031	1.141	1.019	1841	—0.0474	—0.0460	—0.0281
Means,	1.105	1.174	1.060	Means,	—0.0545	—0.0477	—0.0311

TABLE XI. SHEWING THE DEPTHS AT WHICH THE ANNUAL RANGE IS REDUCED TO  $0.01^\circ$  CENT.

	Observatory.	Experimental Garden.	Craigleith.
1837	58.1	72.2	97.3
1838	49.3	61.8	91.0
1839	59.2	63.5	100.0
1840	55.9	67.1	98.8
1841	63.9	68.3	107.4
Means,	57.3	66.6	98.9

\* The French foot and centigrade degree are here taken as units.

On these results it may be remarked, that  $A$ , which is the logarithm of the superficial range, is necessarily variable according to the season, and that it appears, singularly enough, to have been constantly on the decrease throughout the period of these experiments. This gives a great probability that the mean of these will be very nearly an average result for this climate. The depth at which the annual variation disappears is also evidently dependent, in part, on the quality of the season.  $B$  is the only proper constant, depending solely upon the specific heat and conductivity of the soil; and the mean results of Table X. are evidently near approximations to the truth.

These computations have been made on the supposition that the logarithmic law of the diminution of the range is correct, and that the deviations from it are due to accidental errors. These deviations appear, however, to be too systematic to admit exactly of this conclusion. The observations at Craighleith coincide most nearly with theory; those at the Observatory much less so, although there is every reason to believe that the observations there were in every respect the most unexceptionable of the three. At the Observatory, the observations at great depths indicate a less rapid contraction of the range than do those at the surface, as an inspection of the curves in Plates IX. and X., and the points through which they have been drawn, sufficiently proves.

To illustrate this difference, I had the constants  $A$  and  $B$  separately computed from all the possible combinations by pairs of the observations of 1837-38, with the following results.

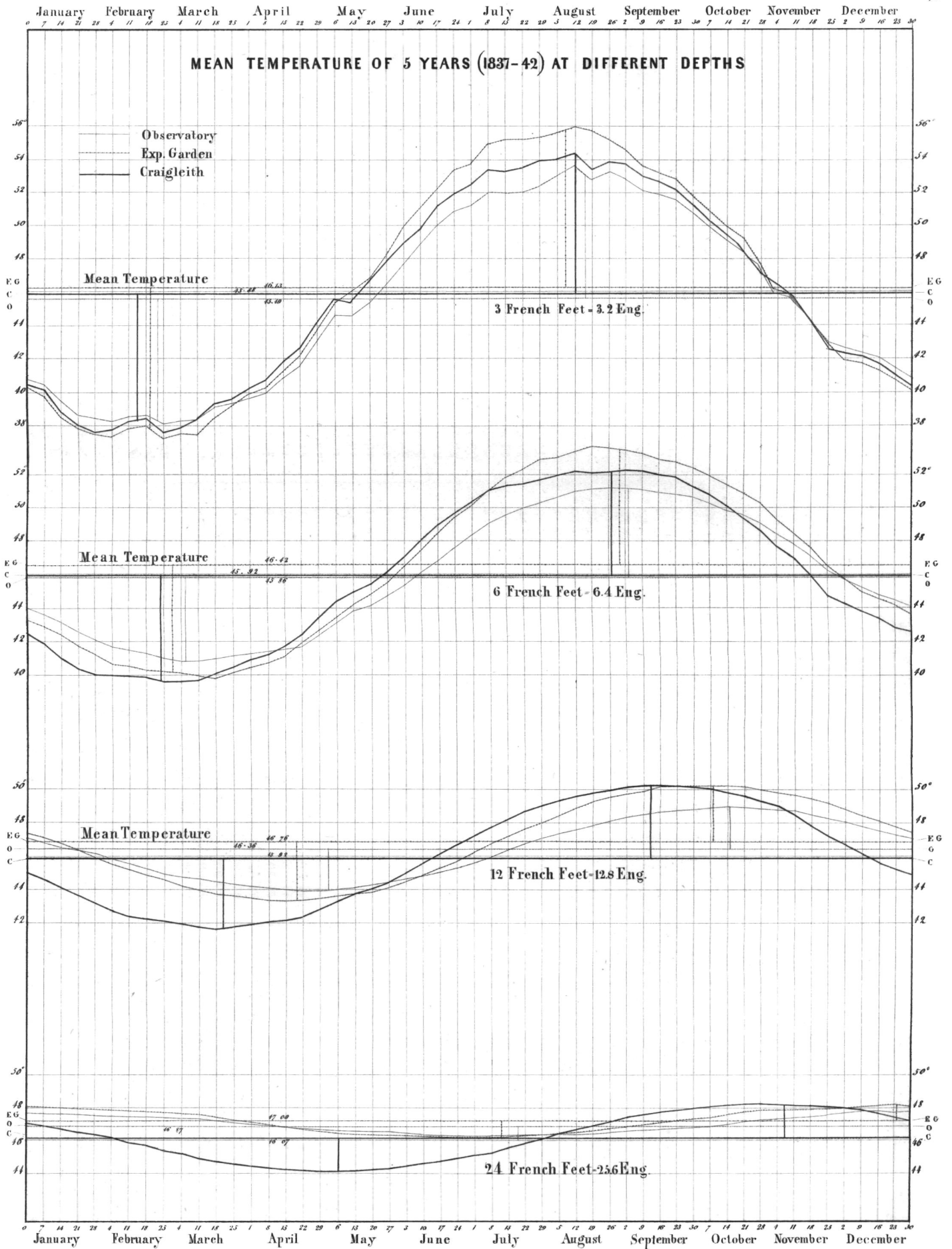
TABLE XII.

Taken in combination with	Observatory.			Experimental Garden.			Craigleith.		
	12 Feet.	6 Feet.	3 Feet.	12 Feet.	6 Feet.	3 Feet.	12 Feet.	6 Feet.	3 Feet.
	A = 1.08 B = —.0484	A = 1.126 B = —.0510	A = 1.182 B = —.0533	A = 1.180 B = —.0465	A = 1.204 B = —.0475	A = 1.191 B = —.0459	A = 1.077 B = —.0300	A = 1.064 B = —.0294	A = 1.070 B = —.0297
	24 Feet. {	A = 1.156 B = —.0560	A = 1.202 B = —.0598	{ . . . . {	A = 1.216 B = —.0495	A = 1.193 B = —.0476	{ . . . . {	A = 1.058 B = —.0283	A = 1.069 B = —.0293
12 Feet. . . . . {									
6 Feet. . . . . {		A = 1.225 B = —.0674			A = 1.182 B = —.0438				A = 1.075 B = —.0312
	Mean Values, . {	A = 1.1594 B = —.0560		Mean Values, . {	A = 1.1943 B = —.0469		Mean Values, . {	A = 1.0690 B = —.0297	



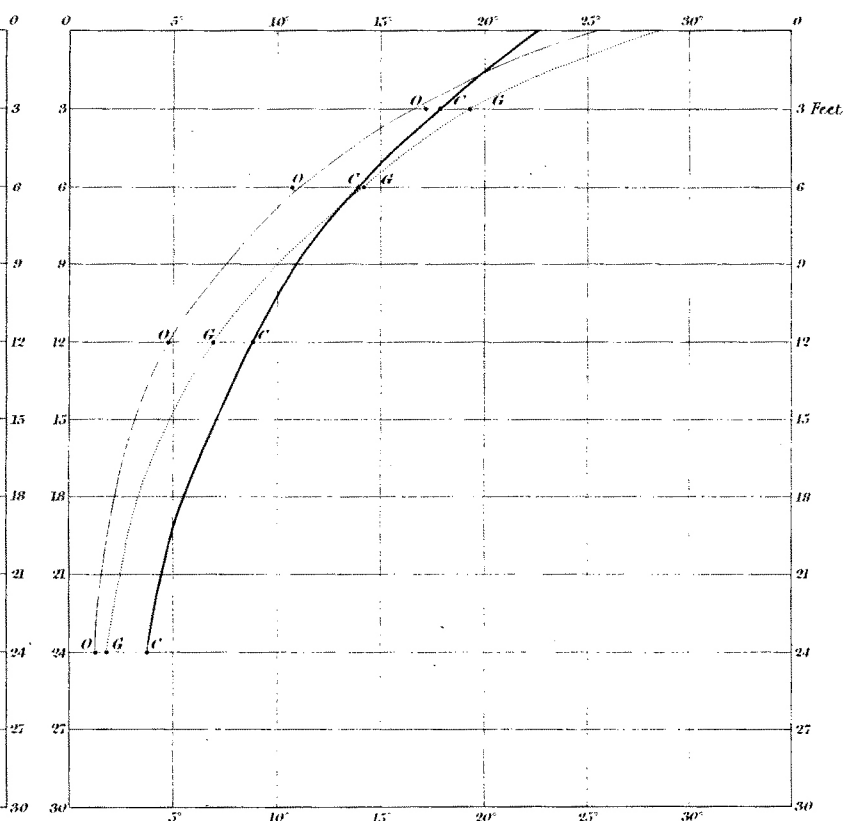
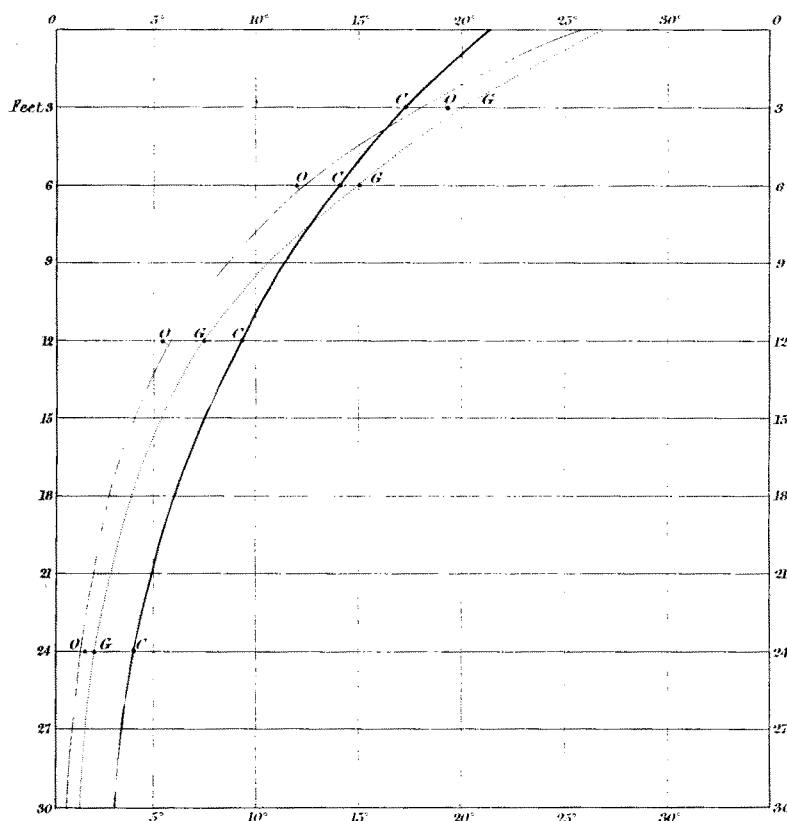






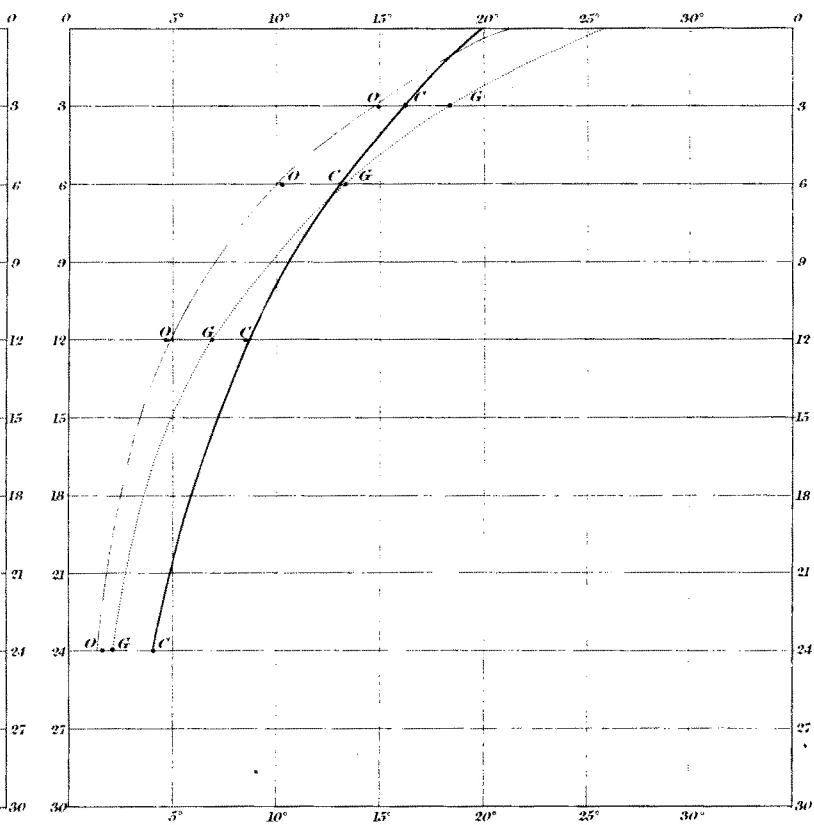
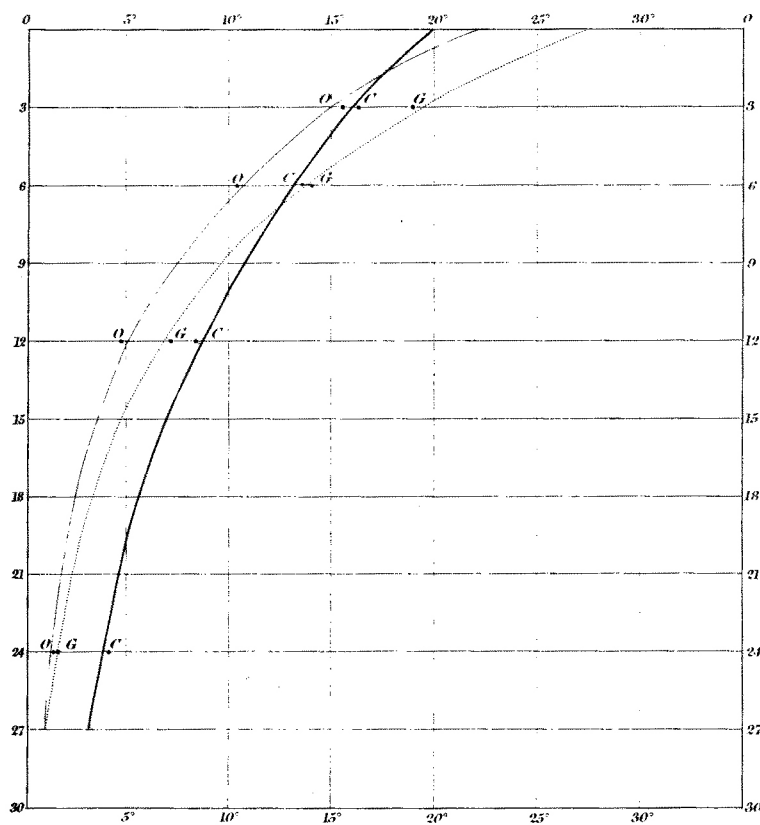
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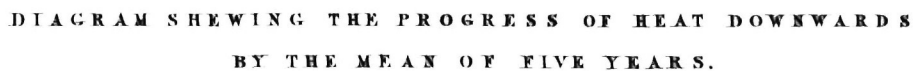
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1840



— OBSERVATORY    ..... EXPERIMENTAL GARDENS    — CRAIGLEITH

**MEAN 1837 41**



OBSERVATORY ..... EXPERIMENTAL GARDENS — GRAIGLEITH

TABLE XIII. EPOCHS OF MINIMUM AND MAXIMUM TEMPERATURE (BY INTERPOLATION)  
FROM 1837 TO 1842.

MINIMUM.												
	3 Feet.			6 Feet.			12 Feet.			24 Feet.		
	Observa- tory.	Experi- mental Garden.	Craig- leith.	Observa- tory.	Experi- mental Garden.	Craig- leith.	Observa- tory.	Experi- mental Garden.	Craig- leith.	Observa- tory.	Experi- mental Garden.	Craig- leith.
1837							May 6	Apr. 30	Apr. 10	July 26	July 12	May 18
1838	Feb. 23	Mar. 3	Feb. 23	Mar. 14	Mar. 19	Mar. 3	Apl. 20	Apr. 22	Mar. 20	July 18	July 8	May 12
1839	Mar. 14	Feb. 24	Feb. 24	Mar. 27	Mar. 25	Mar. 4	Apl. 30	Apr. 22	Apr. 1	July 12	June 24	May 12
1840	Mar. 1	Feb. 25	Mar. 1	Mar. 14	Mar. 15	Mar. 8	Apl. 19	Apr. 18	Mar. 21	July 5	June 26	Apr. 30
1841	Feb. 1	Feb. 1	Jan. 27	Feb. 17	Feb. 15	Feb. 2	Mar. 24	Mar. 20	Feb. 24	July 5	June 15	Apr. 5
1842	Jan. 25	Jan. 22	Jan. 25	Feb. 19	Feb. 15	Feb. 6						
Means	Feb. 18	Feb. 14	Feb. 13	Mar. 7	Mar. 7	Feb. 21	Apr. 20	Apr. 16	Mar. 21	July 13	June 29	May 3
MAXIMUM.												
1837	Aug. 6	July 31	Aug. 5	Sept. 2	Aug. 24	Aug. 19	Oct. 17	Oct. 6	Sept. 11	Jan. 8	Dec. 30	Nov. 11
1838	Aug. 8	Aug. 6	Aug. 16	Sept. 6	Aug. 31	Aug. 23	Oct. 19	Oct. 14	Sept. 19	Jan. 5	Jan. 4	Nov. 2
1839	Aug. 1	July 30	July 30	Aug. 26	Aug. 19	Aug. 14	Oct. 10	Oct. 3	Sept. 11	Jan. 8	Dec. 26	Nov. 4
1840	Aug. 23	Aug. 18	Aug. 18	Sept. 4	Sept. 2	Aug. 23	Oct. 6	Sept. 30	Sept. 9	Jan. 3	Dec. 18	Oct. 26
1841	Sept. 6	Aug. 23	Aug. 25	Sept. 24	Sept. 19	Sept. 15	Oct. 20	Oct. 16	Oct. 4	Dec. 29	Dec. 18	Nov. 3
Means	Aug. 15	Aug. 9	Aug. 13	Sept. 6	Sept. 1	Aug. 25	Oct. 14	Oct. 8	Sept. 17	Jan. 4	Dec. 25	Nov. 3

It will readily be understood, by the inspection of the curves, that these determinations are liable to considerable uncertainties,—in most cases amounting to several days. The curves at small depths are liable to many anomalous fluctuations, and even occasionally present an appearance of two minima; and at great depths the curves, though even, are so flat, that a considerable error may occur in detecting their highest and lowest points. It does not appear, however, that more real accuracy would be obtained by the methods of calculation which have usually been employed, instead of interpolating curves. We shall presently, however, shew how the two may be advantageously combined.

We thus see that the greatest cold of winter attains the depth of 24 French feet,—

At the Observatory (trap rock), on the 13th July;

At the Experimental Garden (loose sand), on the 29th June;

At Craigleith (sandstone), on the 3d May;

and that the greatest heat occurs on the 4th January, 25th December, 3d November respectively; shewing, in both cases, the very same order of facility in conducting heat which we had before deduced from the diminution of ranges, namely, that the Observatory ground is the worst conductor, that of the Experimental Garden but little better, and the rock at Craigleith by far the best.

Unfortunately, the measure of the retardation of epochs has, as yet, been so

imperfectly reduced to theory, that we cannot satisfactorily compare it with experiment;\* but one law of great simplicity has long been known from theory to be approximately true, namely, that the retardation of epochs is *uniformly* greater as the depth increases. This is also easily verified graphically. By taking the depths in a vertical direction, and setting off the day of greatest or least temperature horizontally, a series of points is obtained through which a straight line should pass. I have not engraved these projections for *each* year, but that for the mean of the whole will be seen in the lower part of Plate X., where the interpolating lines in general pass so nearly through the dots that they cannot be distinguished. From these projections the mean rate of propagation downwards is easily determined, and affords a palpable illustration of the conducting powers of the soil.

TABLE XIV. SHEWING THE NUMBER OF DAYS REQUIRED BY THE IMPRESSION OF HEAT TO PASS THROUGH ONE FOOT OF SOIL.

	MAXIMA.			MINIMA.		
	Observatory.	Experimental Garden.	Craigleith.	Observatory.	Experimental Garden.	Craigleith.
	Days.	Days.	Days.	Days.	Days.	Days.
1837	7·5	7·1	4·9	...	...	...
1838	6·8	6·8	3·6	6·5	5·8	3·6
1839	7·8	7·2	4·6	6·0	5·1	3·6
1840	6·6	5·95	3·5	6·1	5·7	3·05
1841	5·4	5·1	3·0	6·4	5·7	3·6
Means	6·82	6·43	3·92	6·25	5·58	3·46

It must be added, that in the several years the law of *uniform* progression is by no means accurate, although, in the mean of five, the accidents are nearly compensated. And here, again, we find the good conductor, the sandstone, gives by far the most regular and consistent results.

E.—On the Form of the Annual Curves.

With a view to approximate more nearly to the form of the annual curves of temperature at different depths, I have had the mean temperature for each week of the year taken by the mean of five years, which has the effect of disposing of the more irregular fluctuations, as may be seen in Plate VIII., the curves in which are taken from the following Table :

\* See the Appendix.



TABLE XV. MEAN TEMPERATURE OF EACH YEAR FOR FIVE YEARS, 1837-42.

Mean Day.	OBSERVATORY.				EXPERIMENTAL GARDEN.				CRAIGLEITH.			
	24 Feet.	12 Feet.	6 Feet.	3 Feet.	24 Feet.	12 Feet.	6 Feet.	3 Feet.	24 Feet.	12 Feet.	6 Feet.	3 Feet.
January 0.	47.47	46.95	44.07	40.99	47.98	47.21	43.46	40.39	47.09	44.92	42.47	40.54
" 7.	47.47	46.73	43.68	40.96	47.95	46.86	42.99	40.16	46.93	44.46	42.09	40.47
" 14.	47.46	46.49	43.21	39.63	47.91	46.64*	42.46	38.82	46.68	44.11	41.20	39.13
" 21.	47.43	46.26	42.69	38.95	47.90	46.45	41.84	38.19	46.51	43.66	40.55	38.28
" 28.	47.41	45.99	42.18	38.62	47.86	45.87	41.30	37.88	46.31	42.95	40.05	37.95
February 4.	47.54	45.77	41.82	38.35	47.86	45.52	40.85	37.45	46.23	42.95	39.97	38.13
" 11.	47.48	45.44	41.49	38.73	47.75	45.16	41.28*	38.05	46.00	42.51	39.98	38.53
" 18.	47.43	45.23	41.42	38.80	47.69	44.80	40.39	38.25	45.75	42.35	40.01	38.69
" 25.	47.36	45.01	41.29	38.29	47.63	44.49	40.36	37.78	45.54	42.14	39.65	37.91
March 4.	47.30	44.79	41.04	38.54	47.50	44.29	40.14	37.94	45.32	41.99	39.65	38.22
" 11.	47.22	44.60	40.96	38.46	47.45	44.02	39.98	37.73	45.13	41.87	39.64	38.34
" 18.	47.15	44.42	40.99	39.32	47.33	43.82	39.98	38.82	44.95	41.59	40.08	39.50
" 25.	47.07	44.27	41.18	39.47	47.21	43.63	40.28	39.29	44.77	41.77	40.45	39.71
April 1.	46.99	44.17	41.27	39.89	47.06	43.49	40.50	40.03	44.61	41.91	40.86	40.39
" 8.	46.91	44.07	41.40	40.01	46.93	43.39	40.75	40.13	44.49	42.04	41.09	40.64
" 15.	46.84	44.02	41.56	40.91	46.85	43.38	41.07	41.13	44.39	42.16	41.63	41.80
" 22.	46.76	43.97	42.33	42.78	46.75	43.34	41.62	41.99	44.31	42.31	42.16	42.32
" 29.	46.68	44.02	43.03	44.54	46.64	43.39	42.06	43.14	44.26	43.62	43.02	43.75
May 6.	46.61	44.10	43.08	44.55	46.51	43.51	43.08	45.38	44.23	43.10	44.18	45.43
" 13.	46.54	44.23	44.01	45.02	46.48	43.69	43.93	45.71	44.30	43.96	44.70	45.22
" 20.	46.47	44.30	44.47	46.00	46.39	43.92	44.51	46.35	44.37	44.36	45.87	46.34
" 27.	46.40	44.40	45.09	47.26	46.28	44.18	45.14	47.46	44.46	44.48	46.63	47.33
June 3.	46.35	44.56	45.85	48.41	46.16	44.77	47.08	50.61	44.57	45.31	47.61	49.43
" 10.	46.30	44.75	46.59	49.69	46.13	45.15	48.05	51.98	44.73	45.92	48.63	50.91
" 17.	46.26	44.99	47.39	50.63	46.12	45.54	49.08	53.10	44.92	46.49	49.49	51.67
" 24.	46.22	45.20	48.05	51.04	46.13	46.02	49.90	53.30	45.08	46.99	49.92	52.09
July 1.	46.21	45.55	48.66	51.74*	46.12	46.49	50.72	54.87	45.28	47.49	50.72	53.11
" 8.	46.19	45.87	49.38	51.96*	46.12	46.95	51.55	55.04	45.51	48.06	51.11	53.09*
" 15.	46.20	46.19	49.79	52.00*	46.23	47.04	51.99	55.12	45.74	48.50	51.22*	53.32*
" 22.	46.20	46.53	50.09	52.32*	46.99*	48.06*	52.53*	55.19*	45.97	48.91	51.52*	53.63*
August 5.	46.25	47.13	50.37	52.96	46.29	48.28	52.78	55.45	46.20	49.25	51.79*	53.73*
" 12.	46.30	47.42	50.67	53.57	46.37	48.67	53.10	56.06	46.44	49.48	52.12*	54.15*
" 19.	46.35	47.70	50.99	52.75	46.46	49.05	53.45	55.61	46.66	49.78	52.02*	53.30*
" 26.	46.40	47.93	51.06	53.10	46.51	49.33	53.42	55.25	46.88	49.96	52.07*	53.74
September 2.	46.47	48.15	51.06	52.81	46.66	49.64	53.17	54.79	47.07	50.05	52.13*	53.53
" 9.	46.54	48.35	51.03	52.03	46.80	49.84	53.16	53.50	47.30	50.22	52.10	52.78
" 16.	46.62	48.52	50.82	51.71	46.99	50.09	52.70	53.02	47.46	50.20	51.73	52.52
" 23.	46.69	48.62	50.69	51.49	47.03	50.09	52.64	52.91	47.58	50.12	51.84	52.18
" 30.	46.77	48.71	50.52	50.91	47.15	50.17	52.29	52.08	47.71	50.08	51.23	51.50
October 7.	46.86	48.77	50.28	50.03	47.26	50.20	51.93	50.92	47.83	49.97	50.73	50.38
" 14.	46.93	48.80	49.86	49.21	47.36	50.19	51.28	50.04	47.93	49.77	49.98	49.47
" 21.	47.01	48.79	49.45	48.62	47.46	50.11	50.80	49.40	47.97	49.50	49.42	48.81
" 28.	47.08	48.75	49.01	47.46	47.58	50.02	50.18	48.13	48.03	49.15	48.64	47.34
November 4.	47.15	48.67	48.27	45.78	47.65	49.83	49.16	46.00	48.05	48.72	47.42	46.27
" 11.	47.23	48.55	47.63	45.63	47.77	49.67	48.48	45.78	48.03	48.22	47.01	45.68
" 18.	47.29	48.38	47.11	44.43	47.82	49.42	47.60	44.35	48.01	47.74	46.07	44.29
" 25.	47.34	48.19	46.38	43.05	47.88	49.06	46.56	42.93	47.89	47.13	44.84	42.79
December 2.	47.38	47.97	45.64	42.46	47.85	48.74	45.66	41.97	47.85	46.62	44.16	42.36
" 9.	47.42	47.71	45.18	42.38	47.97	48.38	44.95	41.81	47.63	46.08	43.81	42.19
" 16.	47.45	47.46	44.83	42.12	47.99	48.03	44.50	41.55	47.33	45.67	43.41	41.91
" 23.	47.47	47.19	44.41	41.70	47.98	47.59	44.22	40.94	47.29	45.18	42.89	41.18
" 30.	47.47	46.95	44.07	40.99	47.98	47.21	43.46	40.39	47.09	44.92	42.47	40.54

The numbers marked thus \* are obtained from the Mean of Four Years only.

The dates in the preceding Table are the mean of the corresponding days of observation during the five years. More correctly they ought to be about half a-day earlier; thus, the temperature of February 4 belongs to February 3·5, or to midnight of the 3d, instead of the 4th at noon, and so of the others.

The practice of denoting periodic variations of temperature by a series of the form

$$y_n = A + B \sin (n + b) + C \sin (2n + c) + \&c.$$

(where  $y_n$  is the temperature corresponding to the fraction of the year denoted by  $n$ , and  $A, B, C, b, c$ , are constant quantities), has prevailed in Germany at least since the time of LAMBERT.\* I have thought it worth while to compute the equations for each of the 12 curves, so as to facilitate comparison with the results of QUETELET† and others. But my method of proceeding has been somewhat different from his. I sketched very carefully interpolating curves through the curves of Plate VIII., so as to diminish their remaining irregularities, and having divided the horizontal space corresponding to a year into 12 equal parts (each of which may be represented by the space of  $30^\circ$ , the whole period of variation being  $360^\circ$ ), I measured and inserted in a table the ordinates of the interpolated curve corresponding to these points; and with the aid of these ordinates, the equation to the curve was calculated by the aid of the tables given at the end of the second volume of DOVE's *Repertorium*. The results were as follows:—The first term is of course the mean temperature of the year, which has been taken from Table V.

TABLE XVI. CONTAINING THE EQUATIONS TO THE ANNUAL CURVES.

3 FEET.	
Observatory, $y_n = 45.49 - 7.39 \sin (n . 30^\circ + 43^\circ) + 0.362 \sin (n . 60^\circ + 29^\circ)$	
Ex. Garden, $y_n = 46.13 - 9.00 \sin (n . 30^\circ + 49^\circ) + 0.737 \sin (n . 60^\circ + 63^\circ)$	
Craigleith, $y_n = 45.88 - 8.16 \sin (n . 30^\circ + 47^\circ) + 0.284 \sin (n . 60^\circ + 34^\circ)$	
6 FEET.	
Observatory, $y_n = 45.86 - 5.06 \sin (n . 30^\circ + 23^\circ) + 0.433 \sin (n . 60^\circ + 7^\circ)$	
Ex. Garden, $y_n = 46.42 - 6.66 \sin (n . 30^\circ + 29^\circ) + 0.501 \sin (n . 60^\circ + 5^\circ)$	
Craigleith, $y_n = 45.92 - 6.16 \sin (n . 30^\circ + 36^\circ) + 0.368 \sin (n . 60^\circ + 340^\circ)$	
12 FEET.	
Observatory, $y_n = 46.36 - 2.44 \sin (n . 30^\circ + 344^\circ) + 0.075 \sin (n . 60^\circ + 330^\circ)$	
Ex. Garden, $y_n = 46.76 - 3.38 \sin (n . 30^\circ + 348^\circ) + 0.230 \sin (n . 60^\circ + 319^\circ)$	
Craigleith, $y_n = 45.92 - 4.22 \sin (n . 30^\circ + 13^\circ)$	
24 FEET.	
Observatory, $y_n = 46.87 - 0.655 \sin (n . 30^\circ + 85^\circ)$	
Ex. Garden, $y_n = 47.09 - 0.920 \sin (n . 30^\circ + 275^\circ)$	
Craigleith, $y_n = 46.07 - 1.940 \sin (n . 30^\circ + 327^\circ)$	

The following table contains the experimental ordinates, and those obtained from the preceding equations. The coincidence would have been somewhat closer had the mean of the 12 equidistant ordinates been taken for the mean temperature (A), instead of the mean of the entire observations.

\* Pyrometrie, § 675.

† Ann. de l'Observatoire de Bruxelles, iv. 169.

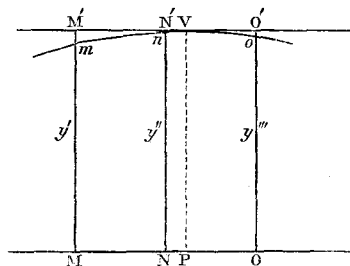
TABLE XVII.

3 FEET.									
n.	Observatory.			Experimental Garden.			Craigleith.		
	Obs.	Calc.	Diff.	Obs.	Calc.	Diff.	Obs.	Calc.	Diff.
0	-4.5	-4.88	-.38	-6.0	-6.10	-.10	-5.5	-5.85	-.35
1	-6.75	-6.71	+.04	-8.25	-8.21	+.04	-7.7	-7.68	+.02
2	-7.2	-7.01	+.19	-8.45	-8.57	-.12	-7.7	-7.66	+.04
3	-5.75	-5.56	+.19	-6.5	-6.60	-.10	-5.7	-5.68	+.02
4	-2.4	-2.40	.00	-2.25	-2.38	-.13	-1.85	-2.07	-.22
5	+1.25	+1.40	+.15	+3.0	+2.93	-.07	+2.3	+2.30	.00
6	+5.5	+5.22	-.28	+7.3	+7.42	+.12	+6.15	+6.16	+.01
7	+7.2	+7.43	+.23	+9.3	+9.45	+.15	+8.0	+8.25	+.25
8	+7.3	+7.39	+.09	+8.5	+8.48	-.02	+7.65	+7.90	+.25
9	+5.2	+5.22	+.02	+5.75	+5.28	-.47	+5.55	+5.36	-.19
10	+1.8	+1.78	-.02	+1.25	+1.15	-.10	+1.2	+1.50	+.30
11	-2.3	-1.87	+.43	-3.20	-2.85	+.35	-3.0	-2.55	+.45
6 FEET.									
0	-1.75	-1.92	-.17	-3.15	-3.18	-.03	-3.5	-3.75	-.25
1	-3.5	-3.64	-.14	-5.25	-5.25	.00	-5.7	-5.39	+.31
2	-4.6	-4.68	-.08	-6.2	-6.25	-.05	-5.2	-5.77	-.57
3	-4.6	-4.71	-.11	-6.0	-5.87	+.13	-5.0	-4.86	+.14
4	-3.5	-3.45	+.05	-4.0	-3.88	+.12	-2.75	-2.74	+.01
5	-0.9	-0.96	-.06	-0.65	-0.52	+.13	+0.25	+0.28	+.03
6	+2.3	+2.03	-.27	+3.3	+3.27	-.03	+4.0	+3.50	-.50
7	+4.45	+4.44	-.01	+6.2	+6.16	-.04	+5.8	+5.87	+.07
8	+5.25	+5.37	+.12	+6.8	+7.07	+.27	+6.2	+6.50	+.30
9	+4.8	+4.60	-.20	+5.75	+5.78	+.03	+5.3	+5.11	-.19
10	+3.0	+2.65	-.35	+3.3	+2.97	-.33	+2.6	+2.27	-.33
11	0.0	+0.27	+.27	-0.7	-0.30	+.40	-1.4	-1.01	+.39
12 FEET.									
0	+0.55	+0.64	+.09	+0.35	+0.55	+.20	-1.0	-0.95	+.05
1	-0.5	-0.55	-.05	-1.2	-0.97	+.23	-2.8	-2.88	-.08
2	-1.7	-1.62	+.08	-2.45	-2.28	+.17	-3.9	-4.03	-.13
3	-2.35	-2.31	+.04	-3.35	-3.15	+.20	-4.15	-4.11	+.04
4	-2.55	-2.40	+.15	-3.35	-3.28	+.07	-3.25	-3.08	+.17
5	-1.9	-1.83	+.07	-2.7	-2.49	+.21	-1.3	-1.23	+.07
6	-0.9	-0.71	+.19	-1.0	-0.85	+.15	+1.0	+0.95	-.05
7	+0.5	+0.62	+.12	+1.0	+1.11	+.11	+3.0	+2.88	-.12
8	+1.7	+1.77	+.07	+2.7	+2.74	+.04	+4.0	+4.03	+.03
9	+2.25	+2.38	+.13	+3.25	+3.45	+.20	+4.0	+4.11	+.11
10	+2.3	+2.32	+.02	+2.9	+3.14	+.24	+3.25	+3.08	-.17
11	+1.7	+1.68	-.02	+2.0	+2.03	+.03	+0.9	+1.23	+.33
24 FEET.									
0	+0.80	+0.65	-.15	+0.8	+.92	+.12	+1.0	+1.06	+.06
1	+0.6	+0.59	-.01	+0.7	+.75	+.05	+0.2	+0.10	-.10
2	+0.5	+0.38	-.12	+0.45	+.39	-.06	-0.75	-0.88	-.13
3	+0.1	+0.06	-.04	0.0	-.08	-.08	-1.5	-1.63	-.13
4	-0.25	-0.28	-.03	-0.45	-.53	-.08	-1.85	-1.94	-.09
5	-0.35	-0.54	-.19	-0.9	-.83	+.07	-1.75	-1.73	+.02
6	-0.6	-0.65	-.05	-1.05	-.92	+.13	-1.05	-1.06	-.01
7	-0.5	-0.59	-.09	-0.75	-.75	.00	0.0	-0.10	-.10
8	-0.25	-0.38	-.13	-0.3	-.39	-.09	+1.0	+0.88	-.12
9	-0.05	-0.06	-.01	+0.05	+.08	+.03	+1.75	+1.63	-.12
10	+0.30	+0.28	-.02	+0.65	+.53	-.12	+1.9	+1.94	+.04
11	+0.7	+0.54	-.16	+0.8	+.83	+.03	+1.85	+1.73	-.12

The following method of determining the absolute maxima and minima of the temperature curves and the epochs seems to be simpler in its application than those hitherto in use.

Although the temperature-curves cannot be represented, either altogether or in great part, by parabolas, the summits may always be represented sufficiently accurately by osculating parabolas, which may, of course, be determined from three points of the curve, and that with the less error as these three points approach more nearly to the point of maximum or minimum sought. In the preceding cases, the ordinates of the curve are already calculated for abscissæ corresponding to every  $30^\circ$ . It is easy to find, by simple inspection of the Tables, between which two ordinates the summit of the curve lies. It will necessarily be between those having the greatest values (+ or -); or, if there be two ordinates with the same value, it must be precisely half way between (supposing the portion of the curve to be parabolic).

Let  $y'$ ,  $y''$ , be the two greatest ordinates (calculated by the formula), and let  $y''$  be an ordinate half way between them (calculated from the Equations, Table XVI.) Then the difference of abscissæ M N, N O, is in this case  $15^\circ$ . Let it be more generally  $m$ , a number always positive. Let V P be the axis of the parabola whose position is sought; and let its distance from the ordinate  $y''$ , or N P be  $x$  (+ if to the right hand, - if to the left). Then, supposing the parabola found, and the tangent to the vertex drawn, by the property of the curve,



$$a \cdot M' m = \overline{M' V}^2$$

$$a \cdot N' n = \overline{N' V}^2$$

$$a \cdot O' o = \overline{O' V}^2$$

where  $a$  is the parameter. Or,

$$a (V P - y') = (m + x)^2 \quad . \quad . \quad . \quad (1)$$

$$a (V P - y'') = x^2 \quad . \quad . \quad . \quad (2)$$

$$a (V P - y''') = (m - x)^2 \quad . \quad . \quad . \quad (3)$$

Subtracting (2) from (1),

$$a (y'' - y') = m^2 + 2 m x \quad . \quad . \quad . \quad (4)$$

Subtracting (2) from (3),

$$a (y'' - y''') = m^2 - 2 m x \quad . \quad . \quad . \quad (5)$$

Making  $y'' - y' = A$  and  $y'' - y''' = B$ , and adding together the last two equations.

$$a (A + B) = 2 m^2$$

$$a = \frac{2 m^2}{A + B}$$

Subtracting (5) from (4),

$$4mx = a(A - B)$$

and substituting the value of  $a$  just found

$$x = \frac{m}{2} \cdot \frac{A - B}{A + B}$$

which determines the position of the greatest ordinate, whence that ordinate may be deduced.

The results are contained in the following table.

TABLE XVIII.

	MAXIMA.				MINIMA.			
	$y$	$x$	Epoch.		$y$	$x$	Epoch.	
			Fraction of Year.	Month and Day.			Fraction of Year.	Month and Day.
3 FEET.								
Observatory . . .	53·20	224° 30'	·624	Aug. 16·7	36·39	50° 22'	·140	Feb. 21·0
Experimental Garden	55·73	214° 48'	·597	Aug. 7·0	37·46	50° 12'	·139	Feb. 20·5
Craigleith . . .	54·29	220° 50'	·613	Aug. 12·7	37·96	44° 42'	·124	Feb. 15·3
6 FEET.								
Observatory . . .	51·23	240° 19'	·668	Sept. 2·0	41·02	75° 47'	·211	Mar. 19·0
Experimental Garden	53·50	235° 23'	·654	Aug. 27·7	40·12	67° 30'	·188	Mar. 10·7
Craigleith . . .	52·45	234° 39'	·652	Aug. 27·0	40·13	53° 00'	·147	Feb. 23·7
12 FEET.								
Observatory . . .	48·85	282° 30'	·785	Oct. 14·7	43·86	108° 58'	·303	April 21·7
Experimental Garden	50·23	275° 41'	·766	Oct. 7·7	43·39	109° 15'	·303	April 21·7
Craigleith . . .	50·14	257° 00'	·714	Sept. 18·7	41·70	77° 00'	·214	Mar. 20·0
24 FEET.								
Observatory . . .	47·53	5° 00'	·014	Jan. 6·0	46·21	185° 00'	·514	July 7·7
Experimental Garden	48·01	355° 00'	·986	Dec. 27·0	46·17	175° 00'	·486	June 27·3
Craigleith . . .	48·01	303° 00'	·842	Nov. 4·3	44·13	123° 00'	·342	May 6·0

These results, obtained in a different manner, may be compared with those in Tables VIII. and XIII. The inspection of the deviations of the annual curve in Plate VII., from the average results in Plate VIII., illustrates well the remarkable variations in the character of the seasons in these five years, and renders it probable that the mean effects of ordinary atmospheric temperatures throughout the year may be most conveniently and accurately studied, and the annual curve ascertained, by observations at a moderate depth in the soil.

#### F. On the Influence of "Specific Heat" on the Results.

The quantity which we have, in page 208, called B (after M. QUETELET\*) is equal to

$$\frac{\sqrt{\pi}}{a} \log e$$

Where  $\pi = 3·1416$ ,  $e$  is the base of natural logarithms, and  $a$  the symbol used by

\* Annales, &c., vol. iv. p. 112.

POISSON to express the ratio  $\sqrt{\frac{k}{c}}$  where  $k$  is the conductivity of the soil and  $c$  is specific heat. Whence, if the whole quantity  $B$  be known, and  $c$  the specific heat be deduced from direct experiment in the laboratory,  $k$  may be found. [In the present instance, it is to be recollected that the *French foot* is taken as the unit.]

M. ELIE DE BEAUMONT, who has taken much interest in the experiments described in this paper, very obligingly requested M. REGNAULT of Paris (whose skill in this matter is well known) to determine the specific heat of specimens taken from the grounds of the Observatory, Experimental Garden, and Craigleith respectively; and M. REGNAULT had the goodness promptly to submit them to experiment, and he communicated to me the following results:—

				Specific Heat.
Porphry of the Calton Hill,	.	.	.	0·20654
Another Experiment,	.	.	.	0·20587
Mean,				0·20620
Sand of the Experimental Garden,				0·19432
Sandstone of Craigleith Quarry,	.	.	.	0·19257
Another Experiment,	.	.	.	0·19152
				0·19205

Some correction would, no doubt, require to be made for the moisture contained in the soil, but this appears difficult to apply, and probably would be inconsiderable. The above results evidently represent specific heats referred to unit of *weight* of the body, but that referred to in the theoretical investigation, is taken with respect to unity of volume.\* The above results require, therefore, to be multiplied by the specific gravities (water being the standard in each case) which I have found to be, when reduced to 60° F.

	Trap.	Sand.	Sandstone.
Specific gravity,	2·562	1·547†	2·408
Whence we have specific heat referred to unit of <i>volume</i> ,	0·5283	0·3006	0·4623

### G. Final Results.

The value of Poisson's constant  $a$ , expressive of the ratio  $\sqrt{\frac{k}{c}}$  being obtained from our constant  $B$  by means of the relation

$$a = \frac{\sqrt{\pi}}{B} \log e$$

\* POISSON, *Théorie de la Chaleur*; *Suppl.*, p. 4.

† Mean of two experiments, 1·556 and 1·538. It is evident, that since it is required to find the specific heat of unit of volume of the mass to be heated or cooled, we must take the aggregate of sand as we find it in the soil, and not the specific gravity of the individual grains. Accordingly, the specific gravity was determined by comparing the weights of closely packed sand and of distilled water contained in a stoppered phial.

(which is equivalent to the expression in the *Theorie de la Chaleur*, p. 499, Eq. (26) ), gives the following numerical result :—

Trap.	Sand.	Sandstone.
14·124	16·137	24·750

but if referred to the French METRE instead of *foot* as unity (the centigrade degree has been already employed), they become

<i>a</i>	4·588	5·242	8·040
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which are comparable with POISSON'S result, 5·11655 for the Observatory of Paris. Now, the specific heat *c* having been found in the last section, we may eliminate it, and obtain the following numerical values of *k*, the conducting power of the strata, which it may be presumed has rarely been so accurately determined for any kind of matter.

	Trap.	Sand.	Sandstone.
<i>k</i>	11·120	8·260	29·884

There is another constant *b* employed by Poisson, which involves the character of the recipient surface of the ground as well as the interior conductivity, and which is determinable from the retardation of epochs by equation (27) of page 499 of the *Theorie de la Chaleur*.

$$b = \frac{\sqrt{\pi}}{a} \left\{ \cot \left[ \frac{1}{2} (\theta + \theta_1) - \frac{x}{2a\sqrt{\pi}} \right] 360^\circ - 1 \right\}$$

where  $\theta$  and  $\theta_1$  are the epochs of maximum and minimum temperature at any given depth, reckoned from the 21st March in fractions of a year (= 1), the metre being also the unit. Instead of taking observations at a single depth, we may take the epoch for 24 French feet from the interpolating lines in Plate X., which represent not merely the observations at that depth, but the result of their combination with all the others.

	Trap.	Sand.	Sandstone.
	Year.	Year.	Year.
Maxima at 24 F. ft.,	July 8. = ·515	July 1. = ·496	May 6. = ·234
Minima, . . . . .	Jan. 4. = 1·008	Dec. 26. = ·984	Nov. 4. = ·841
Mean reckoned from 1st Jan.,	·761	·740	·591
Reckoned from 21st Mar. = $\frac{1}{2} (\theta + \theta_1)$	·545	·524	·375

Substituting the values of  $x = 7·7961$  metres (24 F. ft.), and of *a* before found, we obtain

	Trap.	Sand.	Sandstone.
<i>b</i>	0·4972	0·1007	0·0772

M. POISSON finds for *b* at the Paris Observatory, the value 1·057. If we examine the circumstances which influence the value of *b*, we shall admit that its determination in this manner is liable to so great errors as to render it almost worthless.

I shall not follow farther the application of these results, of which  $a$  and  $k$  are the most immediately important. In particular, I shall not attempt to find, with POISSON, the whole climateric effect of the solar influence which he deduces from the quantities  $a$  and  $b$  found above; both on account of the uncertainty of the value of  $b$ , and because I have attempted elsewhere to shew that the physical assumptions, upon which the great French analyst has founded the determination of this quantity, are exceedingly precarious.\*

I have only farther to add, that the extensive reductions and computations of which the results have been given in this paper, were performed under my immediate superintendence by different persons at different times. My thanks are due to Mr BROUN, Mr MOFFAT, Mr LINDSAY, and especially to Mr GREGG, for their attention and accuracy in conducting them.

EDINBURGH, June 1846.

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## APPENDIX,

*Containing Remarks on the Connection of the Preceding Observations with the Theory of Fourier and Poisson.†*

“ So far as the effect of SOLAR HEAT is concerned, the *à priori* solution of the problem of the temperature of any part of the earth's surface may be thus imagined:—(1.) The *whole* quantity of sunshine which falls on any part of the earth's surface in the course of a year is to be found, and also the law of its variation of force at different seasons. (2.) The part of this heat which becomes effective in heating the earth's crust is to be found by multiplying the amount by a constant depending upon the absorbent power of the surface. (3.) This quantity of heat thus reduced is propagated towards the interior, according to the laws of conduction, which again presuppose the knowledge of two constants proper to each soil, namely, the Conductivity and the Specific Heat.

“(1.) The measure of the quantity of sunshine received by any place in a year, and its distribution at different seasons, has been a favourite problem with mathematicians. In ultimate analysis, it depends of course on the astronomical elements which affect the progress of the seasons, viz., the obliquity of the ecliptic ( $\gamma$ ), the latitude of the place ( $\mu$ ), the eccentricity of the earth's orbit ( $\alpha$ ), and the longitude of the sun's perigee ( $\omega$ ). But there are also elements quite as important as any of these; the imperfect transparency of the air and its varying thickness, owing to differences of obliquity of the transmitted rays, and the condition of opacity depending on the weather. Neither of these is insignificant, neither of them compensatory; both may be considered as functions of the hour-angle and fraction of the year, and the second is besides subjected to the most capricious changes. Yet of these ele-

\* See Second Report on Meteorology, Arts. 104, &c., in the British Association Reports for 1840.

† Taken from the Second Report on Meteorology, British Association Report, 1840, Art. 88, &c.



ments theory has hitherto taken no account, and consequently the expression for the quantity of sunshine obtained, in terms of the astronomical constants, with so much labour, we must hold to be nearly useless as a physical datum. It is vain to say, with M. POISSON, "Les lois d'absorption de la chaleur solaire à travers l'atmosphère, les variations diurnes et annuelles sont également inconnues, et l'on peut seulement *supposer qu'elles sont peu considérables*." We know, on the contrary, that they are so considerable, that, estimating the loss of radiant heat by a *vertical* passage through the atmosphere at only twenty-five per cent., at an angle of elevation of  $25^\circ$  the force of the solar rays would be reduced to a half, and at  $5^\circ$  to *one-twentieth* part. We know, indeed, that the difference of the *direct* effect of a vertical and a horizontal sun is due to this cause alone, exaggerated, of course, immensely by the variable meteorological state of the atmosphere, which again is a function of the latitude.

"(2.) The receptive power of the surface is a datum which we find it very difficult directly to determine, and which, since the quantity of sunshine cannot (as we have seen) possibly be directly computed, must be inextricably mixed up with it. It might be a question, whether, by covering a tolerably extensive surface of soil, in which thermometers are inserted, with a composition of known superficial conductivity, this element might not become known.

"(3.) The specific heat ( $c$ ) and conductivity ( $k$ ) of the soil are also inextricably mixed up together in the analysis; but either becoming known, the other may be inferred from thermometric observations carried below the surface. The specific heat seems that best adapted for laboratory experiments; M. ELIE DE BEAUMONT has assigned 0.5614 for the value of  $c$  (that of an equal *bulk* of water being = 1), proper to the soil at the Observatory at Paris.

"To obtain the conductivity of the soil *à posteriori*, it is fortunately not necessary that the preceding theoretical estimation of the distribution of sunshine should be correct; but there are other estimates into which it essentially enters, and which must therefore be received with corresponding caution. To facilitate reference to M. POISSON's work, I will shew how the simple and very satisfactory observation of maximum and minimum temperature of the earth's crust at given small depths (above the *invariable stratum*) may be made to yield a knowledge of some of the constants above referred to.

"Let the excess of the annual maximum above annual minimum temperature at a depth  $p$  be expressed by  $\Delta_p$ ; then

$$\log \Delta_p = A + B p$$

in which  $A$  of course denotes the log. range when  $p = 0$  or at the surface, and  $B$  determines the common ratio of the geometrical progression according to which the range diminishes. From observations with two thermometers at different depths,  $A$  and  $B$  may be obtained *à posteriori*.

"Now when we consult M. POISSON's work, we find that his equation (23.), page 497, which is equivalent to the preceding one, is thus composed. The quantity  $A$ , on which the superficial range depends, contains (1) astronomical constants of climate  $\gamma, \mu, \alpha, \bar{\omega}$  already mentioned; (2) a temperature  $h$ , depending on the mean force of the solar rays which have traversed the atmosphere and entered into combination with the earth's surface by absorption at a given place; (3) the constant of conductivity  $k$ , and of specific heat  $c$ .

"The coefficient  $B$ , on which the *rate* of diminution of the range depends, is fortunately a very simple quantity, involving neither astronomical constants, nor those proper to the superficies. It is, in fact, an absolute number multiplied by  $\sqrt{\frac{c}{k}}$ , and from a knowledge of it (by

observations with two or more thermometers) this quantity may be very readily and accurately determined; and it affords the only unexceptionable manner of ascertaining the conductivity of the earth's crust on a large scale.

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“The epochal retardations for the annual curves at the depth of a few feet, follow, generally speaking, a simple law, for they are propagated uniformly downwards with a velocity which is easily connected with the constants proper to the soil, determined from the range at two given depths, as just explained. It must not be concluded, however, that the epochs of earth-temperature at the surface coincide with those of air-temperature in the adjoining stratum. The difference of epoch may be obtained in terms of the conductivity and superficial characters of the solid stratum. But the complete expression for the epoch at any depth in terms of the dates of maximum and minimum at some other depth, and of the constants of conductivity and surface, derived from two observed ranges, is so complex, that, so far as I know, no attempt has been made to verify M. POISSON'S formulæ except in a single example by himself, taken from M. ARAGO'S observations.”

# TABLES.

$t_1$  denotes the deepest, or 24 feet Thermometer,  $t_2$  at 12 feet,  $t_3$  at 6 feet,  $t_4$  at 3 feet (French Measure);  $t_5$  at the surface of the ground;  $T$ , the temperature of the air in the Thermometer box.

## OBSERVATORY.

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$ .	$T$ .
1837.																		
Feb. 4	48.10	+03	+02	48.15	45.93	+01	+01	45.95	42.06	.00	.00	42.06	39.11	.00	-.02	39.09		
13	47.98	+03	+03	48.04	45.59	+01	+02	45.62	42.00		+01	42.01	40.54		+03	40.57		
20	47.87	+03	+02	47.92	45.37	+01	+01	45.39	42.17		.00	42.17	40.89		-.01	40.88		
27	47.79	+03	+02	47.84	45.22	+01	.00	45.23	42.05		-.01	42.04	38.90		-.03	38.87		
Mar. 6	47.73	+03	-.01	47.75	45.09	+01	-.02	45.08	41.68		-.03	41.65	39.39		-.07	39.92		
13	47.63	+03	.00	47.66	44.94	+01	-.01	44.94	41.66		-.02	41.64	39.40		-.05	39.35		
20	47.52	+03	+03	47.58	44.75	+01	+01	44.77	41.28		.00	41.28	38.08		-.01	38.07		
27	47.42	+03	+01	47.46	44.59	+01	+02	44.62	40.90		+02	40.92	37.49		+02	37.51		
Apr. 3	47.34	+03	+04	47.41	44.42	+01	+02	44.45	40.49		+02	40.51	37.11		+01	37.12		
10	47.29	+03	+01	47.33	44.26	+01	.00	44.27	40.32		-.01	40.31	37.69		-.04	37.65		
17	47.22	+03	.00	47.25	44.08	+01	-.01	44.08	40.45		-.02	40.43	38.72		-.04	38.68		
24	47.12	+03	+01	47.16	43.87	+01	.00	43.88	40.76		-.01	40.75	40.09		-.03	40.06		
May 1	47.05	+03	-.02	47.06	43.83	.00	-.02	43.81	41.37		-.04	41.33	41.73		-.08	41.65		
8	46.96	+02	.00	46.98	43.82	.00	.00	43.82	42.10		-.02	42.08	43.13		-.02	43.11		
15	46.92	+02	-.04	46.90	43.90	.00	-.03	43.87	42.72		-.07	42.65	43.23		-.13	43.10		
22	46.82	+02	-.01	46.83	44.00	.00	-.01	43.99	43.38		-.03	43.35	45.31		-.05	45.26		
29	46.78	+01	-.05	46.74	44.16	.00	-.04	44.12	44.21		-.09	44.12	46.57		-.15	46.42		
June 5	46.70	+01	-.03	46.68	44.35	.00	-.03	44.32	44.94		-.07	44.87	47.42		-.10	47.32		
12	46.65	+01	-.06	46.60	44.60	.00	-.05	44.55	45.81		-.13	45.68	48.69		-.20	48.49		
19	46.58	.00	-.07	46.51	44.88	-.01	-.04	44.83	46.80		-.14	46.66	50.99		-.10	50.89		
26	46.55	.00	-.05	46.50	45.18	-.01	-.05	45.12	47.79		-.13	47.66	52.69		-.17	52.52		
July 3	46.53	-.01	-.07	46.45	45.55	-.01	-.06	45.48	48.85		-.15	48.70	53.46		-.19	53.27		
10	46.52	-.01	-.08	46.43	45.98	-.01	-.08	45.89	49.87		-.21	49.66						
17	46.49	-.01	-.06	46.42	46.44	-.01	-.07	46.36	50.98		-.16	50.82						
24	46.48	-.01	-.06	46.41	46.82	-.01	-.06	46.75	51.50		-.13	51.37						
31	46.49	-.02	-.03	46.44	47.32	-.01	-.04	47.27	51.79		-.06	51.73						
Aug. 7	46.53	-.02	-.06	46.45	47.78	-.01	-.07	47.70	51.90		-.12	51.78	53.88		-.15	53.73		
14	46.59	-.02	-.06	46.51	48.10	-.01	-.08	48.01	51.87		-.15	51.72	54.66		-.20	54.46		
21	46.65	-.02	-.05	46.58	48.38	-.01	-.07	48.30	52.23		-.10	52.13						
28	46.70	-.02	-.03	46.65	48.60	-.01	-.04	48.55	52.49		-.05	52.44	54.40		-.04	54.36		
Sept. 4	46.78	-.02	-.03	46.73	48.87	-.01	-.04	48.82	52.11		-.05	52.06	52.67		-.05	52.62		
11	46.86	-.02	-.03	46.81	49.05	.00	-.03	49.02	51.60		-.03	51.57	52.25		-.04	52.21		
18	46.96	-.02	-.04	46.90	49.21	.00	-.05	49.16	51.41		-.07	51.34	51.48		-.10	51.38		
25	47.06	-.02	-.04	47.00	49.27	.00	-.05	49.22	51.20		-.08	51.12	52.12		-.10	52.02		
Oct. 2	47.16	-.02	-.04	47.10	49.35	.00	-.07	49.28	51.09		-.11	50.98	51.10		-.15	50.95		
9	47.24	-.01	-.04	47.19	49.34	.00	-.04	49.30	50.91		-.07	50.84	51.80		-.09	51.71		
16	47.33	-.01	-.05	47.27	49.37	.00	-.05	49.32	50.88		-.08	50.80	50.84		-.11	50.73		
23	47.38	-.01	-.01	47.36	49.34	.00	.00	49.34	50.49		.00	50.49	50.28		.00	50.28		
30	47.43	-.01	+01	47.43	49.30	.00	+02	49.32	49.86		+02	49.88	47.30		+02	47.32		
Nov. 6	47.50	-.01	+02	47.51	49.25	.00	+03	49.28	48.72		+05	48.77	45.05		+03	45.08		
13	47.57	-.01	+03	47.59	49.09	.00	+04	49.13	47.88		+05	47.93	45.73		+06	45.79		
20	47.63	.00	+03	47.66	48.86	.00	+04	48.90	47.15		+05	47.20	43.47		+02	43.49		
27	47.69	.00	+03	47.72	48.62	.00	+04	48.66	46.42		+04	46.46	43.35		+03	43.38		
Dec. 4	47.74	+01	+03	47.78	48.35	+01	+04	48.40	45.80		+04	45.84	42.75		+03	42.78		
11	47.76	+01	+04	47.81	48.05	+01	+05	48.11	45.21		+05	45.26	41.70		+04	41.74		
18	47.82	+01	-.01	47.82	47.82	+01	-.01	47.82	44.72		+03	44.75	41.80		-.07	41.73		
25	47.84	+01	-.01	47.84	47.45	+01	-.01	47.45	44.41		+03	44.44	42.79		-.05	42.74		
1838.																		
Jan. 1	47.82	+01	+01	47.84	47.24	.00	+01	47.25	44.80		.00	44.80	43.65		.00	43.65		
8	47.79	+01	+05	47.85	47.02	.00	+05	47.07	44.70		+06	44.76	42.50		+07	42.57		
15	47.76	+01	+06	47.83	46.86	+01	+05	46.92	44.10		+06	44.16	40.20		+06	40.26		
22	47.75	+02	+04	47.81	46.70	+01	+03	46.74	43.30		+02	43.32	38.88		.00	38.88		
29	47.71	+02	+05	47.78	46.41	+01	+04	46.46	42.41		+03	42.44	37.80		+02	37.82		

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$
1838.																		
Feb. 5	47.69	+02	+04	47.75	46.14	+01	+03	46.18	41.79	-00	+02	41.81	37.50	-00	-00	37.50		
12	47.61	+03	+06	47.70	45.64	+01	+04	45.69	40.99		+03	41.02	36.81		-02	36.79		
19	47.58	+03	+05	47.66	45.43	+01	+03	45.47	40.65		+02	40.67	35.80		-00	35.80		
26	47.51	+03	+06	47.60	45.13	+01	+04	45.18	40.17		+03	40.20	35.75		+02	35.77		
Mar. 5	47.47	+03	+02	47.52	44.75	+01	+01	44.77	39.60		-00	39.60	35.70		-02	35.68		
12	47.41	+03	+01	47.45	44.43	+01	-00	44.44	39.60		-01	39.59	37.10		-04	37.06		
19	47.34	+03	+01	47.38	44.17	+01	-00	44.18	40.06		-01	40.05	38.25		-03	38.22		
26	47.25	+03	+01	47.29	43.97	+01	-00	43.98	40.21		-01	40.20	37.78		-03	37.75		
Apr. 2	47.16	+03	+01	47.20	43.85	+01	-00	43.86	40.46		-01	40.45	39.52		-02	39.50		
9	47.05	+03	-00	47.08	43.69	-00	-00	43.69	40.75		-02	40.73	39.91		-04	39.87		
16	46.96	+03	+02	47.01	43.68	-00	+01	43.69	41.15		-00	41.15	40.89		-00	40.89		
23	46.88	+03	+01	46.92	43.68	-00	-00	43.68	41.37		-01	41.36	40.22		-03	40.19		
30	46.80	+03	-01	46.82	43.70	-00	-01	43.69	41.59		-03	41.56	41.00		-07	40.93	39.80	51.0
May 7	46.75	+02	-02	46.75	43.73	-00	-03	43.70	41.95		-08	41.87	42.58		-15	42.43	47.50	63.0
14	46.64	+02	-00	46.66	43.75	-00	-01	43.74	42.80		-02	42.78	44.55		-03	44.52	41.25	48.0
21	46.57	+02	-02	46.57	43.88	-00	-02	43.86	43.37		-04	43.33	44.02		-09	43.93	46.80	53.0
29	46.46	+01	-01	46.46	44.05	-00	-01	44.04	43.85		-03	43.82	45.31		-04	45.27	47.20	49.5
June 4	46.43	+01	-04	46.40	44.21	-00	-03	44.18	44.44		-07	44.37	46.09		-14	45.95	50.40	58.3
11	46.37	+01	-03	46.35	44.38	-00	-02	44.36	45.11		-06	45.05	47.29		-09	47.20	50.40	55.2
18	46.29	+01	-01	46.29	44.62	-00	-01	44.61	45.78		-03	45.75	48.51		-02	48.49	51.25	50.9
25	46.26	-00	-06	46.20	44.87	-00	-05	44.82	46.57		-12	46.45	49.58		-21	49.37	55.35	65.7
July 2	46.24	-00	-01	46.23	45.15	-00	-02	45.13	47.36		-03	47.33	50.82		-01	50.81	51.60	51.7
9	46.25	-01	-05	46.19	45.50	-01	-06	45.43	48.20		-12	48.08	52.38		-19	52.19	59.00	65.7
16	46.25	-01	-05	46.19	45.83	-01	-06	45.76	49.10		-12	48.98	53.26		-17	53.09	56.80	64.3
24	46.24	-01	-04	46.19	46.24	-01	-05	46.18	49.66		-11	49.55	52.53		-15	52.38	52.80	62.1
30	46.26	-01	-05	46.20	46.57	-01	-06	46.50	49.84		-12	49.72	52.39		-18	52.21	55.20	64.6
Aug. 6	46.28	-01	-05	46.22	46.88	-01	-06	46.81	50.14		-12	50.02	53.37		-17	53.20	57.20	64.7
13	46.32	-01	-04	46.27	47.17	-01	-05	47.11	50.55		-10	50.45	53.44		-12	53.32	54.60	61.5
20	46.36	-02	-04	46.30	47.45	-01	-05	47.39	50.70		-10	50.60	53.11		-12	52.99	55.20	61.2
27	46.43	-02	-06	46.35	47.74	-01	-08	47.65	50.84		-15	50.69	52.50		-24	52.26	56.75	68.2
Sept. 3	46.47	-02	-04	46.41	47.93	-00	-05	47.88	50.76		-08	50.68	52.50		-12	52.38	52.20	60.0
10	46.53	-02	-03	46.48	48.12	-00	-04	48.08	50.70		-05	50.65	51.04		-08	50.96	48.00	56.7
17	46.60	-01	-04	46.55	48.27	-00	-04	48.23	50.31		-06	50.25	51.78		-07	51.71	53.50	57.0
24	46.68	-01	-04	46.63	48.39	-00	-05	48.34	50.42		-08	50.34	51.20		-11	51.09	51.40	59.0
Oct. 1	46.76	-01	-04	46.71	48.49	-00	-05	48.44	50.30		-09	50.21	51.29		-12	51.17	52.40	60.2
8	46.83	-01	-03	46.79	48.54	-00	-04	48.50	50.10		-06	50.04	49.71		-11	49.60	48.00	57.5
15	46.89	-01	-02	46.86	48.57	-00	-03	48.54	49.59		-03	49.56	48.06		-07	47.99	46.00	54.0
22	46.98	-01	-03	46.94	48.58	-00	-04	48.54	48.96		-08	48.88	47.81		-12	47.69	51.00	57.6
29	47.00	-01	+01	47.00	48.46	-00	+02	48.48	48.70		+03	48.73	48.09		+05	48.14	40.60	44.3
Nov. 5	47.07	-01	+01	47.07	48.39	-00	+02	48.41	48.16		+03	48.19	45.64		+01	45.65	41.80	44.2
12	47.13	-00	+03	47.16	48.29	-00	+04	48.33	47.35		+05	47.40	44.80		+05	44.85	35.70	39.0
19	47.19	-00	+02	47.21	48.14	-00	+03	48.17	46.61		+03	46.64	43.29		+02	43.31	35.70	41.3
27	47.22	+01	+05	47.28	47.86	+01	+06	47.93	45.57		+08	45.65	41.85		+08	41.93	31.50	33.0
Dec. 3	47.29	+01	-00	47.30	47.69	+01	-00	47.70	45.00		-02	44.98	42.52		-06	42.46	42.30	48.1
10	47.32	+01	-00	47.33	47.41	-00	-00	47.41	44.91		-01	44.90	42.55		-04	42.51	41.25	46.9
17	47.34	+01	+02	47.37	47.15	-00	+03	47.18	44.68		+03	44.71	42.13		+02	42.15	38.10	40.1
24	47.35	+01	+02	47.38	46.92	+01	+02	46.95	44.22		+01	44.23	41.30		-01	41.29	38.70	42.0
31	47.34	+01	+03	47.38	46.71	+01	+02	46.74	43.80		+02	43.82	41.04		+02	41.06	35.40	39.5
1839.																		
Jan. 7	47.33	+01	+03	47.37	46.47	+01	+03	46.51	43.50		+02	43.52	40.57		+02	40.59	36.00	38.2
14	47.32	+02	+03	47.37	46.25	+01	+02	46.28	42.99		+02	43.01	40.10		+01	40.11	37.30	39.0
21	47.29	+02	+03	47.34	46.02	+01	+03	46.06	42.61		+03	42.64	39.03		+01	39.04	34.00	37.0
28	47.26	+02	+04	47.32	45.78	+01	+03	45.82	42.12		+03	42.15	38.85		+03	38.88	31.75	35.0
Feb. 4	47.24	+02	+01	47.27	45.54	+01	+01	45.56	41.68		-01	41.67	37.63		-04	37.59	34.20	43.7
11	47.22	+02	-00	47.24	45.30	+01	-08	45.31	41.34		-01	41.33	39.21		-05	39.16	39.50	45.8
18	47.14	+02	+04	47.20	45.02	+01	+03	45.06	41.55		+02	41.57	39.31		+03	39.34	32.00	35.3
25	47.09	+03	+02	47.14	44.83	+01	+01	44.85	41.30		-00	41.30	38.30		-02	38.28	34.10	41.0
Mar. 4	47.04	+03	+02	47.09	44.66	+01	+01	44.68	41.09		-00	41.09	38.97		-02	38.95	36.60	42.0
11	46.97	+03	+02	47.02	44.48	+01	+01	44.50	41.03		-00	41.03	37.85		-02	37.83	31.20	40.5
18	46.90	+03	+02	46.95	44.30	+01	+01	44.32	40.65		-00	40.65	38.42		-01	38.41	33.60	39.6
25	46.84	+03	+01	46.88	44.12	+01	-00	44.13	40.69		-01	40.68	38.86		-03	38.83	36.25	43.1
Apr. 1	46.75	+03	+02	46.80	43.95	+01	+01	43.97	40.80		-00	40.80	38.92		-00	38.92	35.50	39.4
8	46.72	+03	-01	46.74	43.85	+01	-01	43.85	40.72		-03	40.69	38.30		-08	38.22	35.80	49.1

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$ .
1839.																		
Apr. 15	46.63	+03	.00	46.66	43.74	+01	-.01	43.74	40.68	.00	-.02	40.66	39.98	.00	-.06	39.92	41.60	48.0
22	46.57	+03	-.02	46.58	43.65	.00	-.01	43.64	41.26		-.03	41.23	41.00		-.10	40.90	43.80	51.4
29	46.51	+02	-.02	46.51	43.63	.00	-.02	43.61	41.89		-.05	41.84	42.68		-.11	42.57	47.50	53.8
May 6	46.41	+02	.00	46.43	43.65	.00	.00	43.65	42.67		-.01	42.66	44.50		-.01	44.49	43.60	45.6
13	46.34	+01	.00	46.35	43.76	.00	.00	43.76	43.33		-.01	43.32	44.32		-.01	44.31	44.50	45.6
20	46.30	+01	-.03	46.28	43.93	.00	-.02	43.91	43.60		-.07	43.53	44.18		-.13	44.05	48.60	57.6
27	46.26	+01	-.05	46.22	44.10	.00	-.04	44.06	44.09		-.10	43.99	45.57		-.20	45.37	51.60	64.0
June 3	46.18	+01	-.02	46.17	44.24	.00	-.02	44.22	44.80		-.04	44.76	47.21		-.06	47.15	48.20	51.9
10	46.15	+01	-.04	46.12	44.45	.00	-.03	44.42	45.57		-.08	45.49	48.64		-.14	48.50	53.80	59.9
17	46.13	.00	-.06	46.07	44.71	.00	-.05	44.66	46.42		-.14	46.28	49.54		-.25	49.29	58.10	68.8
24	46.06	-.01	-.05	46.00	44.99	-.01	-.04	44.94	47.65		-.11	47.54	51.72		-.15	51.57	55.00	63.0
July 1	46.06	-.01	-.06	45.99	45.36	-.01	-.06	45.29	48.32		-.14	48.18	51.04		-.22	50.82	53.50	67.5
8	46.06	-.01	-.07	45.98	45.72	-.01	-.07	45.64	48.76		-.16	48.60	52.69		-.26	52.43	59.20	70.0
15	46.04	-.01	-.04	45.99	46.05	-.01	-.05	45.99	49.49		-.10	49.39	53.00		-.14	52.86	54.40	61.7
22	46.05	-.01	-.05	45.99	46.42	-.01	-.06	46.35	49.87		-.11	49.76	52.81		-.15	52.66	56.20	63.2
29	46.09	-.02	-.05	46.02	46.76	-.01	-.06	46.69	50.19		-.13	50.06	53.48		-.19	53.29	56.70	65.1
Aug. 5	46.14	-.02	-.06	46.06	47.01	-.01	-.08	46.92	50.62		-.16	50.46	54.12		-.22	53.90	58.00	68.3
12	46.16	-.02	-.04	46.10	47.35	-.01	-.05	47.29	50.99		-.08	50.91	53.90		-.09	53.81	54.30	60.2
19	46.19	-.02	-.01	46.16	47.62	-.01	-.01	47.60	51.02		+01	51.03	52.63		+05	52.68	49.70	49.8
26	46.27	-.02	-.04	46.21	47.89	-.01	-.05	47.83	50.82		-.08	50.74	52.58		-.10	52.48	54.40	59.9
Sept. 2	46.33	-.02	-.04	46.27	48.07	-.01	-.06	48.00	50.81		-.09	50.72	52.50		-.12	52.38	53.40	60.9
9	46.40	-.02	-.04	46.34	48.24	.00	-.05	48.19	50.83		-.07	50.76	52.29		-.10	52.19	54.20	59.0
16	46.49	-.02	-.03	46.44	48.36	.00	-.04	48.32	50.79		-.05	50.74	51.51		-.09	51.42	52.00	57.2
23	46.58	-.02	-.04	46.52	48.50	.00	-.05	48.45	50.55		-.08	50.47	51.03		-.13	50.90	50.50	59.8
30	46.65	-.02	-.03	46.60	48.56	.00	-.04	48.52	50.28		-.06	50.22	50.61		-.08	50.53	49.20	57.0
Oct. 7	46.72	-.01	-.03	46.68	48.60	.00	-.04	48.56	49.89		-.05	49.84	48.75		-.09	48.66	46.40	56.1
14	46.79	-.01	-.02	46.76	48.59	.00	-.02	48.57	49.30		-.03	49.27	49.02		-.05	48.97	48.50	53.0
21	46.88	-.01	-.03	46.84	48.55	.00	-.03	48.52	49.10		-.05	49.05	48.10		-.10	48.00	45.80	55.8
28	46.94	-.01	-.01	46.92	48.49	.00	.00	48.49	48.70		.00	48.70	48.05		.00	48.05	43.60	48.5
Nov. 4	46.99	-.01	.00	47.00	48.39	.00	+01	48.40	48.23		+01	48.24	46.52		+01	46.53	44.00	46.0
11	47.06	.00	-.01	47.05	48.31	.00	-.01	48.30	47.74		-.01	47.73	46.30		-.05	46.25	45.00	49.9
18	47.11	.00	.00	47.11	48.18	.00	.00	48.18	47.42		.00	47.42	46.31		-.01	46.30	43.90	47.0
25	47.14	.00	+03	47.17	48.02	.00	+03	48.05	47.11		+05	47.16	45.12		+07	45.19	39.50	39.6
Dec. 2	47.17	.00	+04	47.21	47.87	.00	+05	47.92	46.30		+06	46.36	42.99		+06	43.05	34.80	36.0
9	47.20	+01	+04	47.25	47.68	+01	+05	47.74	45.44		+06	45.50	41.60		+05	41.65	33.50	35.9
16	47.24	+01	+02	47.27	47.45	+01	+03	47.49	44.61		+02	44.63	41.59		+01	41.60	38.50	40.7
23	47.28	+01	+01	47.30	47.18	+01	.00	47.19	44.30		-.01	44.29	42.14		-.04	42.10	42.00	45.7
31	47.28	+01	+02	47.31	46.86	+01	+02	46.89	44.14		+01	44.15	40.63		-.01	40.62	37.40	42.0
1840.																		
Jan. 6	47.27	+01	+04	47.32	46.65	+01	+04	46.70	43.60		+04	43.64	40.66		+04	40.70	33.00	36.0
13	47.29	+02	.00	47.31	46.44	+01	.00	46.45	43.15		-.02	43.14	40.08		-.06	40.02	41.80	47.0
20	47.25	+02	+02	47.29	46.18	+01	+02	46.21	43.07		+01	43.08	41.02		.00	41.02	36.50	40.6
27	47.22	+02	+04	47.28	45.91	+01	+03	45.95	42.90		+04	42.94	40.49		+05	40.54	33.00	34.9
Feb. 3	47.20	+02	+03	47.25	45.72	+01	+02	45.75	42.44		+01	42.45	39.10		.00	39.10	36.20	39.5
11	47.17	+02	.00	47.19	45.48	+01	.00	45.49	42.08		-.02	42.06	39.59		-.05	39.54	37.40	45.8
17	47.13	+02	+02	47.17	45.30	+01	+01	45.32	42.05		+01	42.06	40.29		-.01	40.28	40.00	41.5
24	47.08	+02	+02	47.12	45.10	+01	+01	45.12	42.06		+01	42.07	39.14		-.01	39.13	33.40	39.9
Mar. 2	47.02	+03	+02	47.07	44.95	+01	+01	44.97	41.59		.00	41.59	38.25		-.02	38.23	32.80	41.3
9	47.01	+03	-.03	47.01	44.81	+01	-.02	44.80	41.24		-.05	41.19	38.40		-.13	38.27	38.90	56.0
16	46.91	+03	+01	46.95	44.59	+01	.00	44.60	41.26		-.01	41.25	40.21		-.04	40.17	40.40	44.9
23	46.84	+02	+04	46.90	44.42	+01	+02	44.45	41.67		+02	41.69	40.45		+03	40.48	36.60	36.3
30	46.79	+02	.00	46.81	44.34	.00	.00	44.34	41.76		-.02	41.74	40.70		-.05	40.65	42.50	46.4
Apr. 6	46.72	+02	+01	46.75	44.26	.00	.00	44.26	42.08		-.01	42.07	41.46		-.03	41.43	41.20	44.0
13	46.69	+02	-.04	46.67	44.26	.00	-.03	44.23	42.33		-.06	42.27	42.39		-.15	42.24	46.20	58.2
20	46.62	+02	-.03	46.61	44.24	.00	-.03	44.21	42.90		-.06	42.84	43.63		-.13	43.50	46.30	56.3
27	46.58	+01	-.05	46.54	44.30	.00	-.04	44.26	43.58		-.10	43.48	45.79		-.20	45.59	53.40	64.0
May 5	46.47	+01	+01	46.49	44.40	.00	.00	44.40	44.73		+01	44.74	47.71		+05	47.76	46.20	44.0
11	46.40	+01	+01	46.42	44.55	.00	.00	44.55	45.31		+01	45.32	45.72		+02	45.74	40.00	43.5
18	46.35	+01	-.01	46.35	44.80	.00	-.01	44.79	45.10		-.02	45.08	45.42		-.03	45.39	42.70	48.6
25	46.32	+01	-.02	46.31	44.97	.00	-.02	44.95	45.10		-.04	45.06	46.03		-.08	45.95	48.80	53.5
June 1	46.31	+01	-.05	46.27	45.10	.00	-.05	45.05	45.55		-.11	45.44	47.15		-.21	46.94	54.60	63.9
8	46.29	.00	-.07	46.22	45.24	.00	-.07	45.17	46.25		-.15	46.10	48.50		-.28	48.22	54.20	70.0
15	46.25	.00	-.04	46.21	45.40	.00	-.04	45.36	46.91		-.09	46.82	49.59		-.15	49.44	52.80	60.2

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$
1840.																		
June 22	46.24	.00	-.04	46.20	45.62	.00	-.04	45.58	47.42	.00	-.08	47.34	49.70	.00	-.13	49.57	52.50	59.1
29	46.26	-.01	-.05	46.20	45.89	.00	-.05	45.84	47.79		-.12	47.67	50.02		-.21	49.81	55.30	65.1
July 6	46.22	-.01	-.03	46.18	46.09	.00	-.03	46.06	48.25		-.06	48.19	50.60		-.07	50.53	51.70	56.0
13	46.26	-.01	-.05	46.20	46.36	-.01	-.06	46.29	48.63		-.12	48.51	50.98		-.18	50.80	52.20	63.5
20	46.26	-.01	-.04	46.21	46.59	-.01	-.04	46.54	48.99		-.08	48.91	51.43		-.13	51.30	55.70	60.0
27	46.31	-.01	-.07	46.23	46.84	-.01	-.08	46.75	49.42		-.17	49.25	51.87		-.26	51.61	57.40	70.0
Aug. 3	46.33	-.01	-.06	46.26	47.06	-.01	-.07	46.98	49.75		-.13	49.62	52.43		-.21	52.22	57.50	66.0
10	46.36	-.02	-.04	46.30	47.28	-.01	-.06	47.21	50.20		-.10	50.10	53.95		-.13	53.82	60.30	61.8
18	46.41	-.02	-.05	46.34	47.59	-.01	-.07	47.51	51.01		-.12	50.89	53.67		-.17	53.50	53.80	64.5
24	46.45	-.02	-.05	46.38	47.81	-.01	-.06	47.74	51.08		-.10	50.98	53.94		-.13	53.81	55.60	62.1
31	46.51	-.02	-.05	46.44	48.07	-.01	-.06	48.00	51.33		-.10	51.23	53.87		-.13	53.74	54.30	62.2
Sept. 7	46.57	-.02	-.04	46.51	48.30	-.01	-.06	48.23	51.40		-.09	51.31	52.90		-.12	52.78	54.80	60.9
14	46.60	-.02	-.01	46.57	48.45	.00	-.01	48.44	51.10		+.01	51.11	51.92		+.03	51.95	48.90	50.0
21	46.68	-.02	-.02	46.64	48.63	.00	-.02	48.61	50.69		-.02	50.67	50.39		-.06	50.33	49.20	54.0
28	46.76	-.02	-.05	46.69	48.74	.00	-.06	48.68	50.20		-.09	50.11	49.76		-.16	49.60	53.00	61.5
Oct. 5	46.82	-.01	-.02	46.79	48.74	.00	-.02	48.72	49.79		-.03	49.76	48.95		-.07	48.88	46.80	53.8
12	46.91	-.01	-.03	46.87	48.72	.00	-.04	48.68	49.31		-.06	49.25	48.40		-.10	48.30	46.10	56.6
19	46.96	-.01	-.02	46.93	48.64	.00	-.02	48.62	48.93		-.03	48.90	48.45		-.05	48.40	46.70	52.5
26	47.01	-.01	.00	47.00	48.54	.00	+.01	48.55	48.65		+.02	48.67	47.30		+.02	47.32	41.10	45.6
Nov. 2	47.08	-.01	.00	47.07	48.46	.00	.00	48.46	48.03		.00	48.03	46.27		-.02	46.25	45.40	48.5
9	47.12	.00	+.01	47.13	48.33	.00	+.02	48.35	47.60		+.03	47.63	45.90		+.02	45.92	42.20	43.7
17	47.18	.00	+.03	47.21	48.15	.00	+.04	48.19	46.99		+.05	47.04	44.41		+.06	44.47	39.00	38.8
23	47.25	.00	-.02	47.23	48.06	.00	-.02	48.04	46.40		-.04	46.36	43.07		-.09	42.98	43.20	52.0
30	47.29	.00	-.02	47.27	47.86	.00	-.02	47.84	45.86		-.04	45.82	43.01		-.10	42.91	46.00	53.0
Dec. 7	47.30	+.01	+.01	47.32	47.61	.00	+.01	47.62	45.50		.00	45.50	43.44		-.02	43.42	42.00	45.0
14	47.29	+.01	+.05	47.35	47.35	+.01	+.06	47.42	45.20		+.07	45.27	42.64		+.09	42.73	34.00	32.6
21	47.31	+.01	+.05	47.37	47.15	+.01	+.05	47.21	44.58		+.05	44.63	41.25		+.06	41.31	34.20	34.6
28	47.30	+.01	+.05	47.36	46.93	+.01	+.05	46.99	43.89		+.05	43.94	39.80		+.05	39.85	32.50	32.7
1841.																		
Jan. 5	47.29	+.02	+.05	47.36	46.63	+.01	+.05	46.69	43.18		+.04	43.22	39.83		+.05	39.88	31.00	32.7
11	47.28	+.02	+.05	47.35	46.38	+.01	+.05	46.44	42.72		+.04	42.76	38.31		+.04	38.35	30.20	32.8
18	47.27	+.02	+.04	47.33	46.10	+.01	+.04	46.15	41.96		+.03	41.99	37.43		+.01	37.44	30.20	35.2
25	47.25	+.03	+.04	47.32	45.79	+.01	+.03	45.83	41.39		+.02	41.41	37.25		+.01	37.26	30.80	36.0
Feb. 1	47.21	+.03	+.05	47.29	45.46	+.01	+.03	45.42	41.09		+.03	41.12	38.43		+.04	38.47	32.80	35.5
8	47.15	+.03	+.05	47.23	45.15	+.01	+.03	45.11	41.00		+.03	41.03	37.56		+.03	37.59	30.40	32.3
15	47.14	+.03	+.01	47.18	44.91	+.01	.00	44.92	40.63		-.01	40.62	37.75		-.05	37.70	39.00	45.0
22	47.10	+.03	-.01	47.12	44.66	+.01	-.01	44.66	40.87		-.03	40.84	39.46		-.08	39.38	41.30	49.8
Mar. 1	47.01	+.03	+.01	47.05	44.45	+.01	.00	44.46	41.29		-.01	41.28	39.92		-.02	39.90	36.80	43.0
8	46.97	+.03	-.02	46.98	44.34	+.01	-.02	44.33	41.40		-.04	41.36	39.89		-.11	39.78	44.00	53.8
15	46.91	+.02	-.04	46.89	44.27	.00	-.03	44.24	41.78		-.06	41.72	41.87		-.15	41.72	47.20	58.9
22	46.82	+.02	-.02	46.82	44.21	.00	-.02	44.19	42.45		-.04	42.41	42.88		-.09	42.79	44.60	52.0
29	46.75	+.02	-.03	46.74	44.24	.00	-.02	44.22	42.92		-.05	42.87	43.37		-.11	43.26	44.10	54.7
Apr. 5	46.65	+.02	.00	46.67	44.29	.00	.00	44.29	43.20		-.01	43.19	42.90		-.03	42.87	42.00	46.0
12	46.59	+.02	.00	46.61	44.37	.00	-.01	44.36	43.30		-.02	43.28	42.89		-.06	42.83	40.80	49.5
19	46.53	+.02	-.01	46.54	44.44	.00	-.01	44.43	43.38		-.04	43.34	43.10		-.09	43.01	42.80	51.7
26	46.48	+.02	-.02	46.48	44.49	.00	-.01	44.48	43.50		-.04	43.46	43.26		-.10	43.16	45.20	52.6
May 3	46.41	+.01	.00	46.42	44.53	.00	.00	44.53	43.80		-.02	43.78	44.96		-.03	44.93	42.00	47.9
10	46.39	+.01	-.03	46.37	44.61	.00	-.03	44.58	44.30		-.07	44.23	45.23		-.14	45.09	49.40	58.0
17	46.34	+.01	-.02	46.33	44.71	.00	-.02	44.69	44.80		-.04	44.76	46.55		-.09	46.46	49.00	54.0
24	46.34	+.01	-.07	46.28	44.89	.00	-.05	44.84	45.49		-.14	45.35	47.29		-.28	47.01	56.20	70.2
31	46.31	.00	-.06	46.25	45.06	.00	-.05	45.01	46.15		-.14	46.01	49.18		-.26	48.92	56.00	69.5
June 7	46.25	.00	-.02	46.23	45.24	.00	-.01	45.23	46.99		-.04	46.95	49.70		-.05	49.65	49.00	54.2
14	46.24	-.01	-.02	46.21	45.50	.00	.02	45.48	47.50		-.05	47.45	50.39		-.06	50.33	52.20	55.0
21	46.24	-.01	-.05	46.18	45.80	-.01	-.05	45.74	48.10		-.11	47.99	50.62		-.18	50.44	54.50	63.6
28	46.21	-.01	-.03	46.17	46.07	-.01	-.03	46.03	48.45		-.06	48.39	50.60		-.11	50.49	52.60	57.1
July 5	46.22	-.01	-.03	46.18	46.35	-.01	-.03	46.31	48.80		-.06	48.76	51.90		-.09	51.81	53.60	58.0
12	46.25	-.01	-.05	46.19	46.63	-.01	-.06	46.56	49.30		-.11	49.19	51.30		-.20	51.10	54.00	64.8
19	46.27	-.01	-.04	46.22	46.87	-.01	-.04	46.82	49.44		-.09	49.35	51.79		-.13	51.66	56.00	61.0
26	46.30	-.01	-.05	46.24	47.11	-.01	-.06	47.04	49.82		-.11	49.71	52.37		-.20	52.17	58.80	65.0
Aug. 2	46.34	-.01	-.05	46.28	47.33	-.01	-.06	47.26	50.10		-.11	49.99	51.93		-.17	51.76	53.50	64.0
9	46.39	-.02	-.04	46.33	47.55	-.01	-.05	47.49	50.27		-.10	50.17	52.58		-.13	52.45	54.40	62.2
16	46.44	-.02	-.06	46.36	47.79	-.01	-.07	47.71	50.42		-.13	50.29	52.03		-.20	51.83	56.20	66.0
23	46.48	-.02	-.03	46.43	47.94	-.01	-.04	47.89	50.52		-.07	50.44	52.67		-.09	52.58	53.00	59.0

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$ .
1841.																		
Aug. 30	46.54	-.02	-.03	46.49	48.10	-.01	-.05	48.04	50.70	.00	-.08	50.62	53.05	.00	-.12	52.93	57.00	60.8
Sept. 6	46.59	-.02	-.02	46.54	48.26	-.01	-.03	48.22	50.90	.00	-.03	50.87	52.05		-.04	52.01	48.90	54.7
13	46.69	-.02	-.03	46.64	48.47	.00	-.04	48.43	50.71	.00	-.06	50.65	52.19		-.10	52.09	58.30	58.8
20	46.75	-.02	-.04	46.69	48.56	.00	-.05	48.50	50.96	.00	-.08	50.88	53.25		-.12	53.13	56.80	60.7
27	46.80	-.02	-.02	46.76	48.67	-.01	-.03	48.63	51.09	.00	-.02	51.07	52.34		-.03	52.31	51.30	54.3
Oct. 4	46.87	-.02	-.01	46.84	48.80	.00	-.02	48.78	50.92	.00	-.01	50.91	51.34		-.03	51.31	47.80	53.5
11	46.94	-.02	-.01	46.91	48.91	.00	-.01	48.90	50.43	.00	-.01	50.42	50.07		-.03	50.04	48.60	51.9
18	47.00	-.01	.00	46.99	48.92	.00	+.01	48.93	49.90	.00	+.04	49.94	48.68		+.05	48.73	42.00	44.9
25	47.06	-.01	.00	47.05	48.89	.00	+.01	48.90	49.03	.00	+.03	49.06	46.48		+.01	46.49	41.10	44.7
Nov. 1	47.13	-.01	.00	47.12	48.80	.00	.00	48.80	48.13	.00	.00	48.13	45.41		-.02	45.39	43.00	47.4
8	47.21	.00	-.01	47.20	48.65	.00	-.01	48.64	47.50	.00	-.03	47.47	45.25		-.07	45.32	47.20	52.5
15	47.23	.00	+.03	47.26	48.39	.00	+.05	48.44	47.18	.00	+.07	47.25	44.75		+.10	44.85	33.50	35.6
22	47.28	.00	+.03	47.31	48.20	+.01	+.04	48.25	46.24	.00	+.05	46.29	41.74		+.03	41.77	35.50	38.5
29	47.34	.00	.00	47.34	47.98	+.01	.00	47.99	45.20	+.01	.00	45.21	41.15		-.04	41.11	39.00	46.4
Dec. 6	47.39	+.01	.00	47.40	47.68	+.01	.00	47.69	44.75	.00	.00	44.75	42.61		-.03	42.58	42.80	46.0
13	47.41	+.01	+.01	47.44	47.37	+.01	+.01	47.39	44.77	.00	.00	44.77	42.42		-.02	42.40	41.00	44.0
20	47.38	+.01	+.05	47.44	47.07	+.01	+.06	47.14	44.40	.00	+.06	44.46	40.99		+.08	41.07	31.40	31.2
27	47.41	+.01	+.02	47.44	46.86	+.01	+.02	46.89	43.62	.00	+.02	43.64	39.85		-.04	39.81	34.30	39.8
1842.																		
Jan. 3	47.40	+.02	+.04	47.46	46.62	+.01	+.03	46.66	43.24	.00	+.03	43.27	41.06		.00	41.06	36.20	36.5
10	47.35	+.02	+.06	47.43	46.32	+.01	+.05	46.38	43.03	.00	-.05	42.98	39.42		.00	39.42	31.20	30.0
17	47.34	+.02	+.03	47.39	46.10	+.01	+.03	46.14	42.45	.00	-.02	42.43	38.42		-.03	38.39	32.40	37.2
24	47.31	+.02	+.04	47.37	45.83	+.01	+.03	45.87	41.96	.00	-.02	41.94	38.63		-.02	38.61	32.00	35.3
31	47.28	+.02	+.02	47.32	45.57	+.01	+.01	45.59	41.63	.00	.00	41.63	38.26		-.02	38.24	37.00	40.8
Feb. 7	47.22	+.02	+.03	47.27	45.29	+.01	+.03	45.33	41.50	.00	-.01	41.49	39.07		-.03	39.04	31.60	35.7
14	47.19	+.03	+.01	47.23	45.08	+.01	+.01	45.10	41.41	.00	.00	41.41	39.42		-.05	39.37	36.50	43.1
21	47.12	+.02	+.02	47.16	44.87	+.01	+.01	44.89	41.57	.00	.00	41.57	40.13		-.02	40.11	37.80	40.8
28	47.06	+.03	+.01	47.10	44.72	+.01	+.01	44.74	41.73	.00	.00	41.73	39.51		-.04	39.47	36.10	42.0
Mar. 7	47.02	+.03	-.02	47.03	44.61	+.01	-.01	44.61	41.56	.00	-.04	41.52	39.72		-.09	39.63	41.10	53.0
14	46.95	+.03	-.01	46.97	43.49	+.01	.00	44.50	41.64	.00	-.03	41.61	40.10		-.08	40.02	41.70	51.5
21	46.85	+.02	+.01	46.88	44.37	.00	+.01	44.38	41.94	.00	.00	41.94	41.11		-.04	41.07	35.90	41.1
28	46.81	+.02	-.02	46.81	44.33	.00	-.01	44.32	42.04	.00	-.04	42.00	40.65		-.08	40.57	44.20	54.0

## EXPERIMENTAL GARDEN.

Date.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$ .
1837.																		
Feb. 4	48.13	+.05	+.03	48.21	45.41	+.02	+.01	45.44	40.99	.00	.00	40.99	38.39	.00	-.03	38.36		42
12	47.96	+.05	+.04	48.05	45.04	+.01	+.02	45.07	40.88	.00	.00	40.88	40.06		.00	40.06		40
20	47.88	+.05	+.03	47.96	44.75	+.01	+.01	44.77	41.11	.00	.00	41.11	40.53		-.01	40.52		42
27	47.85	+.05	+.03	47.93	44.61	+.01	+.01	44.63	41.21	.00	.00	41.21	38.63		-.03	38.60		42
Mar. 6	47.70	+.05	+.02	47.77	44.45	+.01	.00	44.46	40.78	.00	-.01	40.77	38.99		-.04	38.95		44
13	47.63	+.05	+.01	47.69	44.25	+.01	-.01	44.25	40.72	.00	-.02	40.70	39.30		-.05	39.25		46
20	47.48	+.06	+.03	47.57	44.07	+.01	+.01	44.09	40.50	.00	.00	40.50	37.68		-.03	37.65		42
27	47.32	+.06	+.06	47.44	43.87	+.01	+.03	43.91	40.11	.00	+.02	40.13	37.58		+.02	37.60		35
Apr. 3	47.20	+.06	+.06	47.32	43.68	+.01	+.03	43.72	39.79	.00	+.02	39.81	37.48		+.02	37.50		35
10	47.20	+.06	+.01	47.27	43.48	+.01	-.01	43.48	39.74	.00	-.02	39.72	38.03		-.06	37.97		46
17	47.07	+.06	-.04	47.09	43.35	+.01	-.04	43.32	39.98	.00	-.05	39.93	39.10		-.13	38.97		56
24	46.94	+.05	-.02	46.97	43.20	+.01	-.02	43.19	40.48	.00	-.04	40.44	40.63		-.08	40.55		50
May 1	46.86	+.05	-.06	46.85	43.08	.00	-.05	43.03	41.25	.00	-.08	41.17	42.52		-.16	42.36		60
8	46.74	+.04	-.05	46.73	43.18	.00	-.04	43.14	41.98	.00	-.07	41.91	43.90		-.15	43.75		58
15	46.70	+.04	-.11	46.63	43.35	.00	-.08	43.27	42.80	.00	-.14	42.66	44.81		-.28	44.53		70
22	46.58	+.04	-.05	46.57	43.51	.00	-.04	43.47	43.60	.00	-.07	43.53	46.42		-.13	46.29		57
29	46.50	+.03	-.08	46.45	43.79	-.01	-.06	43.72	44.81	-.01	-.10	44.70	47.98		-.18	47.80		62
June 5	46.45	+.03	-.10	46.38	44.09	-.01	-.07	44.01	45.62	-.01	-.13	45.48	48.80		-.23	48.57		66

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$
1837.																		
June 12	46.41	+01	-12	46.30	44.45	-01	-09	44.35	46.72	-01	-18	46.53	50.41	-00	-30	50.11	°	72
?	46.39	-01	-13	46.25	44.95	-02	-11	44.82	48.12	-01	-22	47.89	53.00		-33	52.67		75
26	46.35	-02	-13	46.20	45.30	-02	-12	45.16	49.29	-01	-22	49.06	54.80		-33	54.47		75
July 3	46.34	-02	-13	46.19	45.89	-02	-13	45.74	50.62	-01	-24	50.37	55.80		-35	55.45		76
10	46.35	-04	-17	46.14	46.49	-03	-17	46.29	51.98	-01	-32	51.65	57.82		-47	57.35		84
17	46.35	-05	-13	46.17	47.16	-03	-15	46.98	53.34	-01	-25	53.08	57.91		-33	57.58		76
24	46.39	-05	-13	46.21	47.74	-03	-15	47.56	53.82	-01	-23	53.58	58.09		-31	57.78		75
31	46.44	-05	-08	46.31	48.51	-02	-08	48.41	54.30	-00	-10	54.20	56.72		-11	56.61		63
Aug. 7	46.53	-05	-18	46.30	48.90	-02	-21	48.67	54.52	-00	-32	54.20	56.38		-47	55.91		82
14	46.62	-05	-14	46.43	49.35	-02	-16	49.17	54.39	-00	-24	54.15	56.89		-32	56.57		75
21	46.69	-06	-11	46.52	49.70	-02	-12	49.56	54.60	-01	-15	54.44	57.83		-18	57.65		68
28	46.82	-06	-10	46.66	50.02	-02	-11	49.89	54.83	-00	-14	54.69	56.34		-19	56.15		67
Sept. 4	46.93	-05	-07	46.81	50.30	-01	-08	50.21	54.30	-00	-09	54.21	54.40		-13	54.27		62
11	47.03	-05	-05	46.93	50.46	-01	-04	50.41	53.54	-00	-03	53.51	53.62		-03	53.59		56
18	47.21	-05	-10	47.06	50.62	-01	-11	50.50	53.23	-00	-15	53.08	52.68		-22	52.46		67
25	47.34	-05	-05	47.24	50.58	-01	-04	50.53	52.74	-00	-03	52.71	53.10		-05	53.05		56
Oct. 2	47.46	-04	-08	47.34	50.60	-00	-09	50.51	52.50	-00	-11	52.39	52.00		-16	51.84		63
9	47.60	-04	-05	47.51	50.55	-00	-05	50.50	52.26	-00	-06	52.20	52.93		-08	52.85		58
16	47.68	-04	-05	47.59	50.53	-00	-04	50.49	52.12	-00	-05	52.07	51.61		-08	51.53		57
23	47.75	-04	+02	47.73	50.42	-00	+04	50.46	51.50	-00	+08	51.58	50.79		+10	50.89		44
30	47.81	-03	+04	47.82	50.35	-00	+07	50.42	50.83	-00	+10	50.93	47.98		+10	48.08		40
Nov. 6	47.96	-01	-03	47.92	50.27	+01	-02	50.26	49.30	+01	-04	49.27	44.81		-09	44.72		53
13	47.98	-01	+04	48.01	50.02	+01	+06	50.09	48.29	-00	+06	49.35	45.95		+06	46.01		41
20	48.04	-00	+04	48.08	49.65	+01	+06	49.72	47.34	+01	+05	47.40	43.05		+02	43.07		41
27	48.09	-00	+04	48.13	49.30	+01	+06	49.37	46.41	+01	+04	46.46	43.08		+03	43.11		40
Dec. 4	48.15	+03	+01	48.19	48.92	+01	+02	48.95	45.60	+01	-01	45.60	42.38		-04	42.34		46
11	48.15	+03	+07	48.25	48.40	+02	+07	48.49	44.70	+01	+06	44.77	41.00		+04	41.04		36
18	48.23	+03	-02	48.24	48.13	+02	-02	48.13	44.20	+01	-05	44.16	41.20		-10	41.10		52
25	48.22	+03	-01	48.24	47.71	+01	-01	47.71	44.01	-00	-04	43.97	41.48		-08	41.40		50
1838.																		
Jan. 1	48.18	+03	+03	48.24	47.35	+01	+03	47.39	44.20	-00	+01	44.21	43.34		+01	43.35		42
8	48.10	+03	+09	48.22	47.06	+01	+08	47.15	44.06	-00	+07	44.13	42.03		+09	42.12		32
15	48.00	+04	+09	48.13	46.80	+01	+07	46.88	43.49	+01	+06	43.56	39.62		+07	39.69		32
22	48.03	+04	+06	48.13	46.55	+02	+05	46.62	42.58	+01	+03	42.62	38.42		+01	38.43		37
29	47.90	+05	+08	48.03	46.20	+02	+05	46.27	41.70	+01	+04	41.75	37.60		+03	37.63		34
Feb. 5	47.89	+05	+07	48.01	45.80	+02	+05	45.87	41.00	+01	+03	41.04	37.10		+01	37.11		35
12	47.85	+05	+02	47.92	45.58	+02	+01	45.61	40.52	+01	-01	40.52	36.50		-04	36.46		44
19	47.70	+07	+07	47.84	45.05	+02	+04	45.11	39.90	+01	+01	39.92	36.00		-00	36.00		36
26	47.65	+07	+09	47.81	44.65	+02	+05	44.72	39.40	+01	+02	39.43	35.50		+02	35.52		32
Mar. 5	47.65	+07	-07	47.65	44.45	+02	-06	44.41	39.02	+01	-07	38.96	35.38		-14	35.24		61
12	47.55	+08	-03	47.60	44.01	+02	-03	44.00	38.62	+01	-04	38.59	35.06		-10	34.96		54
19	47.42	+07	+01	47.50	43.59	+02	-01	43.60	38.60	-00	-02	38.58	37.20		-07	37.13		47
26	47.30	+07	+01	47.38	43.35	+02	-01	43.36	38.90	-00	-02	38.88	37.40		-05	37.35		45
Apr. 2	47.17	+07	+01	47.25	43.05	+01	-01	43.05	39.30	-00	-02	39.28	39.49		-05	39.44		45
9	47.05	+07	-01	47.11	42.85	+01	-01	42.85	39.91	-00	-03	39.88	40.08		-07	40.01		48
16	46.93	+06	+01	47.00	42.86	+01	-01	42.86	40.58	-00	-02	40.56	41.05		-04	41.01		45
23	46.80	+05	+01	46.86	42.91	+01	-00	42.92	40.90	-00	-01	40.89	40.63		-03	40.60		44
30	46.65	+05	+01	46.71	42.83	-00	-00	42.83	41.30	-00	-01	41.29	41.52		-03	41.49	41.2	44
May 7	46.66	+04	-12	46.58	43.05	-00	-08	42.97	41.92	-00	-15	41.77	43.51		-28	43.23	31.4?	72
14	46.50	+04	-01	46.53	43.12	-00	-02	43.10	42.99	-00	-02	42.97	45.70		-02	45.68	42.2	48
21	46.41	+03	-04	46.40	43.32	-00	-03	43.29	43.70	-00	-06	43.64	45.23		-11	45.12	46.9	55
28	46.30	+03	-05	46.28	43.62	-00	-04	43.58	44.50	-00	-07	44.43	46.42		-14	46.28	50.1	58
June 4	46.30	+01	-08	46.23	44.00	-01	-07	43.92	45.32	-00	-13	45.19	47.80		-22	47.58	56.2	65
11	46.20	+01	-05	46.16	44.25	-01	-05	44.19	46.10	-01	-08	46.01	49.10		-12	48.98	51.8	58
18	46.15	-00	-03	46.12	44.64	-01	-03	44.60	46.90	-01	-04	46.85	50.20		-04	50.16	52.2	53
25	46.20	-01	-11	46.08	45.08	-01	-10	44.99	48.03	-01	-18	47.84	51.71		-28	51.43	58.1	71
July 2	46.12	-01	-04	46.07	45.59	-02	-03	45.45	48.98	-01	-04	48.93	52.81		-02	52.79	52.1	54
9	46.15	-03	-07	46.05	46.00	-02	-07	45.91	50.04	-01	-11	49.92	54.51		-13	54.38	59.1	62
16	46.16	-04	-09	46.03	46.43	-02	-09	46.32	51.08	-01	-16	50.91	55.50		-20	55.30	60.4	67
23	46.26	-04	-11	46.11	47.00	-02	-11	46.87	51.63	-01	-18	51.44	55.00		-25	54.75	63.0	70
30	46.30	-04	-11	46.15	47.50	-02	-12	47.36	52.10	-00	-18	51.92	54.83		-25	54.58	56.5	70
Aug. 6	46.30	-05	-09	46.16	47.90	-02	-10	47.78	52.50	-01	-14	52.35	55.90		-17	55.73	59.1	66
13	46.42	-05	-09	46.28	48.37	-02	-11	48.24	52.91	-00	-14	52.77	55.82		-17	55.65	56.1	66



Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$
1838.																		
Aug. 20	46.49	-.05	-.06	46.38	48.75	-.02	-.07	48.66	53.12	.00	-.08	53.04	55.51	.00	-.08	55.43	56.1	60
27	46.61	-.05	-.14	46.42	49.12	-.02	-.16	48.94	53.29	.00	-.24	53.05	54.82		-.33	54.49	59.2	75
Sept. 3	46.66	-.05	-.09	46.52	49.35	-.01	-.11	49.23	53.11	.00	-.14	52.97	54.63		-.18	54.45	54.9	66
10	46.80	-.05	-.09	46.66	49.51	-.01	-.10	49.40	52.80	.00	-.13	52.67	52.50		-.19	52.31	53.2	65
17	46.86	-.05	-.07	46.74	49.72	-.01	-.08	49.63	52.40	.00	-.10	52.30	53.51		-.14	53.37	54.1	62
24	47.01	-.04	-.10	46.87	49.85	-.01	-.11	49.73	52.48	.00	-.16	52.32	52.71		-.22	52.49	50.6	67
Oct. 1	47.15	-.04	-.11	47.00	49.95	-.01	-.13	49.81	52.21	.00	-.18	52.03	52.60		-.25	52.35	53.1	69
8	47.25	-.04	-.10	47.11	49.97	.00	-.11	49.86	51.82	.00	-.16	51.66	50.70		-.23	49.47	50.2?	67
15	47.30	-.03	-.08	47.19	49.90	.00	-.09	49.81	50.99	.00	-.12	50.87	48.81		-.19	48.62	48.2	63
22	47.42	-.03	-.07	47.32	49.89	.00	-.07	49.82	50.22	.00	-.10	50.12	48.68		-.16	48.52	52.8	61
29	47.48	-.03	-.01	47.44	49.69	.00	+.01	49.70	49.82	.00	+.01	49.83	48.89		.00	48.89	42.0	49
Nov. 5	47.59	-.01	+.04	47.62	49.52	.00	+.06	49.58	49.10	+.01	+.08	49.19	45.78		+.07	45.85	40.2	40
12	47.61	-.01	+.02	47.62	49.45	+.01	+.03	49.49	48.03	+.01	+.02	48.06	45.00		.00	45.00	33.4	45
19	47.67	.00	+.02	47.69	49.10	+.01	+.03	49.14	47.01	+.01	+.02	47.04	43.04		-.01	43.03	35.0	44
26	47.70	+.01	+.05	47.70	48.72	+.01	+.06	48.79	45.82	+.01	+.05	45.88	42.03		+.03	42.06	33.3	39
Dec. 3	47.71	+.01	+.03	47.69	48.44	+.01	-.04	48.41	45.10	+.01	-.06	45.05	42.61		-.11	42.50	43.1	54
10	47.82	+.01	.00	47.83	48.01	+.01	.00	48.02	44.91	.00	-.02	44.89	42.05		-.06	41.99	42.1	48
17	47.81	+.03	+.03	47.87	47.61	+.01	+.03	47.65	44.51	.00	+.01	44.52	41.70		.00	41.70	36.2	42
24	47.80	+.03	+.03	47.86	47.30	+.01	+.02	47.33	44.91	+.01	+.01	44.93	40.53		-.02	40.51	38.8	43
31	47.81	+.04	+.01	47.86	46.95	+.01	+.01	46.97	43.20	.00	-.02	43.18	40.50		-.05	40.45	39.2	46
1839.																		
Jan. 7	47.75	+.04	+.05	47.84	46.60	+.01	+.04	46.65	42.91	.00	+.02	42.93	40.01		+.01	40.02	35.8	39
14	47.72	+.04	+.04	47.80	46.32	+.02	+.03	46.37	42.28	+.01	+.01	42.30	39.30		-.01	39.29	37.0	40
21	47.70	+.05	+.06	47.81	46.02	+.02	+.04	46.08	41.82	+.01	+.02	41.85	38.03		.00	38.03	33.0	38
28	47.70	+.05	+.07	47.82	45.61	+.02	+.05	45.68	41.20	+.01	+.03	41.24	37.90		+.02	37.92	30.4	35
Feb. 4	47.53	+.05	+.06	47.64	45.30	+.02	+.04	45.36	40.60	+.01	+.02	40.63	37.01		.00	37.01	30.4	37
11	47.51	+.04	+.01	47.56	45.01	+.01	.00	45.02	44.32?	+.01	-.01	44.32	38.53		-.04	38.49	40.2	45
18	47.42	+.05	+.04	47.51	44.60	+.01	+.02	44.63	40.60	.00	.00	40.60	38.52		-.01	38.51	31.8	40
25	47.38	+.05	+.02	47.45	44.35	+.02	.00	44.37	40.30	.00	-.01	40.29	37.51		-.03	37.48	32.2	43
Mar. 4	47.30	+.06	+.03	47.39	44.21	+.02	+.01	44.24	40.01	.00	-.01	40.00	38.30		-.03	38.27	36.2	42
11	47.32	+.06	+.02	47.40	43.85	+.02	.00	43.87	40.04	.00	-.01	40.03	37.40		-.04	37.36	31.9	43
18	47.05	+.06	+.01	47.12	43.70	+.01	.00	43.71	39.71	.00	-.02	39.69	38.15		-.05	38.10	35.1	45
25	47.01	+.06	.00	47.07	43.50	+.01	-.01	43.50	39.99	.00	-.02	39.97	38.80		-.05	38.75	37.0	46
Apr. 1	46.85	+.06	+.03	46.94	43.32	+.01	+.01	43.34	40.05	.00	-.00	40.05	38.99		-.01	38.98	36.0	40
8	46.81	+.06	-.04	46.83	43.25	+.01	-.03	43.23	40.12	.00	-.06	40.06	38.41		-.13	38.28	38.2	55
15	46.75	+.06	-.04	46.77	43.25	+.01	-.03	43.23	40.20	.00	-.06	40.12	40.30		-.13	40.17	43.4	55
22	46.60	+.05	-.03	46.62	43.05	+.01	-.03	43.03	40.97	.00	-.05	40.92	41.51		-.10	41.41	44.8	53
29	46.51	+.05	-.04	46.52	43.20	+.01	-.03	43.18	41.01	.00	-.06	40.95	41.72		-.12	41.60	43.5?	55
May 6	46.30	+.03	-.02	46.31	43.20	.00	-.02	43.18	42.90	.00	-.04	42.86	45.30		-.06	45.24	45.8	50
13	46.39	+.03	-.01	46.41	43.41	.00	-.01	43.40	43.70	.00	-.02	43.68	45.60		-.02	45.58	45.2	48
20	46.30	+.02	-.05	46.27	43.70	.00	-.04	43.66	44.30	.00	-.08	44.22	46.00		-.13	45.87	50.1	57
27	46.40	+.02	-.11	46.31	44.00	-.01	-.09	43.90	44.90	.00	-.15	44.75	47.30		-.28	47.02	54.0	70
June 3	46.10	+.01	-.05	46.06	44.40	-.01	-.05	44.34	45.96	-.01	-.07	45.88	49.40		-.11	49.29	50.1	57
10	46.02	.00	-.08	45.94	44.60	-.01	-.07	44.52	47.26	-.01	-.14	47.11	51.60		-.19	51.41	57.2	65
17	46.03	-.01	-.14	45.88	44.98	-.02	-.13	44.83	48.20	-.01	-.25	47.94	52.50		-.40	52.10	63.0	78
24	46.10	-.02	-.09	45.99	45.40	-.02	-.08	45.30	49.51	-.01	-.14	49.36	54.60		-.18	54.42	56.0	66
July 1	46.20	-.03	-.13	46.04	46.00	-.02	-.13	45.85	50.50	-.01	-.24	50.25	53.60		-.33	53.27	56.1	75
8	46.20	-.03	-.13	46.04	46.50	-.02	-.14	46.34	51.20	-.01	-.24	50.95	56.10		-.33	55.77	61.0	75
15	46.20	-.04	-.10	46.06	47.01	-.02	-.11	46.88	52.10	-.01	-.17	51.92	56.10		-.21	55.89	58.8	68
22	46.30	-.04	-.09	46.17	47.50	-.02	-.09	47.39	52.60	-.01	-.13	52.46	55.61		-.16	55.45	59.9	65
29																		
Aug. 5	46.40	-.04	-.13	46.23	48.49	-.02	-.15	48.32	53.52	-.01	-.22	53.29	57.10		-.30	56.80	60.4	74
12	46.41	-.06	-.09	46.26	48.85	-.02	-.10	48.73	53.73	.00	-.12	53.61	56.70		-.14	56.56	57.3	65
19	46.49	-.06	-.02	46.41	49.28	-.02	-.01	49.25	53.80	.00	+.03	53.83	55.00		+.07	55.07	51.0	51
25	46.55	-.06	-.08	46.41	49.53	-.01	-.09	49.43	53.52	.00	-.11	53.41	54.81		-.15	54.66	56.2	64
Sept. 2	46.73	-.06	-.07	46.60	49.90	-.01	-.08	49.81	53.30	.00	-.10	53.20	54.30		-.13	54.17	52.2	62
9	46.85	-.05	-.10	46.70	49.96	-.01	-.12	49.83	53.30	.00	-.16	53.14	54.38		-.23	54.15	57.4	68
16	46.92	-.05	-.06	46.81	50.05	-.01	-.07	49.97	53.02	.00	-.08	52.94	53.20		-.11	53.09	54.4	60
23	47.08	-.05	-.10	46.93	50.18	-.01	-.11	50.06	52.70	.00	-.15	52.55	52.60		-.21	52.39	52.8	67
30	47.17	-.04	-.09	47.04	50.22	-.01	-.10	50.11	52.28	.00	-.14	52.14	52.12		-.20	51.92	50.0	65
Oct. 7	47.26	-.04	-.06	47.16	50.19	.00	-.06	50.13	51.68	.00	-.07	51.61	49.82		-.12	49.70	47.4	59
14	47.30	-.04	-.04	47.22	50.20	.00	-.03	50.17	50.84	.00	-.04	50.80	50.01		-.07	49.94	49.0	55
21	47.42	-.03	-.07	47.32	50.01	.00	-.07	49.94	50.61	.00	-.09	50.52	48.82		-.14	48.68	43.0	60

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$ .
1839-																		
Oct. 28	47.52	-.03	-.04	47.45	49.91	.00	-.04	49.87	50.01	.00	-.06	49.95	49.02	.00	-.09	48.93	44.0	56
Nov. 3	47.50	-.02	+.02	47.50	49.60	.00	+.04	49.64	49.20	.00	+.04	49.26	47.10		+.04	47.14	43.0	44
11	47.70	-.01	+.02	47.71	49.40	+.01	+.03	49.44	48.44	.00	+.02	48.46	46.60		+.02	46.62	41.0	45
18	47.70	-.01	+.02	47.71	49.40	+.01	+.03	49.44	48.20	.00	+.02	48.22	46.70		+.02	46.72	42.0	45
25	47.72	.00	+.04	47.76	49.06	+.01	+.05	49.12	47.70	.00	+.05	47.75	45.03		+.04	45.07	39.2	41
Dec. 2	47.75	.00	+.07	47.82	48.74	+.01	+.08	48.83	46.60	+.01	+.09	46.70	42.70		+.08	42.78	33.4	35
9	47.73	+.01	+.09	47.83	48.50	+.02	+.09	48.61	45.50	+.01	+.09	45.60	41.01		+.07	41.08	31.5	33
16	47.80	+.02	+.04	47.86	48.30	+.02	+.05	48.37	44.50	+.01	+.03	44.54	41.03		+.01	41.04	37.0	40
23	47.75	+.02	+.01	47.78	47.70	+.02	+.01	47.73	44.03	.00	-.01	44.02	41.90		-.04	41.86	41.8	46
31	47.80	+.03	+.04	47.87	47.20	+.02	+.04	47.26	43.60	+.01	+.02	43.63	40.10		.00	40.10	34.0	40
1840.																		
Jan. 6	47.80	+.03	+.04	47.87	47.02	+.02	+.04	47.08	43.20	+.01	+.02	43.23	40.02		.00	40.02	31.8	40
13	47.73	+.04	+.02	47.79	46.61	+.02	+.01	46.64	42.53	+.01	-.01	42.53	39.10		-.05	39.05	41.5	45
20	47.70	+.04	+.06	47.80	46.30	+.02	+.04	46.36	42.20	.00	+.02	42.22	40.30		+.03	40.33	36.0	37
27	47.68	+.04	+.07	47.79	45.92	+.02	+.05	45.99	42.10	.00	+.03	42.13	39.80		+.04	39.84	34.0	35
Feb. 3	47.60	+.05	+.06	47.71	45.62	+.02	+.04	45.68	41.61	+.01	+.03	41.65	38.02		+.01	38.03	35.2	36
10	47.52	+.05	-.01	47.56	45.30	+.02	-.02	45.30	41.10	.00	-.04	41.06	39.00		-.08	38.92	36.0	50
17	47.50	+.05	+.03	47.58	45.00	+.02	+.01	45.03	41.02	.00	.00	41.02	39.70		-.03	39.67	40.4	42
24	47.40	+.05	+.02	47.47	44.61	+.01	.00	44.62	41.30	.00	-.01	41.29	38.72		-.04	38.68	33.1	44
Mar. 2	47.30	+.06	+.02	47.38	44.50	+.02	.00	44.52	40.80	+.01	-.01	40.80	37.60		-.03	37.57	32.0	44
9	47.22	+.06	-.03	47.25	44.30	+.02	-.03	44.29	40.30	.00	-.05	40.25	37.60		-.11	37.49	37.0	53
16	47.20	+.06	.00	47.26	44.10	+.01	-.01	44.10	40.20	.00	-.03	40.17	39.50		-.07	39.43	42.0	48
23	47.10	+.05	+.02	47.17	43.80	+.01	.00	43.81	40.80	.00	-.01	40.79	40.10		-.03	40.07		43
30	47.01	+.05	-.03	47.03	43.75	+.01	-.03	43.73	41.10	.00	-.05	41.05	41.05		-.11	40.94		52
Apr. 6	46.75	+.05	.00	46.80	43.65	+.01	-.01	43.65	41.44	.00	-.03	41.41	41.50		-.06	41.44		48
13	46.70	+.04	-.08	46.68	43.70	.00	-.06	43.64	41.90	.00	-.10	41.80	42.70		-.21	42.49		64
20	46.70	+.04	-.07	46.67	43.65	.00	-.05	43.60	42.70	.00	-.09	42.61	44.10		-.18	43.92		61
27	46.70	+.03	-.13	46.60	43.85	.00	-.09	43.76	43.60	-.01	-.16	43.43	47.01		-.32	46.69	55.2	73
May 4	46.50	+.02	-.07	46.45	44.01	-.01	-.06	43.94	45.02	-.01	-.11	44.90	49.01		-.16	48.85	53.2	61
11	46.42	+.02	+.01	46.45	44.30	-.01	.00	44.27	45.80	.00	+.02	45.82	46.60		+.05	46.65	41.8	43
18	46.40	+.01	-.04	46.37	44.68	.00	-.04	44.64	45.80	.00	-.06	45.74	46.52		-.10	46.42	45.5	55
25	46.30	+.01	-.08	46.23	45.01	.00	-.07	44.94	45.90	.00	-.11	45.79	47.70		-.19	47.51	51.8	63
June 1	46.30	.00	-.07	46.23	45.23	-.01	-.07	45.15	46.72	.00	-.11	46.61	49.60		-.16	49.44	55.5	62
8	46.34	-.01	-.16	46.17	45.45	-.01	-.15	45.29	47.60	.00	-.25	47.35	50.95		-.42	50.53	60.2	80
15	46.30	-.01	-.09	46.20	45.75	-.01	-.08	45.66	48.50	.00	-.13	48.37	51.80		-.19	51.61	55.2	65
22	46.30	-.02	-.09	46.19	46.14	-.01	-.08	46.05	49.20	.00	-.14	49.06	52.12		-.20	51.92	57.8	65
29	46.32	-.02	-.13	46.17	46.45	-.01	-.14	46.30	49.60	.00	-.22	49.38	52.43		-.35	52.08	60.2	75
July 6	46.30	-.03	-.08	46.19	46.82	-.01	-.08	46.73	50.20	.00	-.12	50.08	52.80		-.15	52.65	56.0	63
13	46.28	-.03	-.12	46.13	47.20	-.01	-.13	47.06	50.70	.00	-.21	50.49	53.48		-.32	53.16	55.8	73
20	46.51	-.03	-.11	46.37	47.63	-.02	-.12	47.49	51.18	.00	-.20	50.98	53.92		-.27	53.65	59.2	71
27	46.50	-.04	-.11	46.35	47.98	-.02	-.12	47.84	51.63	.00	-.18	51.45	54.50		-.26	54.24	60.8	70
Aug. 3	46.51	-.05	-.12	46.34	48.32	-.02	-.14	48.16	52.10	.00	-.22	51.88	55.20		-.30	54.90	62.0	73
10	46.51	-.05	-.07	46.39	48.50	-.02	-.09	48.39	52.70	.00	-.11	52.59	56.80		-.11	56.69	61.8	63
17	46.60	-.05	-.13	46.42	48.90	-.02	-.15	48.73	53.60	-.01	-.22	53.37	56.30		-.31	55.99	55.8	74
24	46.55	-.06	-.09	46.40	49.25	-.02	-.10	49.13	53.62	.00	-.12	53.50	56.30		-.16	56.14	58.5	65
31	46.80	-.06	-.13	46.61	49.60	-.02	-.15	49.43	53.90	.00	-.21	53.69	56.20		-.29	55.91	55.2	73
Sept. 7	46.82	-.06	-.09	46.67	49.85	-.01	-.11	49.73	53.80	.00	-.13	53.67	54.70		-.18	54.52	56.2	66
14	47.00	-.06	-.05	46.89	50.50	-.01	-.06	50.43	53.40	.00	-.06	53.34	53.49		-.08	53.41	49.4	58
21	47.13	-.05	-.07	47.01	50.25	-.01	-.07	50.17	52.81	.00	-.09	52.72	51.97		-.13	51.84	51.0	61
28	47.24	-.04	-.07	47.13	50.31	.00	-.07	50.24	52.12	.00	-.09	52.03	51.11		-.14	50.97	54.2	61
Oct. 5	47.35	-.04	-.06	47.25	50.28	.00	-.05	50.23	51.53	.00	-.06	51.47	50.10		-.11	49.99	48.4	58
12	47.50	-.03	-.07	47.40	50.20	.00	-.07	50.13	50.70	.00	-.09	50.61	49.11		-.15	48.96	48.5	60
19	47.52	-.03	-.03	47.46	50.06	.00	-.02	50.04	50.29	.00	-.03	50.26	49.50		-.05	49.45	48.0	53
26	47.60	-.02	+.01	47.59	49.80	.00	+.03	49.83	49.80	.00	+.04	49.84	47.90		+.03	47.93	38.2	46
Nov. 2	47.56	-.02	-.04	47.50	49.57	.00	-.03	49.54	49.10	.00	-.05	49.05	46.60		-.10	46.50	46.2	55
9	47.70	-.01	+.03	47.72	49.50	+.01	+.04	49.55	48.40	.00	+.04	48.44	46.01		+.04	46.05	41.2	43
16	47.80	.00	+.01	47.81	49.35	+.01	+.02	49.38	47.60	+.01	+.02	47.63	44.01		-.02	43.99	38.2	46
23	47.80	+.01	+.02	47.83	48.90	+.01	+.02	48.93	46.10	.00	+.01	46.11	43.00		-.02	42.98	41.2	45
30	47.80	+.01	-.04	47.77	48.75	+.01	-.04	48.72	45.90	+.01	-.06	45.85	42.40		-.13	42.27	45.8	55
Dec. 7	47.90	+.01	+.02	47.93	48.30	+.01	+.02	48.33	45.20	.00	+.01	45.21	42.80		-.01	42.79	41.2	44
14	47.90	+.02	+.07	47.99	47.91	+.01	+.07	47.99	44.80	.00	+.06	44.86	41.90		+.06	41.96	32.2	36
21	47.89	+.03	+.07	47.99	47.60	+.02	+.07	47.69	44.10	+.01	+.05	44.16	40.30		+.04	40.34	33.0	35
28	47.80	+.03	+.09	47.92	47.20	+.02	+.08	47.30	43.20	+.01	+.06	43.27	38.60		+.05	38.65	30.2	32

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$ .
1841.																		
Jan. 4	47.70	+04	+07	47.81	46.80	+02	+05	46.87	42.30	+01	+03	42.34	38.60	.00	+02	38.62	32.20	36
11	47.75	+05	+09	47.89	46.40	+02	+07	46.49	41.70	+01	+05	41.76	37.50		+03	37.53	29.20	32
18	47.75	+05	+07	47.87		+02	+05		40.95	+01	+02	40.98	36.50		.00	36.50	30.50	36
25	47.70	+06	+07	47.83	45.60	+02	+05	45.67	40.30	+01	+02	40.33	36.50		+01	36.51	30.20	35
Feb. 1	47.60	+06	+08	47.74	45.20	+02	+04	45.26	39.90	.00	+02	39.92	36.70		+02	36.72	31.50	34
8	47.50	+06	+08	47.64	44.75	+02	+05	44.82	39.60	.00	+02	39.62	36.30		+02	36.32	30.80	33
15	47.50	+07	+02	47.59	44.45	+02	.00	44.47	39.30	.00	+02	39.28	36.60		+05	36.55	38.80	45
22	47.45	+06	+02	47.49	44.10	+02	+02	44.10	39.60	.00	+04	39.56	38.70		+09	38.61	41.20	51
Mar. 1	47.25	+06	+02	47.33	43.80	+01	.00	43.81	40.20	.00	+01	40.19	39.10		+03	39.07	39.20	43
8	47.30	+06	+05	47.31	43.72	+01	+04	43.69	40.40	.00	+06	40.34	39.70		+13	39.57	44.00	56
15	47.20	+05	+03	47.22	43.60	+01	+03	43.58	41.01	.00	+05	40.96	41.90		+10	41.80	45.20	53
22	47.00	+05	+04	47.01	43.60	.00	+04	43.56	41.70	.00	+06	41.64	42.80		+12	42.68	45.80	55
29	46.80	+04	+07	46.77	43.65	.00	+05	43.60	42.40	.00	+09	42.31	43.50		+19	43.31	44.20	61
Apr. 5	46.70	+04	.00	46.64	43.75	.00	+01	43.74	42.70	.00	+03	42.67	43.00		+05	42.95	42.20	48
12	46.72	+04	+06	46.70	43.90	.00	+05	43.85	43.05	.00	+09	42.96	43.20		+17	43.03	46.25	60
19	46.62	+03	+04	46.61	44.00	.00	+04	43.96	43.30	.00	+07	43.23	43.58		+12	43.46	44.25	56
26	46.50	+03	+03	46.50	44.20	.00	+03	44.17	43.50	.00	+05	43.45	43.62		+08	43.54	46.50	52
May 3	46.48	+02	+02	46.48	44.35	.00	+02	44.33	44.00	.00	+04	43.96	45.90		+06	45.84	42.75	51
10	46.43	+02	+07	46.38	44.48	.00	+06	44.42	44.60	.00	+10	44.50	46.30		+19	46.11	52.25	62
17	46.40	+01	+06	46.35	44.61	+01	+05	44.55	45.50	.00	+10	45.40	48.20		+15	48.05	52.00	60
24	46.30	.00	+15	46.15	44.90	+01	+14	44.75	46.30	.00	+25	46.05	49.10		+42	48.68	62.25	80
31	46.35	.00	+14	46.21	45.20	+01	+13	45.06	47.30	+01	+24	47.05	51.60		+38	51.22	60.25	78
June 7	46.30	+01	+06	46.23	45.45	+01	+05	45.39	48.51	+01	+08	48.42	52.10		+10	52.00	51.25	59
14	46.30	+01	+07	46.22	45.91	+01	+07	45.83	49.33	.00	+12	49.21	53.50		+15	53.35	55.50	63
21	46.30	+03	+11	46.16	46.35	+02	+11	46.22	50.30	.00	+20	50.10	53.40		+12	53.28	58.25	71
28	46.30	+02	+08	46.20	46.85	+02	+09	46.74	50.70	.00	+13	50.57	53.10		+19	52.91	57.80	65
July 5	46.30	+03	+07	46.20	47.30	+02	+07	47.21	51.08	.00	+10	50.98	54.30		+11	54.19	55.75	61
12	46.35	+04	+08	46.23	47.60	+01	+08	47.51	51.50	.00	+14	51.36	53.45		+19	53.26	55.25	65
19	46.40	+04	+08	46.28	48.01	+01	+09	47.91	51.60	.00	+13	51.47	54.15		+18	53.97	59.25	65
26	46.52	+04	+13	46.34	48.35	+02	+15	48.18	52.10	.00	+24	51.86	54.62		+32	54.30	61.50	75
Aug. 2	46.60	+05	+12	46.43	48.62	+01	+14	48.47	52.41	.00	+23	52.18	54.23		+32	53.91	56.50	74
9	46.62	+05	+08	46.49	48.91	+01	+09	48.81	52.53	.00	+13	52.40	55.00		+17	54.83	57.50	65
16	46.75	+05	+11	46.59	49.20	+01	+14	49.05	52.78	.00	+21	52.57	54.20		+30	53.90	59.25	73
23	46.80	+05	+08	46.67	49.35	+01	+09	49.25	52.80	.00	+13	52.67	55.00		+17	54.83	59.00	65
30	46.92	+05	+09	46.78	49.60	+01	+09	49.50	52.00	.00	+24	51.76	55.30		+17	55.13	58.75	65
Sept. 6	47.22	+05	+11	47.06	49.95	+01	+13	49.81	53.00	.00	+18	52.82	53.21		+26	52.95	58.50	70
13	47.16	+04	+13	46.99	50.03	+01	+16	49.96	52.09	.00	+23	51.86	53.09		+33	52.76	62.00	74
20	47.22	+05	+07	47.10	50.09	+01	+08	50.00	53.00	.00	+10	52.90	54.90		+11	54.79	54.50	62
27	47.35	+05	+08	47.22	50.30	+01	+09	50.20	53.00	.00	+11	52.89	53.48		+15	53.33	52.25	64
Oct. 4	47.35	+05	+04	47.26	50.32	+01	+03	50.28	52.73	.00	+02	52.71	52.63		+03	52.60	49.25	55
11	47.49	+04	+07	47.38	50.40	.00	+07	50.33	52.12	.00	+08	52.04	51.30		+13	51.17	48.75	60
18	47.50	+03	+01	47.46	50.31	.00	.00	50.31	51.50	.00	.00	51.50	49.50		+03	49.47	43.25	51
25	47.60	+03	+01	47.58	50.25	.00	+03	50.28	50.30	+01	+04	50.35	46.80		+02	46.82	41.25	45
Nov. 1	47.70	+02	+01	47.69	50.10	+01	+03	50.14	49.00	.00	+03	49.03	45.80		+01	45.81	38.50	45
8	47.80	+01	+02	47.77	49.80	+01	+01	49.80	48.10	.00	+03	48.07	45.32		+08	45.24	46.25	52
15	47.80	+01	+03	47.82	49.50	+01	+05	49.44	47.65	.00	+05	47.70	44.80		+03	44.83	33.75	42
22	47.85	+01	+05	47.91	49.15	+01	+06	49.08	46.52	+01	+06	46.59	41.40		+03	41.43	32.25	38
29	47.80	+01	+05	47.76	48.80	+02	+05	48.77	45.20	+01	+09	45.12	40.10		+15	39.95	36.25	58
Dec. 6	48.00	+02	+01	48.03	48.42	+02	+01	48.45	44.30	.00	.00	44.30	42.20		+03	42.17	41.25	45
13	48.00	+02	+01	48.03	47.98	+01	+01	48.00	44.40	.00	.00	44.40	42.00		+03	41.97	40.75	45
20	47.90	+03	+09	48.02	47.40	+02	+07	47.49	43.92	+01	+07	44.00	40.51		+08	40.59	31.50	32
27	47.92	+03	+04	47.99	47.10	+02	+03	47.15	43.00	.00	+02	43.02	38.88		.00	38.88	33.25	40
1842.																		
Jan. 3	47.90	+04	+07	48.01	46.50	+02	+05	46.57	42.30	.00	+03	42.33	40.00		+04	40.04	33.25	35
10	47.81	+05	+09	47.95	46.25	+02	+06	46.33	42.10	+01	+04	42.15	38.50		.04	38.54	30.50	32
17	47.80	+05	+04	47.89	45.90	+02	+03	45.95	41.50	+01	.00	41.51	37.70		+01	37.69	31.75	40
24	47.70	+05	+06	47.81	45.70	+02	+04	45.76	41.00	+01	+02	41.03	37.50		.00	37.50	31.50	36
31	47.70	+06	.00	47.76	45.20	+02	.00	45.22	40.40	.00	+03	40.37	37.80		+06	37.74	37.50	47
Feb. 7	47.60	+06	+05	47.71	44.80	+02	+03	44.85	40.30	.00	+01	40.31	38.10		.00	38.10	31.50	37
14	47.51	+06	+02	47.59	44.55	+02	.00	44.57	40.30	.00	+01	40.29	38.60		+03	38.57	37.25	44
21	47.50	+06	.00	47.56	44.30	+01	+01	44.30	40.50	.00	+03	40.47	39.50		+06	39.44	38.25	48
28	47.40	+06	+01	47.45	44.10	+01	+02	44.09	40.90	.00	+04	40.86	39.00		+08	38.92	37.75	50
Mar. 7	47.20	+06	+01	47.27	43.90	+01	.00	43.91	40.60	.00	+01	40.59	39.70		+04	39.66	36.25	45

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T.$
1842.																		
Mar. 14	47.10	+ .05	- .02	47.13	43.80	+ .01	- .03	43.78	40.80	.00	- .04	40.76	39.70	.00	- .10	39.60	41.25	52
22	47.00	+ .05	- .03	47.02	43.70	+ .01	- .03	43.68	41.30	.00	- .05	41.25	40.60		- .11	40.49	36.25	54
28	46.90	+ .05	- .02	46.93	43.75	+ .01	- .02	43.74	41.42	.00	- .04	41.38	40.39		- .09	40.30	41.50	51
Apr. 4	46.80	+ .05	- .06	46.79	43.63	+ .01	- .05	43.59	41.60	.00	- .08	41.52	41.50		- .16	41.34	40.75	60
11	46.71	+ .04	- .04	46.71	43.62	.00	- .03	43.60	42.00	.00	- .06	41.94	42.50		- .11	42.39	45.50	55
18	46.70	+ .04	- .07	46.67	43.70	.00	- .05	43.65	42.62	.00	- .09	42.53	43.50		- .17	43.33	44.75	61
25	46.55	+ .03	- .06	46.52	43.80	.00	- .04	43.76	43.50	.00	- .08	43.42	45.70		- .16	45.54	50.00	60
May 2	46.50	+ .02	- .08	46.44	44.10	.00	- .06	44.04	44.70	.00	- .11	44.59	47.50		- .18	47.32	31.50	63
9	46.41	+ .01	- .07	46.35	44.20	- .01	- .05	44.14	45.50	.00	- .09	45.41	48.00		- .15	47.85	47.00	60
16	46.35	+ .01	- .10	46.26	44.60	- .01	- .07	44.52	46.14	.00	- .14	46.00	48.50		- .22	47.28	53.25	66
23	46.25	.00	- .08	46.18	45.00	- .01	- .06	44.93	47.00	.00	- .11	46.89	49.30		- .17	49.13	51.75	62
30	46.24	.00	- .09	46.15	45.34	- .01	- .07	45.26	47.50	.00	- .12	47.38	50.10		- .19	49.91	55.00	64
June 6	46.30	- .01	- .13	46.16	45.60	- .01	- .10	45.49	48.30	- .01	- .20	48.09	52.30		- .30	52.00	59.25	72
13	46.30	- .02	- .17	46.11	46.10	- .02	- .17	45.91	49.65	- .01	- .29	49.35	55.24		- .46	54.78	63.00	83
20	46.20	- .03	- .08	46.09	46.40	- .02	- .08	46.30	51.10	- .01	- .14	50.95	56.50		- .14	56.36	57.25	65
27	46.30	- .04	- .09	46.17	47.10	- .02	- .10	46.98	52.20	- .01	- .15	52.04	55.60		- .18	55.42	57.25	67
July 4	46.30	- .04	- .06	46.20	47.50	- .02	- .06	47.42	52.34	.00	- .08	52.26	55.10		- .08	55.02	55.75	60
11	46.30	- .06	- .06	46.18	48.10	- .02	- .07	48.01	52.50	.00	- .08	52.42	54.60		- .08	54.52	54.25	60
18	46.40	- .05	- .09	46.26	48.45	- .02	- .09	48.34	52.70	.00	- .13	52.57	55.80		- .16	55.64	59.50	65
25																		
Aug. 1	46.70	- .06	- .16	46.58	49.20	- .02	- .20	48.98	54.30	- .01	- .31	53.98	58.40		- .42	57.98	64.25	81
8	46.50	- .07	- .08	46.35	49.50	- .02	- .10	49.38	54.90	- .01	- .12	54.77	58.60		- .11	58.49	61.25	65
15	46.80	- .07	- .10	46.63	50.00	- .02	- .14	49.94	55.35	.00	- .19	55.16	58.60		- .22	58.38	64.25	71
22																		
29	47.10	- .07	- .14	46.99	50.80	- .02	- .16	50.62	55.80	.00	- .24	55.56	58.10		- .34	57.76	60.00	76
Sept. 5	41.10	- .07	- .04	46.99	50.90	- .02	- .03	50.85	55.70	.00	.00	55.70	57.60		+ .04	57.64	54.75	56
12	47.30	- .07	- .14	47.09	51.26	- .01	- .17	51.08	55.70	.00	- .23	55.47	56.72		- .31	56.41	57.80	75
19	47.40	- .07	- .02	47.31	51.30	- .01	.00	51.29	55.30	.00	+ .03	55.27	56.70		+ .09	56.79	51.25	52
26	47.50	- .06	- .04	47.40	51.50	- .01	- .03	51.46	55.10	.00	- .01	55.09	55.00		- .02	54.98	50.25	56
Oct. 3	47.60	- .06	- .03	47.51	51.55	- .01	- .02	51.52	54.30	.00	- .01	54.29	53.10		- .03	53.07	49.25	55
10	47.80	- .05	- .05	47.70	51.65	.00	- .04	51.61	53.51	.00	- .04	53.47	52.10		- .09	52.01	50.00	58
17	47.87	- .04	- .04	47.79	51.55	.00	- .02	51.53	52.90	.00	- .03	52.87	51.70		- .04	51.66	50.02	55
24	47.96	- .04	+ .01	47.93	51.40	.00	+ .03	51.37	52.10	.00	+ .06	52.16	48.90		+ .04	48.94	40.25	46
31	48.10	- .02	+ .01	48.09	51.22	+ .01	+ .05	51.16	50.80	+ .01	+ .06	50.87	46.50		+ .01	46.51	42.25	45
Nov. 7	48.12	- .01	+ .03	48.10	50.95	+ .01	+ .06	50.88	49.80	.00	+ .06	49.86	47.00		+ .05	47.05	40.50	43
14	48.25	- .01	+ .01	48.25	50.65	+ .01	+ .04	50.60	49.10	.00	+ .03	49.13	46.10		+ .01	46.11	39.25	45
21	48.30	- .01	+ .04	48.33	50.28	+ .01	+ .07	50.20	48.20	+ .01	+ .06	48.27	44.31		+ .04	44.35	34.75	40

## CRAIGLEITH.

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T.$
1837.																		
Feb. 4	46.54	+ .03	+ .02	46.59	43.54	.00	.00	43.54	41.02	.00	.00	41.02	39.15	.00	- .01	39.14		42?
12	46.30	+ .02	+ .02	46.34	42.90	.00	+ .01	42.91	41.42		.00	41.42	40.69		.00	40.69		40
21	46.02	+ .02	+ .01	46.05	42.88	.00	.00	42.88	41.52		.00	41.52	40.18		- .01	40.17		42
27	45.87	+ .03	+ .01	45.91	42.76	.00	.00	42.76	40.47		- .01	40.46	38.21		- .02	38.19		42
Mar. 6	45.69	+ .02	+ .01	45.72	42.70	.00	.00	42.70	40.77		- .01	40.76	39.50		- .02	39.48		44
13	45.57	+ .02	.00	45.59	42.63	.00	.00	42.63	40.93		- .01	40.92	39.10		- .03	39.07		45
20	45.38	+ .03	+ .01	45.42	42.15	.00	.00	42.15	39.70		.00	39.70	38.00		- .02	37.98		42
27	45.22	+ .03	+ .02	45.27	41.98	.00	.00	41.98	39.71		.00	39.71	37.70		.00	37.70		38
Apr. 4	45.02	+ .03	+ .02	45.07	41.84	.00	.00	41.84	39.52		.00	39.52	37.86		.00	37.86		38
10	44.92	+ .03	- .01	44.94	41.74	.00	- .01	41.73	39.77		- .02	39.75	38.73		- .04	38.69		48
17	44.71	+ .02	+ .01	44.74	41.73	.00	.00	41.73	40.42		- .01	40.41	39.68		- .01	39.67		43
24	44.60	+ .02	- .01	44.61	41.68	.00	- .01	41.67	41.38		- .03	41.35	41.25		- .04	41.21		49
May 1	44.50	+ .01	- .03	44.48	42.10	.00	- .02	42.08	42.52		- .05	42.47	43.15		- .09	43.06		57
8	44.37	+ .01	.00	44.38	42.62	.00	.00	42.62	43.60		.00	43.60	44.45		- .01	44.44		45

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$
1837.																		
May 15	44.36	+01	-03	44.34	43.10	.00	-02	43.08	44.00	.00	-06	43.94	44.39	.00	-09	44.30	c	57
22	44.38	.00	-03	44.35	43.57	.00	-02	43.55	45.28		-07	45.21	46.58		-09	46.49		58
30	44.44	-01	-04	44.39	44.19	.00	-04	44.15	46.18		-10	46.08	47.68		-14	47.54		64
June 5	44.53	-01	-04	44.48	44.66	.00	-04	44.62	47.10		-11	46.99	49.05		-15	48.90		64
12	44.67	-01	-06	44.60	45.28	.00	-07	45.21	47.87		-14	47.73	49.68		-19	49.49		69
19	44.88	-02	-07	44.79	46.25	-01	-08	46.16	49.90		-16	49.74	52.40		-21	52.19		70
27	45.04	-02	-06	44.96	46.84	-01	-07	46.76	51.00		-12	50.88	54.00		-14	53.86		65
July 3	45.22	-03	-07	45.12	47.45	-01	-10	47.34	51.50		-18	51.32	53.98		-23	53.75		72
10	45.50	-03	-08	45.39	48.12	-01	-12	47.99	52.10		-20	51.90	54.60		-25	54.35		74
17	45.77	-03	-08	45.66	48.82	-01	-10	48.71	52.81		-15	52.66	Above Scale.					69
24	46.10	-03	-08	45.99	49.68	-01	-12	49.55	Above Scale.									71
31	46.38	-03	-05	46.30	50.17	-01	-06	50.10										60
Aug. 7	46.72	-03	-09	46.60	50.62	-01	-11	50.50										71
14	46.94	-03	-09	46.82	50.47	-01	-11	50.35										70
21	47.15	-03	-07	47.05	50.66	.00	-08	50.58										65
28	47.35	-03	-04	47.28	51.00	.00	-04	50.90					54.60		-04	54.56		58
Sept. 4	47.58	-03	-04	47.51	51.00	.00	-05	50.95					53.40		-08	53.32		60
12	47.84	-02	-07	47.75	51.00	.00	-08	50.92	52.83		-11	52.72	53.50		-13	53.37		65
19	48.02	-02	-04	47.96	51.00	.00	-04	50.96	52.30		-05	52.25	52.45		-06	52.39		57
25	48.12	-02	-04	48.06	50.70	.00	-05	50.65	52.37		-07	52.30	52.62		-07	52.55		59
Oct. 2	48.25	-02	-06	48.17	50.60	.00	-06	50.54	51.72		-09	51.63	51.46		-12	51.34		62
10	48.34	-01	-05	48.28	50.45	.00	-06	50.39	51.85		-07	51.78	52.10		-09	52.01		60
17	48.39	-01	-04	48.34	50.37	.00	-04	50.33	51.18		-06	51.12	50.69		-08	50.61		58
23	48.42	-01	-01	48.40	50.16	.00	.00	50.16	50.66		.00	50.66	49.95		.00	49.95		50
30	48.45	-01	.00	48.44	49.83	.00	+01	49.84	49.30		+01	49.31	47.08		-01	47.07		48
Nov. 6	48.47	.00	+02	48.49	49.22	.00	+03	49.25	47.50		+03	47.53	46.70		+03	46.73		43
13	48.40	.00	+05	48.45	48.54	.00	+06	48.60	47.27		+07	47.34	45.35		+07	45.42		36
20	48.40	+01	+03	48.44	47.90	.00	+03	47.93	45.70		+03	45.73	43.40		+01	43.41		41
27	48.27	+01	+04	48.32	47.20	.00	+03	47.23	45.10		+03	45.13	42.95		+03	42.98		39
Dec. 4	48.37	+01	+05	48.43	46.84	.00	+04	46.88	44.43		+03	44.46	42.55		+04	42.59		37
11	48.00	+02	+05	48.07	46.10	.00	+04	46.14	43.60		+04	43.64	41.20		+03	41.23		36
18	47.17	+01	-01	47.17	45.70	.00	-01	45.69	43.18		-03	43.15	41.70		-05	41.65		50
25	47.61	+03	-01	47.63	45.21	.00	-01	45.20	43.57		-03	43.54	42.90		-05	42.85		50
1838.																		
Jan. 2	47.33	+01	+02	47.36	45.24	.00	+01	45.25	44.17		+01	44.18	43.00		+01	43.01		41
8	47.14	+01	+05	47.20	45.15	.00	+03	45.18	43.60		+04	43.64	41.48		+04	41.52		34
15	46.92	+02	+07	47.01	44.87	.00	+05	44.92	42.34		+05	42.39	39.40		+04	39.44		29
22	46.77	+02	+04	46.83	44.35	+01	+01	44.37	41.15		+01	41.16	37.85		.00	37.85		38
29	46.65	+03	+04	46.72	43.42	+01	+01	43.44	40.00		+01	40.01	37.27		+01	37.28		35
Feb. 5	46.45	+03	+04	46.52	42.85	+01	+01	42.87	39.62		+01	39.63	37.00		.00	37.00		37
12	46.20	+03	+06	46.29	42.32	+01	+01	42.34	39.00		+02	39.02	36.45		+02	36.47		30
19	45.90	+03	+02	45.95	42.14	+01	.00	42.15	38.50		.00	38.50	35.36		-01	35.35		38
26	45.68	+03	+05	45.76	41.42	+01	+01	41.44	37.75		+01	37.76	35.10		-01	35.09		31
Mar. 5	45.45	+04	+02	45.51	40.80	+01	.00	40.81	37.45		.00	37.45	35.50		-01	35.49		39
12	45.20	+03	+01	45.24	40.70	.00	.00	40.70	38.08		-01	38.07	37.15		-02	37.13		43
19	44.92	+03	-01	44.94	40.07	.00	.00	40.07	39.20		-02	39.18	38.17		-03	38.14		47
26	44.65	+03	.00	44.68	40.85	.00	.00	40.85	39.37		-01	39.36	38.38		-03	38.35		45
Apr. 2	44.40	+02	-01	44.41	41.20	.00	-01	41.19	40.50		-03	40.47	39.80		-05	39.75		50
9	44.30	+02	.00	44.32	41.34	.00	.00	41.34	41.02		-01	41.01	40.58		-02	40.56		45
16	44.20	+01	+01	44.22	41.63	.00	.00	41.63	41.68		+01	41.69	41.88		+01	41.89		40
23	44.07	+01	.00	44.08	41.80	.00	.00	41.80	41.38		-01	41.37	40.90		-02	40.88		44
30	44.02	+01	.00	44.03	42.05	.00	.00	42.05	42.10		-01	42.09	42.05		-02	42.03	39.0	45
May 8	44.04	+01	-06	43.99	42.38	.00	-04	42.34	43.35		-13	43.22	45.00?		-22	44.78	42.3	73
14	44.00	.00	-01	43.99	42.85	.00	-01	42.84	44.58		-01	44.57	45.62		-01	45.61	43.2	47
21	44.03	.00	-02	44.01	43.38	.00	-01	43.37	44.45		-04	44.41	45.20		-06	45.14	46.0	52
28	44.17	.00	-02	44.15	43.85	.00	-01	43.84	45.15		-04	45.11	46.58		-05	46.53	47.4	52
June 4	44.23	.00	-03	44.20	44.22	.00	-03	44.19	45.80		-06	45.74	47.25		-10	47.15	49.2	57
11	44.32	-01	-02	44.29	44.68	.00	-02	44.66	46.85		-04	46.81	48.73		-05	48.68	50.0	54
18	44.54	-01	-01	44.52	45.44	.00	-02	45.42	47.90		-03	47.87	50.10		-02	50.08	51.3	52
25	44.70	-01	-04	44.65	46.03	.00	-06	45.97	48.80		-10	48.70	51.10		-15	50.95	54.2	63
July 2	44.88	-02	-02	44.84	46.65	-01	-02	46.62	49.70		-03	49.67	51.77		-02	51.75	52.2	54
9	45.08	-02	-07	44.99	47.15	-01	-09	47.05	50.40		-17	50.23	53.08		-23	52.85	57.2	70
16	45.27	-03	-05	45.19	47.65	-01	-05	47.59	51.20		-10	51.10	53.75		-11	53.64	56.4	62
23	45.47	-03	-03	45.41	48.14	-01	-04	48.09	51.33		-05	51.28	53.17		-05	53.12	54.4	57

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$
1838.																		
July 30	45.74	-.03	-.05	45.66	48.54	-.01	-.07	48.46	51.32	-.00	-.10	51.22	53.02	-.00	-.13	52.89	56.1	63
Aug. 6	46.00	-.03	-.06	45.91	48.82	-.01	-.08	48.73	51.74		-.12	51.62	54.00		-.15	53.85	56.0	65
13	46.25	-.03	-.06	46.16	49.17	-.01	-.07	49.09	52.15		-.10	52.05	54.22		-.13	54.09	55.2	63
20	46.45	-.03	-.05	46.37	49.45	.00	-.06	49.39	52.05		-.07	51.98	53.62		-.08	53.54	55.2	60
27	46.73	-.03	-.08	46.62	49.68	.00	-.10	49.58	52.07		-.15	51.92	53.52		-.20	53.32	56.3	69
Sept. 3	46.90	-.03	-.06	46.81	49.80	.00	-.08	49.72	52.08		-.11	51.97	53.25		-.15	53.10	53.2	64
10	47.26	-.02	-.04	47.20	50.19	.00	-.04	50.15	51.75		-.04	51.71	52.00		-.06	51.94	48.4	57
17	47.28	-.02	-.04	47.22	49.85	.00	-.04	49.81	51.45		-.05	51.40	52.80		-.05	52.75	53.2	57
24	47.43	-.02	-.05	47.36	49.89	.00	-.05	49.84	51.35		-.08	51.27	51.88		-.10	51.78	51.1	60
Oct. 1	47.55	-.02	-.04	47.49	49.84	.00	-.04	49.80	51.10		-.06	51.04	51.90		-.07	51.83	52.2	58
8	47.62	-.01	.00	47.61	49.72	.00	.01	49.73	50.20		+.01	50.21	49.68		+.01	49.69	47.1	49
15	47.72	-.01	-.02	47.69	49.45	.00	-.03	49.42	49.25		-.04	49.21	47.80		-.06	47.74	46.0	54
22	47.80	-.01	-.04	47.75	49.07	.00	-.04	49.03	48.60		-.06	48.54	48.16		-.09	48.07	49.2	57
29	47.78	-.01	+.01	47.78	48.76	.00	+.01	48.77	48.64		+.02	48.66	47.90		+.02	47.92	44.0	46
Nov. 5	47.85	.00	.00	47.85	48.48	.00	.00	48.48	47.20		.00	47.20	45.68		-.01	45.67	43.3	47
12	47.82	+.01	+.05	47.88	47.92	.00	+.05	47.97	46.32		+.06	46.38	44.70		+.08	44.78	37.3	36
19	47.74	+.01	+.04	47.79	47.43	.00	+.03	47.46	45.40		+.03	45.43	43.08		+.02	43.10	37.3	40
26	47.62	+.01	+.01	47.64	46.50	+.01	+.01	46.52	43.72		.00	43.72	41.42		-.03	41.39	40.2	45
Dec. 3	47.57	+.01	.00	47.58	46.12	.00	-.01	46.11	43.78		-.02	43.76	43.02		-.04	42.98	42.2	48
10	47.35	+.01	.00	47.36	45.85	.00	-.01	45.84	43.83		-.02	43.81	42.40		-.04	42.36	41.3	48
17	47.14	+.01	+.03	47.18	45.55	.00	+.02	45.57	43.40		+.01	43.41	41.68		+.01	51.69	38.3	40
27	46.95	+.02	+.03	47.00	44.85	.00	+.02	44.87	42.38		+.01	42.39	40.50		+.01	40.51	36.2	38
31	46.84	+.02	+.03	46.89	44.64	.00	+.01	44.65	22.12		+.01	42.13	40.85		+.01	40.86	36.3	39
1839.																		
Jan. 7	46.68	+.02	+.02	46.72	44.21	.00	+.01	44.22	41.77		+.01	41.78	40.00		.00	40.00	36.2	40
14	46.48	+.02	+.02	46.52	43.70	.00	+.01	43.71	40.95		.00	40.95	39.90		.00	39.90	37.4	40
21	46.28	+.03	+.02	46.33	43.40	+.01	+.01	43.42	40.25		.00	40.25	38.25		.00	38.25	34.3	39
28	46.06	+.03	+.03	46.12	43.07	+.01	+.01	43.09	40.04		+.01	40.05	38.02		+.01	38.03	33.0	36
Feb. 4	45.85	+.03	+.01	45.89	42.58	+.01	.00	42.59	39.28		.00	39.28	37.24		-.02	37.22	33.4	41
11	45.67	+.03	.00	45.70	42.12	.00	-.01	42.11	39.70		-.02	39.68	39.12		-.04	39.08	39.0	46
18	45.43	+.03	+.03	45.49	42.07	.00	+.01	42.08	40.10		+.01	40.11	38.90		+.02	38.92	34.0	35
25	45.23	+.03	+.01	45.26	41.95	.00	.00	41.95	39.33		-.01	39.32	37.98		-.02	37.96	35.0	42
Mar. 4	45.00	+.03	+.01	45.04	41.84	.00	.00	41.84	39.67		-.01	39.66	38.78		-.02	38.76	37.1	43
11	44.80	+.03	+.01	44.84	41.75	.00	.00	41.75	39.30		-.01	39.29	37.42		-.02	37.40	34.3	42
19	44.70	+.03	-.01	44.72	41.60	.00	.00	41.60	39.45		-.02	39.43	38.57		-.04	38.53	36.2	47
25	44.55	+.02	+.01	44.58	41.37	.00	.00	41.37	39.75		.00	39.75	39.43		-.02	39.41	36.4	42
Apr. 1	44.37	+.02	+.01	44.40	41.45	.00	.00	41.45	40.08		.00	40.08	39.22		-.01	39.21	36.3	40
8	44.22	+.02	-.01	44.23	41.55	.00	.00	41.55	39.68		-.02	39.66	38.65		-.05	38.60	47.2	49
15	44.10	+.02	-.01	44.11	41.45	.00	.00	41.45	40.26		-.02	40.24	40.98		-.05	40.93	41.3	48
22	44.00	+.01	-.02	43.99	41.68	.00	-.01	41.67	41.21		-.04	41.17	41.70		-.08	41.62	43.4	53
29	43.92	+.01	-.03	43.90	41.98	.00	-.02	41.96	42.32		-.06	42.26	43.41		-.11	43.30	46.2	57
May 6	43.90	.00	-.03	43.87	42.74	.00	-.02	42.72	43.40		-.06	43.34	43.80		-.10	43.70	45.2	56
13	43.88	.00	-.01	43.87	43.10	.00	-.01	43.09	43.90		-.03	43.87	44.06		-.13	43.93	44.0	50
21	43.93	.00	-.03	43.90	43.34	.00	-.03	43.31	44.15		-.07	44.08	45.50		-.12	45.38	47.3	58
27	43.98	.00	-.04	43.94	43.62	.00	-.04	43.58	44.80		-.09	44.71	46.10		-.16	45.94	48.4	63
June 3	44.07	-.01	-.02	44.04	44.04	.00	-.02	44.02	45.77		-.06	45.71	47.17		-.08	47.09	46.4	55
10	44.17	-.01	-.03	44.13	44.52	.00	-.03	44.49	46.58		-.07	46.51	48.60		-.10	48.50	49.4	58
17	44.31	-.01	-.06	44.24	45.05	.00	-.07	44.98	47.38		-.15	47.23	49.82		-.23	49.59	55.3	70
24	44.53	-.01	-.05	44.47	45.84	-.01	-.07	45.76	49.04		-.13	48.91	51.35		-.18	51.17	54.2	66
July 1	44.68	-.02	-.06	44.60	46.40	-.01	-.08	46.31	49.60		-.15	49.45	51.75		-.21	51.54	54.0	69
7	44.82	-.02	-.06	44.74	46.85	-.01	-.08	46.76	50.49		-.15	50.34	53.50		-.19	53.31	57.0	68
15	45.20	-.03	-.04	45.13	47.87	-.01	-.05	47.81	51.42		-.08	51.34	53.72		-.08	53.64	54.3	60
22	45.33	-.03	-.05	45.25	48.10	-.01	-.07	48.02	51.49		-.11	51.38	53.84		-.12	53.72	56.4	63
29	45.58	-.03	-.06	45.49	48.57	-.01	-.09	48.47	52.10		-.14	51.96	54.68		-.17	54.51	57.0	67
Aug. 5	45.87	-.03	-.08	45.76	49.04	-.01	-.11	48.92	52.47		-.18	52.29	54.70		-.23	54.47	56.4	71
14	46.17	-.03	-.05	46.09	49.44	.00	-.06	49.38	52.50		-.08	52.42	54.15		-.08	54.07	53.3	60
19	46.35	-.03	-.03	46.29	49.58	.00	-.03	49.55	52.10		-.04	52.06	53.27		-.04	53.23	52.3	56
26	46.62	-.03	-.06	46.53	49.68	.00	-.07	49.61	51.92		-.10	51.82	53.43		-.13	53.30	54.4	63
Sept. 3	46.85	-.02	-.05	46.78	49.78	.00	-.06	49.72	52.03		-.08	51.95	53.27		-.11	53.16	53.3	61
10	47.07	-.02	-.06	46.99	49.90	.00	-.07	49.83	51.95		-.09	51.86	53.17		-.12	53.05	53.4	62
16	47.28	-.02	-.04	47.22	50.09	.00	-.04	50.05	51.67		-.04	51.63	52.30		-.06	52.24	52.1	57
23	47.37	-.02	-.06	47.29	49.94	.00	-.07	49.87	51.30		-.10	51.20	51.67		-.13	51.54	51.0	62
30	47.47	-.02	-.04	47.41	49.78	.00	-.04	49.74	50.88		-.06	50.82	51.17		-.09	51.08	50.0	58
Oct. 7	47.60	-.01	-.04	47.55	47.65	.00	-.03	49.62	50.05		-.06	49.99	49.17		-.09	49.08	48.2	57



Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$
1839.																		
Oct. 14	47.66	-.01	-.02	47.63	49.34	.00	-.02	49.32	49.62	.00	-.02	49.60	49.64	.00	-.03	49.61	49.0	53
21	47.62	-.01	-.03	47.58	49.15	.00	-.03	49.12	49.12		-.05	49.07	48.20		-.08	48.12	46.2	56
28	47.80	-.01	.00	47.79	48.88	.00	.00	48.88	48.77		.00	48.77	48.37		-.01	48.36	45.1	49
Nov. 4	47.77	.00	.00	47.77	48.59	.00	+.01	48.60	47.94		+.01	47.95	46.98		.00	46.98	45.1	47
11	47.80	.00	.00	47.80	48.27	.00	.00	48.27	47.47		-.01	47.46	46.98		-.01	46.97	44.3	48
18	47.77	.00	.00	47.77	47.97	.00	.00	47.97	47.20		-.01	47.19	46.65		-.01	46.64	44.2	48
25	47.68	.00	+.03	47.71	47.68	.00	+.03	47.71	46.55		+.04	46.59	45.30		+.04	45.34	41.3	40
Dec. 2	47.60	+.01	+.06	47.67	47.20	.00	+.05	47.25	45.16		+.06	45.22	43.30		+.07	43.37	36.2	34
9	47.47	+.01	+.05	74.53	46.66	.00	+.05	46.71	44.20		+.05	44.25	41.68		+.06	41.74	35.2	34
16	47.43	+.02	+.03	47.48	45.94	.00	+.02	45.96	43.48		+.01	43.49	42.26		+.01	42.27	39.3	40
23	47.28	+.02	.00	47.30	45.50	.00	.00	45.50	43.40		-.01	43.39	42.68		-.02	42.66	42.1	46
30	47.03	+.02	+.06	47.11	45.25	.00	+.04	45.29	43.00		+.05	43.05	40.50		+.06	40.56	33.1	32
1840.																		
Jan. 6	46.90	+.02	+.05	46.97	44.63	.00	+.03	44.66	42.20		+.03	42.23	40.39		+.04	40.43	34.2	34
13	46.69	+.02	-.01	46.70	44.27	.00	-.01	44.26	41.63		-.03	41.60	40.73		-.06	40.67	41.0	50
20	46.53	+.02	+.02	46.57	43.96	.00	+.01	43.97	41.88		+.01	41.89	40.83		+.01	40.84	37.1	40
27	46.32	+.02	+.04	46.38	43.73	.00	+.02	43.75	41.60		+.02	41.62	40.20		+.03	40.23	34.4	35
Feb. 3	46.14	+.03	+.02	46.19	43.41	.00	+.01	43.42	40.62		.00	40.62	39.00		-.01	38.99	36.3	40
10	45.97	+.03	.00	46.00	43.03	.00	.00	43.03	40.62		-.01	40.61	39.40		-.03	39.37	38.0	45
17	45.73	+.02	+.01	45.76	42.94	.00	.00	42.94	41.00		-.01	40.99	40.64		-.02	40.62	40.1	44
24	45.50	+.02	+.02	45.54	42.92	.00	+.01	42.93	40.80		.00	40.80	38.92		-.01	38.91	34.4	40
Mar. 2	45.34	+.03	+.01	45.38	42.65	.00	.00	42.65	39.92		.00	39.92	37.82		-.01	37.81	34.0	41
9	45.20	+.03	-.03	45.20	42.29	.00	-.02	42.27	39.54		-.04	39.50	38.00		-.09	37.91	37.4	56
17	45.02	+.02	-.03	45.01	42.04	.00	-.02	42.02	40.44		-.04	40.40	40.46		-.10	40.36	40.4	56
24	44.80	+.02	.00	44.82	42.14	.00	.00	42.14	40.76		-.01	40.75	39.97		-.04	39.93	37.2	46
30	44.68	+.02	.00	44.70	42.16	.00	.00	42.16	41.00		-.02	40.98	41.28		-.03	41.25	42.0	46
April 6	44.55	+.01	-.01	44.55	42.34	.00	-.01	42.33	41.70		-.02	41.68	41.95		-.05	41.90	42.3	49
14	44.45	+.01	-.02	44.44	42.55	.00	-.01	42.54	42.38		-.04	42.34	43.10		-.08	43.02	46.1	53
20	44.41	.00	-.04	44.37	42.82	.00	-.03	42.79	43.18		-.07	43.11	43.88		-.12	43.76	44.2	59
27	44.40	.00	-.05	44.35	43.22	.00	-.04	43.18	44.32		-.11	44.21	46.22		-.19	46.03	52.1	66
May 4	44.38	-.01	-.02	44.35	43.76	.00	-.02	43.74	45.56		-.04	45.52	47.56		-.06	47.50	48.4	54
11	44.40	.00	.00	44.40	44.32	.00	.00	44.32	45.38		+.01	45.39	45.20		+.01	45.21	41.3	44
19	44.60	.00	-.02	44.58	44.60	.00	-.02	44.58	45.38		-.04	45.34	45.93		-.07	45.86	44.0	53
25	44.64	-.01	-.03	44.60	44.70	.00	-.03	44.67	45.89		-.05	45.84	47.38		-.08	47.30	48.3	55
June 1	44.72	-.01	-.05	44.66	45.05	.00	-.05	45.00	46.65		-.10	46.55	48.68		-.15	48.53	53.3	63
8	44.84	-.01	-.05	44.78	45.57	.00	-.06	45.51	47.66		-.11	47.55	49.56		-.17	49.39	53.1	65
15	44.94	-.01	-.06	44.87	45.98	.00	-.06	45.92	48.48		-.12	48.36	50.50		-.18	50.32	52.4	65
22	45.18	-.02	-.06	45.10	46.49	.00	-.07	46.42	49.03		-.12	48.91	50.78		-.17	50.61	53.2	65
29	45.26	-.02	-.06	45.18	46.94	.00	-.08	46.86	49.42		-.14	49.28	51.76		-.19	51.57	55.1	67
July 6	45.50	-.02	-.05	45.43	47.55	.00	-.05	47.50	50.26		-.08	50.18	52.10		-.10	52.00	54.4	60
13	45.63	-.02	-.05	45.56	47.84	.00	-.06	47.78	50.70		-.09	50.61	52.90		-.12	52.78	53.0	62
20	45.88	-.02	-.07	45.79	48.30	.00	-.10	48.20	51.32		-.16	51.16	53.68		-.21	53.45	56.2	69
27	46.05	-.03	-.07	45.95	48.68	.00	-.08	48.60	51.70		-.12	51.58	53.90		-.15	53.75	56.0	65
Aug. 3	46.26	-.03	-.08	46.15	49.10	.00	-.10	49.00	52.20		-.17	52.03	54.39		-.21	54.18	58.0	69
10	46.47	-.03	-.07	46.37	49.45	-.01	-.09	49.35	52.76		-.12	52.64	55.58		-.15	55.43	59.0	66
18	46.78	-.03	-.07	46.68	50.09	.00	-.08	50.01	52.95		-.11	52.84	54.28		-.14	54.14	56.3	64
24	46.93	-.03	-.07	46.83	50.11	.00	-.09	50.02	52.97		-.13	52.84	54.81		-.16	54.65	54.3	66
31	47.15	-.03	-.07	47.05	50.34	.00	-.09	50.25	53.00		-.12	52.88	54.80		-.14	54.66	52.0	65
Sept. 8	47.35	-.03	-.06	47.26	50.46	.00	-.07	50.39	52.70		-.09	52.61	53.72		-.11	53.61	50.1	62
14	47.50	-.02	-.05	47.43	50.44	.00	-.05	50.39	52.16		-.06	52.10	52.58		-.07	52.51	46.3	58
21	47.68	-.02	-.03	47.63	50.34	.00	-.03	50.31	52.30		-.03	52.27	51.36		-.05	51.31	47.0	55
28	47.83	-.02	-.07	47.74	50.14	.00	-.08	50.06	50.79		-.11	50.68	50.75		-.16	50.59	47.0	64
Oct. 4	47.88	-.01	-.02	47.85	49.88	.00	-.02	49.86	50.13		-.02	50.11	49.56		-.03	49.53	42.0	53
12	47.95	-.01	-.01	47.93	49.55	.00	.00	49.55	49.42		-.01	49.41	48.92		-.01	48.91		50
19	48.00	-.01	-.02	47.97	49.23	.00	-.02	49.21	49.08		-.02	49.06	49.00		-.03	48.97		52
26	47.98	.00	.00	47.98	48.95	.00	.00	48.95	48.46		.00	48.46	46.98		-.01	46.97		48
Nov. 2	48.02	.00	-.02	48.00	48.55	.00	-.01	48.54	47.50		-.03	47.47	46.60		-.05	46.55		52
9	47.92	.00	+.01	47.93	48.18	.00	+.01	48.19	47.08		+.01	47.09	45.70		+.01	45.71		45
16	47.94	+.01	.00	47.95	47.74	.00	.00	47.74	46.10		-.01	46.09	44.30		-.03	44.27		48
24	47.82	+.01	+.02	47.85	47.14	.00	+.01	47.15	44.78		+.01	44.79	43.01		-.01	43.00		44
30	47.70	+.01	-.02	47.69	46.84	.00	-.02	46.82	44.68		-.04	44.64	42.18		-.07	42.11		52
Dec. 7	47.54	+.01	+.01	47.56	46.34	.00	.00	46.34	44.30		.00	44.30	43.25		-.02	43.23		45
14	47.34	+.01	+.05	47.40	46.00	.00	+.04	46.04	43.88		+.04	43.92	41.88		+.05	41.93		35
21	47.25	+.02	+.04	47.31	45.40	.00	+.03	45.43	42.76		+.03	42.79	40.90		+.03	40.93		36

Dates.	$t_1$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_1$ cor- rected.	$t_2$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_2$ cor- rected.	$t_3$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_3$ cor- rected.	$t_4$ uncor- rected.	Cor. for Col.	Cor. for Air.	$t_4$ cor- rected.	$t_5$	$T$ .
1840. Dec. 28	47.02	+02	+05	47.09	45.04	+01	+03	45.08	41.70	-00	+03	41.73	38.98	-00	+03	39.01		33
1841. Jan. 4	46.87	+03	+05	46.95	44.30	-00	+02	44.32	41.15	-00	+02	41.17	39.40		+02	39.42		35
12	46.58	+03	+05	46.66	43.84	+01	+02	43.87	40.15	-00	+02	40.17	37.17		+01	37.18		34
18	46.44	+03	+05	46.52	43.12	+01	+02	43.15	39.38	-00	+02	39.40	36.78		+02	36.80		32
25	41.15	+03	+04	46.22	42.75	+01	+02	42.78	38.98	-00	+01	38.99	36.50		+01	36.51		33
Feb. 1	45.90	+03	+04	45.97	42.32	-00	+01	42.33	39.28	-00	+01	39.29	38.28		+02	38.30		34
8	45.60	+03	+05	45.68	42.13	-00	+01	42.14	39.13	-00	+02	39.15	37.03		+03	37.06		31
15	45.45	+03	+01	45.49	41.68	-00	-00	41.68	38.92	-00	-01	38.91	38.40		-03	38.37		43
22	45.22	+03	-01	45.24	41.64	-00	-01	41.63	39.92	-00	-02	39.90	39.45		-06	39.39		49
Mar. 2	44.93	+02	+01	44.96	41.93	-00	-00	41.93	40.48	-00	-01	40.47	39.60		-01	39.57		42
8	44.80	+02	-03	44.79	42.02	-00	-01	42.01	40.48	-00	-04	40.44	40.28		-09	40.19		55
15	44.66	+01	-02	44.65	42.14	-00	-01	42.13	41.74	-00	-04	41.70	42.58		-09	42.49		54
22	44.54	+01	-02	44.53	42.54	-00	-01	42.53	42.70	-00	-03	42.67	43.20		-06	43.14		51
29	44.48	+01	-03	44.46	42.94	-00	-02	42.92	43.31	-00	-06	43.25	43.97		-10	43.87		56
Apr. 5	44.45	+01	-01	44.45	43.25	-00	-01	43.24	43.38	-00	-02	43.36	43.48		-04	43.44		48
12	44.45	+01	-01	44.45	43.44	-00	-01	43.43	43.48	-00	-02	43.46	43.54		-03	43.51		48
19	44.50	+01	-02	44.49	43.62	-00	-02	43.60	43.85	-00	-04	43.81	44.20		-08	44.12		54
26	44.53	+01	-01	44.53	43.83	-00	-01	43.82	44.10	-00	-03	44.07	44.40		-06	44.34		52
May 3	44.56	-00	-01	44.55	44.08	-00	-01	44.07	45.26	-00	-03	45.23	46.78		-02	46.72		50
10	44.64	-00	-04	44.60	44.54	-00	-04	44.50	45.84	-00	-10	45.74	47.20		-17	47.03		64
17	44.70	-01	-03	44.66	45.02	-00	-04	44.98	47.09	-00	-08	47.01	48.95		-11	48.84		59
24	44.84	-01	-06	44.77	45.62	-00	-08	45.54	47.80	-00	-17	47.63	49.58		-26	49.32		73
31	44.97	-01	-06	44.90	46.14	-00	-07	46.07	48.29	-01	-13	48.15	51.42		-20	51.22		67
June 7	45.12	-02	-03	45.07	46.73	-00	-04	46.69	49.50	-00	-07	49.43	51.19		-08	51.11		58
14	45.30	-02	-04	45.24	47.17	-01	-05	47.11	50.05	-00	-09	49.96	52.48		-11	52.37		61
21	45.52	-02	-06	45.44	47.62	-00	-06	47.56	50.19	-00	-12	50.07	51.94		-16	51.78		65
28	45.72	-02	-04	45.66	47.90	-00	-06	47.84	50.28	-00	-09	50.19	52.00		-12	51.88		62
July 6	45.94	-02	-05	45.87	48.19	-00	-06	48.13	51.02	-00	-09	50.93	53.17		-12	53.05		62
12	46.10	-02	-06	46.02	48.50	-00	-07	48.43	50.97	-00	-11	50.86	52.46		-15	52.31		64
19	46.31	-02	-05	46.24	48.72	-00	-07	48.65	51.18	-00	-10	51.08	53.12		-13	52.99		63
27	46.50	-02	-05	46.43	48.95	-00	-05	48.90	51.40	-00	-08	51.32	53.48		-10	53.38		60
Aug. 2	46.66	-02	-08	46.56	49.18	-00	-10	49.08	51.39	-00	-17	51.22	52.64		-22	52.42		70
9	46.80	-02	-04	46.74	49.27	-00	-05	49.22	51.46	-00	-08	51.38	53.10		-09	53.01		60
16	47.00	-02	-06	46.92	49.45	-00	-07	49.38	51.30	-00	-10	51.20	52.43		-14	52.29		63
23	47.20	-02	-04	47.14	49.71	-00	-05	49.66	51.76	-00	-07	51.69	52.98		-09	52.89		60
30	47.27	-02	-06	47.19	49.68	-00	-08	49.60	51.86	-00	-12	51.74	53.58		-16	53.42		66
Sept. 6	47.36	-01	-06	47.29	49.83	-00	-02	49.81	51.60	-00	-02	51.58	51.98		-04	51.94		55
13	47.55	-02	-08	47.45	49.88	-00	-10	49.78	51.40	-00	-12	51.28	52.94		-21	52.73		69
20	47.66	-02	-06	47.58	49.98	-00	-06	49.92	52.25	-00	-09	52.16	53.82		-11	53.71		62
27	47.80	-02	-02	47.76	50.28	-00	-02	50.26	52.00	-00	-02	51.98	52.68		-01	52.67		54
Oct. 4	47.88	-02	-02	47.84	50.25	-00	-01	50.24	51.55	-00	-00	51.55	51.58		-01	51.57		53
12	48.08	-01	-01	48.06	50.22	-00	-01	50.21	50.58	-00	-00	50.58	50.48		-02	50.46		52
18	48.15	-01	+02	48.16	49.95	-00	+04	49.99	49.73	-00	+05	49.78	48.86		+06	48.92		43
26	48.15	-00	+02	48.17	49.28	-00	+04	49.32	47.96	-00	+04	48.00	46.32		+04	46.36		42
Nov. 1	48.15	-00	-00	48.15	48.75	-00	-00	48.75	46.96	-00	-02	46.94	45.45		-04	45.41		50
9	48.12	+01	-01	49.12	48.06	-00	-01	48.05	46.22	-00	-03	46.19	45.58		-05	45.53		52
15	48.05	+01	+05	48.11	47.54	-00	+05	47.59	45.88	-00	+05	45.93	44.00		+06	44.06		36
22	47.90	+01	+04	47.95	47.04	-00	+03	47.07	43.95	-00	+03	43.98	41.21		+02	41.23		38
29	47.82	+02	+02	47.86	46.03	-00	+01	46.04	42.70	-00	-00	42.70	40.78		-01	40.77		43
Dec. 6	47.64	+02	-00	47.66	45.36	-00	-01	45.35	43.08	-00	-03	43.05	42.43		-05	42.38		49
13	47.38	+02	+02	47.42	45.10	-00	-00	45.10	43.08	-00	-00	43.08	42.02		-00	42.02		42
20	47.14	+02	+06	47.22	44.86	-00	+03	44.89	42.30	-00	+04	42.34	39.90		+05	39.95		32
27	46.95	+03	+03	47.01	44.34	-00	+01	44.35	41.24	-00	+01	41.25	39.26		+01	39.26		37
1842. Jan. 3	46.74	+02	+03	46.79	43.93	-00	+01	43.94	41.61	-00	+01	41.62	40.88		+02	40.90		38
10	46.47	+02	+04	46.53	43.78	-00	+02	43.80	40.85	-00	+03	40.88	38.46		+02	38.48		33
17	46.25	+03	+04	46.32	43.35	+01	+01	43.37	40.03	-00	+01	40.04	37.68		+02	37.68		34
25	46.07	+03	+02	46.12	42.60	-00	-00	42.60	39.57	-00	-00	39.57	37.72		-00	37.72		38
31	45.88	+03	+01	45.92	42.27	-00	-00	42.27	39.19	-00	-00	39.19	37.61		-01	37.60		41
Feb. 7	45.58	+03	+04	45.65	42.19	-00	+01	42.20	39.72	-00	+02	39.74	38.17		+03	38.20		32
15	45.40	+03	-00	45.43	41.85	-00	-00	41.85	39.76	-00	-01	39.75	38.98		-04	38.94		47
21	45.17	+02	+02	45.21	41.90	-00	-00	41.90	40.22	-00	-00	40.22	39.96		+01	39.97		38
Mar. 2	44.90	+02	+01	44.93	42.02	-00	-00	42.02	39.95	-00	-00	39.95	38.82		-00	38.82		40
7	44.88	+02	-01	44.89	41.78	-00	-00	41.78	39.95	-00	-02	39.93	39.62		-05	39.57		49