PHILOSOPHICAL

TRANSACTIONS.

XXII. *An account of experiments for determining the variation in the length of the pendulum vibrating seconds, at the principal stations of the Trigonometrical Survey of Great Britain. By Capt.* HENRY KATER, *F. R. S.*

Read June 24, 1819.

BEFORE I enter upon a detail of the operations which form the subject of this Paper, it may not perhaps be improper to give a brief statement of the occasion to which they owe their origin.

The subject of weights and measures having for some time past been before the British Parliament, an Address was presented to His Royal Highness the Prince Regent, in pursuance of a resolution of the House of Commons of the 15th of March 1816, to the following effect.

"Resolved, that an humble address be presented to His "Royal Highness the Prince Regent, that he will be gra-"ciously pleased to give directions for ascertaining the length "of the pendulum vibrating seconds of time in the latitude "of London, as compared with the standard measure in the

" possession of this house, and for determining the variations
" in length of the said pendulum, at the principal stations of
" the Trigonometrical Survey extended through Great Bri-
" tain; and also for comparing the said standard measures,
" with the ten millionth part of the quadrant of the meridian,
" now used as the basis of linear measure on (*a part of*) the
" continent of Europe."

In consequence of His Royal Highness's compliance with the prayer of this Address, an application was made by His Majesty's Ministers to the Right Honourable Sir Joseph Banks, requesting that the Royal Society would be pleased to afford all the assistance in their power for the accomplishment of the objects therein mentioned; and a Committee was appointed for that purpose, of which I was named a member.

The length of the pendulum vibrating seconds in the latitude of London, and that of the French mêtre having been determined, it remained to ascertain the length of the pendulum at the principal stations of the Trigonometrical Survey.

This work the Royal Society did me the honour to request I would undertake; and the ready compliance of Government with every requisition I made through Sir Joseph Banks, for that assistance without which my success might have been doubtful, led me to devote with pleasure my time and labour to this highly interesting enquiry.

The instruments with which I provided myself were, a transit by Dolland, of three feet and a half in length, constructed on the same principle as the transit at the Royal Observatory at Greenwich, so as admirably to combine lightness with strength.

A repeating circle of one foot diameter by TROUGHTON,

A clock and a box chronometer by ARNOLD, for the loan of which I was indebted to HENRY BROWNE, Esq. F. R. S. and

An invariable pendulum with its support, a description of which will be given hereafter. To these was added, a chest of tools of various kinds.

A small light waggon was constructed at the Royal Arsenal at Woolwich for the conveyance of these instruments, and a party consisting of a non-commissioned officer, two gunners, (one a carpenter), and two drivers with four horses of the Royal Artillery, was placed under my orders: a bell tent, and two others of a smaller description, were issued, which I found particularly useful.

His Royal Highness the Commander in Chief was pleased to direct that I should receive such military assistance as might be necessary for the safety of the instruments at the different stations, and for the use of barracks, where I might find them suited to my experiments; and an application being also made to the Admiralty for a vessel to convey me to the Shetland Islands, His Majesty's sloop of war the Cherokee, commanded by Capt. T. SMITH, was ordered to receive me at Leith, and to bring me back to Scotland.

Thus liberally provided with all that could tend to facilitate the success of my undertaking, I left London on the 24th June with Lieut. FRANKS of the Royal Navy, a gentleman whose fondness for science induced him to accompany me, and arrived at Leith on the evening of the 28th.

Here on enquiry I found that the Cherokee had not been heard of for some time, but the Admiralty having ordered that any requisition I made should be complied with,

and His Majesty's sloop the Nimrod, commanded by Capt. DALLING, being in the harbour, she was directed to prepare immediately for sea, and on the 1st July, her provisions being completed, I embarked for Unst.

Having put into Lerwick for two days, I availed myself of the opportunity to present a letter of introduction to Dr. EDMONDSTONE, and to obtain one from him to his brother THOMAS EDMONDSTONE, Esq. of Unst, to whose hospitality I was aware I must be indebted during my stay on that Island.

On the 9th July we arrived at Unst, having been joined on the voyage by the Cherokee, bearing an order from the Admiral commanding at Leith to relieve the Nimrod. To both Capt. DALLING and Capt. SMITH I feel myself much indebted, not only for their judicious arrangements for the safety of the instruments, but also for the personal kindness and attention I experienced from them.

At Unst, I was welcomed on the beach by Mr. EDMONDSTONE, who had received notice from his brother of my intended visit; and I immediately proceeded to examine the buildings which surrounded this gentleman's house, to select a place proper for my experiments. I at length chose the shell of an unfinished cottage nearly adjoining to the cow-house, in which the preceding summer M. BIOT had made his observations on the pendulum when he visited Shetland on the part of the Institute of France. One wall of this cottage, upwards of three feet thick, was ancient, though the rest of the building was modern, and it seemed to promise sufficient stability for my purpose.

It is now necessary to give a description of the apparatus I employed.

The pendulum was composed of a bar of plate brass 1,6 inches wide, and rather less than the eighth of an inch thick. These dimensions were chosen that the pendulum and the thermometer placed near it, might be affected with equal readiness by any change of temperature. A flat circular weight nicely turned, and pierced in the direction of its diameter to receive the bar, was slid upon it, and fastened with screws and rivets at such a distance from the knife edge which served as the point of suspension, and which will presently be described, as that the pendulum made two vibrations less than the pendulum of the clock, in eight or nine minutes. The inside of the weight having been previously tinned, it was exposed to a sufficient degree of heat to solder it to the bar.

That part of the bar which was below the weight, was reduced to the width of 0,7 inch, and covered with black varnish, in order to enable me the better to observe its coincidence with the pendulum of the clock, in the manner which has been fully described in the Philosophical Transactions for 1818, in an " Account of Experiments on the length of the Pendulum vibrating seconds in the latitude of London." With the contents of this Paper I shall suppose a previous acquaintance, as an occasional reference to it will save much repetition.

To the top of the bar, a strong cross piece of brass was firmly rivetted and soldered, and a triangular hole having been made in the bar, a knife edge was passed through it, and a perfect contact between the back of the knife edge and the cross piece was insured by grinding them together. It was then secured in its place by two screws, the heads of

which were sunk in the cross piece, and having been warmed, were dipped in pitch to prevent the possibility of their being loosened by the motion of the waggon.

The knife edge was made of wootz, precisely in the same manner as described in the experiments on the length of the seconds pendulum, its ultimate angle being about 120°. The length of the bar from the knife edge to the extremity was about five feet, and it terminated in an obtuse angle, serving to indicate the arc of vibration. The weight of the whole pendulum was 15 lb. 2 oz.

The perfect immobility of the point of suspension being of the utmost consequence, every precaution was taken by the arrangement of the form, and by the weight of the frame destined to carry the pendulum, to oppose the lateral force which might result from its vibrations.

The frame was of cast iron; the horizontal part was 19 inches long, 17 wide, and half an inch thick. The back, three inches in width, at right angles to the length was pierced with three equi-distant holes in the horizontal direction, to receive very large screws about five inches long, with coarse threads destined to attach the frame to pickets of wood driven into a wall. Two brackets were firmly screwed to the under part of the horizontal frame; these brackets were bevilled so as to spread at the bottom to the width of three feet, thereby opposing more effectually any disposition to lateral motion. In the lower extremities of the brackets, two holes were made for screws similar to those above mentioned. The weight of the frame was 87 lb.

A bell metal support, furnished with agate planes on which the knife edge of the pendulum was to rest, varied but little

from that described in the Philosophical Transactions before referred to. It was contrived in such a manner as to be attached to the iron frame by three screws, and was levelled by placing thin sheets of lead between it and the frame, a method which was preferred from its promising a great degree of firmness.

An arc divided into degrees and tenths for ascertaining the extent of the vibrations of the pendulum, was attached to a piece of wood which fitted into the opening of the door of the clock case.

Expansion of the pendulum.

When the bar of the pendulum was prepared, previous to the weight being soldered to it, its expansion was determined in the same manner as is described in the Philosophical Transactions before referred to. The results were as follow:

Distance between the lines on the Bar 39,54 inches.				
Highest Temp.	Lowest Temp.	Diff. of Temp.	Div. of Microm.	Expansion in parts of the length for each degree.
°	°	°		
125,0	56,3	68,7	648	,00001022
125,0	99,0	26,0	245	,00001021
99,0	73,8	25,2	220	,00000946
73,8	63,0	10,5	91	,00000938
			Mean	,00000982

Hence the expansion of the pendulum appears to be ,00000982 parts of its length for each degree of the thermometer; and the corresponding correction to be applied to the number of vibrations in 24 hours for such change of temperature will be 0,423.

Operations at Unst.

I have remarked, that I selected for my experiments at Unst, an unfinished cottage, one of the walls of which was three feet thick. This was composed of irregular masses of serpentine, which I feared might be loosened by driving in the pickets to which the iron frame was to be screwed. Happily, however, I found the pickets act as wedges, and secure the stones more firmly in their places. The pickets driven into the wall were of oak, and were upwards of three inches in diameter, and more than a foot in length. To these the iron frame was firmly attached by its five screws, and on the evening of the 10th of July, I had the satisfaction of finding it as securely fixed as I could possibly desire.

Two pieces of deal plank two inches and a half thick, were next fastened by long nails to the wall. To these the clock case was screwed at such a distance beneath the iron frame, as that the end of the brass pendulum might reach a little below the centre of the pendulum of the clock, and the clock was then put *in beat*, by moving the bottom of the case to the right or left, and when properly adjusted, the screws were tightened. The bell metal support was next put in its place and carefully levelled, and the pendulum lodged in the Ys elevated for that purpose.

The triangular stand carrying the telescope, described in the paper on the seconds pendulum before referred to, was firmly screwed to pickets driven into the ground at about eight feet and a half in front of the clock; and the Ys which supported the pendulum being lowered till the knife edge rested on the agate planes, the diaphragm of the telescope was

adjusted so as for its edges to coincide exactly with those of the extremity of the pendulum. The next step was to bring in a right line, the telescope, the extremity of the pendulum, and a white circle of the same diameter pasted on a black ground on the centre of the pendulum of the clock. For this purpose both pendulums being at rest, the telescope was slid laterally on its support* until a small particle of the disk was seen, and a mark was made on the support of the telescope with a pencil. The telescope was now slid in the opposite direction till an equal portion of the disk became visible, when another mark was made, and the telescope being placed so as to bisect these two marks, the centre of the object glass would evidently be in the prolongation of a line joining the white disk and the extremity of the pendulum.

The diaphragm was next brought by the circular horizontal movement of the telescope to correspond with the edges of the pendulum, and the divided arc for indicating the extent of the vibrations was placed so that its zero coincided with the extremity of the pendulum.

The same thermometer which was used in my former experiments and for the loan of which I was indebted to the kindness of Dr. WOLLASTON, was suspended on the clock case near the middle of the pendulum, and every thing being thus arranged, the pendulum of the clock was put in motion, and the knife edge elevated by means of the Ys above the agate planes, to prevent any injury when not in use.

A firm support for the transit instrument became the next object of attention, and for this purpose I tried a box nearly

* The wooden support was placed so as for the telescope to be within the limits of the sliding adjustment.

filled with sand, upon which a flat stone was laid. But as this did not prove so steady as I expected, a larger stone was afterwards procured and laid upon the box, and upon this the transit was placed.

The bell tent before mentioned was suspended over the transit from three spars lashed together at the top.

The *interval* of time between the transits of the same star being all that is required for the present purpose, it is not necessary that the transit instrument should be accurately in the meridian; it is sufficient that it should always describe the same vertical circle; it was however brought very near the meridian, at all the stations, by the following method:

The error of the chronometer was determined by altitudes of the sun, and the times were computed when the first and last limb would be on the meridian.

The axis of the transit was carefully levelled, and a little before the time of the sun's first limb coming to the meridian, the middle wire of the transit was brought in contact with it, and kept so by the horizontal adjustment till the calculated time of its arrival on the meridian. The position of the instrument was afterwards farther corrected if necessary by the transit of the second limb. At other of the stations, when the weather permitted, the instrument was brought extremely near the meridian by the transit of the pole star, the telescope being sufficiently powerful to command this star with ease, at any time of the day.

A mark (generally a flat board sharpened at one end to penetrate the ground) was sent to as great a distance as convenient, and so placed by signal, that it was bisected by the middle wire of the transit; and to this the instrument was

carefully adjusted previously to every observation. The preceding detail may serve, with very little difference, for each of the stations, and I have been thus minute in my description of the various adjustments necessary, in order that no difficulty may be experienced by any who may use the pendulum after me.

In observing the time of the transits, the chronometer was used, and was found to be particularly convenient from its beating half seconds. As soon as possible after the passage of the star, the chronometer was carefully compared with the clock, and the difference being applied to the time of the transit shown by the chronometer, and also the computed gain or loss of the clock during the interval between the observation and the comparison; the time shown by the clock at the instant of the transit was obtained.

These comparisons, as well as the whole of the data necessary for the examination of the results given in this paper, will be found in the Appendix.

The climate of Unst, at the season when I visited it, is such as to render the opportunities for celestial observations extremely rare. I had been informed, that the months of July and August were the most favourable, but on the contrary, I learnt on my arrival that they were considered the least so of any of the year, the atmosphere being generally clearest in May and September. Dense fogs and light rains succeeded each other, rarely permitting a sight of the sun; and it was not until the 22d of July, that I was able first to observe the transits of a few stars.

The following table contains the observations for the rate of the clock at Unst, derived from the table of transits given in the Appendix.

Transits observed at UNST.						
Stars.	July 22.	July 24.	July 25.	July 26.	July 27.	July 28.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
*The Sun	. . .	0.13.59,32	. . .	0.15.41,63	. . .	0.17.25,41
Arcturus	6.14.18,14	. . .	. . .	. . .	. . .	5.55.45,27
α Ophiuchi	. . .	. . .	9.23.43,56	. . .	. . .	9.14.30,51
ν Ophiuchi	9.55.36,41	. . .	9.46.18,11	. . .	. . .	9.37. 4,48
η Serpentis	10.18.25,08	. . .	10. 9. 6,1	. . .	. . .	9.59.52,73
α Lyræ	10.37.5	. . .	10.27.44,82	. . .	. . .	10.18.32,11
α Orionis	21.50.15,3	. . .	. . .	. . .	21.34.48,69	. . .

From the above data the following rates of the clock were obtained, by dividing the difference between the times of the transits of each star by the interval in days, and subtracting this from $3^{m}.55^{s},91$, the acceleration of the fixed stars in 24 hours. To this, which is the rate of the clock in a sidereal day, the gain of the clock ($0^{s},14$) in four minutes was added, to obtain the rate for a mean solar day.

Rate of the clock at UNST. (*Gaining.*)							
Stars.	From 22 to 28.	From 22 to 27.	From 22 to 25.	From 25 to 28.	From 24 to 28.	From 24 to 26.	From 26 to 28.
The Sun	. .	. .	. .	. .	51,10	50,10	52,09
Arcturus	50,57	. .	. .	. .	. .	. .	. .
α Ophiuchi	. .	. .	. .	51,70	. .	. .	. .
ν Ophiuchi	50,73	. .	49,95	51,41	. .	. .	. .
η Serpentis	50,66	. .	49,72	51,59	. .	. .	. .
α Lyræ	50,57	. .	49,32	51,81	. .	. .	. .
α Orionis	. .	50,73	. .	. .	. .	. .	. .
Mean by the Stars	50,63	50,73	49,66	51,63	. .	. .	. .
Mean by the Sun.	. .	. .	. .	. .	51,10	50,10	52,09

* To the observations of the sun the equation of time must always be applied, in order to obtain the rate of the clock.

On the 23d July I began to observe coincidences, in the manner described in my Paper on the length of the seconds pendulum. Two series, each of ten intervals were taken each day; these are given at large in the Appendix, the results were as follow:

Vibrations of the pendulum at Unst.
The clock making 86450,63 vibrations in a mean solar day.

Date.		Barometer.	Thermom.	Vibrations in 24 hours.	Correction for Temp.	Vibrations in 24 hours, at 62 degrees.
July 23	P. M.	30,00	58°,4	86093,78	1,52	86092,26
	P. M.	30,30	59,3	86093,14	1,14	86092,00
24	A. M.	29,90	57,3	86093,33	1,99	86091,34
	P. M.	29,82	59,7	86092,45	0,97	86091,48
25	A. M.	29,84	57,7	86093,12	1,82	86091,30
	P. M.	29,72	59,0	86092,24	1,27	86090,97
26	A. M.	29,95	57,8	86092,37	1,78	86090,59
26	The scapement was oiled without stopping the clock.					
27	A. M.	29,95	56,8	86091,69	2,20	86089,49
	P. M.	30,00	57,2	86091,62	2,03	86089,59
28	A. M.	30,15	54,3	86092,51	3,26	86089,25
	P. M.	30,20	58,0	86091,57	1,69	86089,88
Mean		29,98	57,8			86090,74

The numbers in the above Table are deduced from the rate of the clock (gaining 50^s,63) between the 22d and 28th of July. For any other interval and rate, the mean of the vibrations during such interval is taken, and the difference between the corresponding rate and 50^s,63 is added to, or subtracted from such mean number of vibrations accordingly as the rate of the clock has increased or diminished. The same method is pursued in all the subsequent experiments. In this manner the results contained in the next following table under the head of "computed vibrations in a mean solar day" were obtained.

The invariable pendulum furnishes a means of severely checking the rate of the clock; for should any alteration occur, it immediately indicates it. Thus on referring to the preceding table of "vibrations of the pendulum at 62°," it appears that from the 23d to the 28th of July, a gradual increase in the rate of the clock had taken place, amounting in the whole to a quantity equal to 2,5 vibrations of the pendulum, or 0,5 of a vibration in every 24 hours.

The rate of the clock, is that due to the *middle time* of the interval between the transits from which it is deduced. The number of vibrations of the pendulum is obtained for the *mean* of the times at which the coincidences were observed. If this mean should not coincide with the time for which the rate of the clock is obtained, and the rate of the clock should be variable, the number of vibrations of the pendulum computed on such given rate must evidently be erroneous. If the mean of the interval of the transits should be *before* the mean of the times of the coincidences, the number of vibrations will, in the present case of an accelerating rate, be in *defect*. If *after* the mean of the coincidences, they will be in *excess;* and the proportionate change of rate must be added or subtracted accordingly. On this principle the corrections were calculated and the results obtained, which are contained in the following table.

From	To	Computed Vibrations in a mean solar day.	Mean of Transits B or A coincidences.	Correction.	Corrected Vibrations in a mean solar day.	No. of Stars observed.	Inter. of Transit.
By the Stars. UNST.							
July.	July.		h. m.				
23 P. M.	28 P. M.	86090,71	B. 1. 27	+,03	86090,74	4	6
23 P. M.	28 A M.	86090,93	A. 1. 58	—,04	86090,89	1	5
23 P. M.	25 P. M.	86090,59	B. 2. 37	+,05	86090,64	3	3
26 A. M.	28 P. M.	86090,76	B. 5. 52	+,12	86090,88	4	3
By the Sun.							
24 P. M.	28 A. M.	86090,85	A. 1. 20	—,03	86090,82	2	4
24 P. M.	26 A. M.	86090,55	A. 0. 58	—,02	86090,53	2	2
26 P. M.	28 A. M.	86090,90	B. 6. 11	+,12	86091,02	2	2

We have now to consider what authority attaches to each result, so that we may employ all the observations in obtaining a mean, and yet give to each set that degree of weight only to which it is entitled.

The accuracy of any one result will evidently in the first place depend on the number of stars observed from which the rate of the clock is deduced; and on this head as may be seen by examining the table of transits, there is little probability of serious error.

But the position of the transit intrument with respect to the meridian mark, requires the most minute care, and I soon discovered that to this, and to the accurate levelling of the axis, it was necessary to pay unceasing attention, as a deviation equal to the diameter of the silkworm's thread in the focus of the eye glass, would occasion an error in the time of the transit of a star amounting to about three tenths of a second.

The effect of this error on the daily rate of the clock, is lessened in proportion to the number of days comprised between the two transits; for if the rate of the clock be deduced from transits observed on two successive days, the whole amount of the error arising from any deviation of the instrument from the meridian mark, will be included in the rate; but for any longer interval, it is divided by the number of days constituting such interval.

In order therefore to obtain a true mean, it appears that each result should be multiplied by the product of the number of the stars into the interval between the observations, and the sum of such final products be divided by the sum of the factors.

Observations of the sun are perhaps less entitled to credit than those of the stars, as in consequence of an apparent wavering of the meridian mark, some degree of uncertainty frequently exists in adjusting the transit instrument; setting this aside, a transit of both limbs of the sun may be considered equal to the transits of two stars.

Proceeding in the computation in the manner just described, we obtain 86090,77 vibrations of the pendulum in 24 hours, by the observations of the stars, and 86090,79 by those of the sun. But from what has been said, these results are entitled to credit in the ratio of the sums of their factors, that is, as 50 to 16; the final mean is therefore 86090,77 vibrations in a mean solar day.

The force of gravity decreasing as the square of the distance from the earth's centre increases, the next step is to find the correction on this supposition for the height of the station above the level of the sea. As the square of the

number of vibrations of the pendulum represents the force of gravity, we have this simple rule: convert the height of the station into the decimal of a mile, and divide it by the radius of the earth (3954,583) the quotient is the factor by which the number of vibrations in 24 hours being multiplied, the product will be the correction required.

But the quantity thus obtained is evidently erroneous, being founded on the supposition that the experiments are made on an elevation having no attractive matter surrounding it; and it is observed by Dr. YOUNG, in a letter which that eminent mathematician addressed to me, and which is published in the Phil. Trans. for 1819, entitled "Remarks on the probabilities "of error in physical observations, and on the density of the "earth, considered especially with regard to the reduction "of experiments on the pendulum;" that "if we were raised "on a sphere of earth a mile in diameter, its attraction would "be about $\frac{1}{8000}$ of that of the whole globe, and instead of a "reduction of $\frac{1}{2000}$ in the force of gravity, we should obtain "only $\frac{3}{8000}$, or $\frac{3}{4}$ as much. Nor is it at all probable, that "the attraction of any hill, a mile in height, would be so little "as this, even supposing its density to be only two thirds of "the mean density of the earth. That of a hemispherical "hill of the same height would be more than half as much "more (*than the sphere*) or in the proportion of 1,586 to 1. "And it may be easily shown, that the attraction of a large "tract of table land, considered as an extensive flat surface a "mile in thickness, would be three times as great as that of "a sphere a mile in diameter; or about twice as great as that "of such a sphere of the mean density of the earth: so that, "for a place so situated, the allowance for elevation would "be reduced to one half: and in almost any country that could

"be chosen for the experiment, it must remain less than three "fourths of the whole correction deduced immediately from "the duplicate proportion of the distances from the earth's "centre."

By this interesting, and I believe new view which Dr. YOUNG has taken of the subject, it appears that the correction for the elevation above the sea, will vary (according to the nature of the eminence and also its density) from one half to three fourths of the quantity before deduced from the squares of the distances from the earth's centre, and if the mean density of the earth be taken at 5,5, and that of the matter surrounding the station at 2,5, Dr. YOUNG is of opinion, that the quantity deduced from the duplicate ratio of the distances should be multiplied by $\frac{66}{100}$, to obtain the correction for a table land, and by $\frac{7}{10}$ for that of an eminence of moderate declivity.

By careful levelling, the height of the station at Unst above low water, was found to be 28 feet; whence we have 0,12 for the correction deduced from the squares of the distances from the earth's centre, and as the station at Unst was surrounded by hills composed of serpentine, I shall take $0{,}12 \times \frac{1}{2} = 0{,}06$ for the correction to be applied in order to obtain the number of vibrations which would be made at the level of the sea.

The last correction to be found, is for the buoyancy of the atmosphere. The manner in which this correction is derived, has been fully explained in the "Account of experiments for "determining the length of the seconds pendulum" before referred to. The specific gravities of the weight and bar of the pendulum, were carefully determined. That of the bar was found to be 8,628, and of the weight 8,603. The specific

gravity therefore of the whole pendulum may be taken at 8,610.

The mean height of the barometer during the experiments at Unst, was 29,98 inches, and that of the thermometer 57,°8. The weight of water is to that of air at 29,27 inches of the barometer, and 53° of the thermometer, as 836 to 1, and the expansion of air for each degree of the thermometer is $\frac{1}{480}$ of its bulk. From these data we find that the specific gravity of the pendulum was to that of air, at the time of the experiments, as 7099 to 1. The square of the number of vibrations must therefore be increased $\frac{1}{7099}$ part, or 6,07 be added to the number of vibrations in 24 hours, to obtain the number of vibrations which would be made during the same period in vacuo.

These corrections being added to the mean number of vibrations before given, we have 86096,90 for the number of vibrations made by the pendulum in a mean solar day, in vacuo at the level of the sea.

The very unfavourable weather which I experienced at Unst, prevented my obtaining so many observations for the rate of the clock, as I could have wished; but though the greatest difference between the seven resulting numbers of vibrations amounts to so much as 0,49, I think it probable, after a careful examination, that the final result must be within one tenth of a vibration of the truth.

On the 23d July, I was so fortunate as to obtain one series of meridional observations of the sun, with the repeating circle, for the latitude of the station, which will be given hereafter, and on the 29th I embarked on board the Cherokee, and took leave of my kind host Mr. Edmondstone, to whose most friendly hospitality the eloquent pen of M. Biot has

done but justice, and has left me nothing to add, but that I experienced from him every attention that could contribute to my personal comfort, and every anxious exertion that could tend to forward the enquiry in which I was engaged.

Operations at Portsoy.

On the first of August I arrived at Portsoy, near to which is Cowhythe, the next station of the trigonometrical survey, which I proposed to connect with my observations, and after much search for a place suited to my experiments, was kindly favoured by the Rev. Mr. GRANT, with the use of his school-house, which was perfectly adapted to the purpose, the walls being thick, and firmly built of serpentine. I was also so fortunate as to obtain accommodations for myself, at a house belonging to a gentleman of the name of WATSON, immediately adjoining the school-house, and whose garden afforded an excellent situation for the transit instrument.

On the 5th August I commenced the observations detailed in the Appendix, from which is extracted the following table for obtaining the rate of the clock:

Transits observed at PORTSOY. 1st Series.

Stars.	August 5.	August 6.	August 7.	August 8.	August 10.	August 11.	August 12.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
The Sun	. . .	0.14.41,62	0.15. 7,95	0.15.36,56	0.16.38,83	. . .	0.17.42,63
Arcturus	. . .	. . .	. . .	5.11.20,51	5. 4.46,51	. . .	4.58.16,63
α Ophiuchi	. . .	8.36.42,60	. . .	8.30. 1,45	8.23.28,67	8.20.13,59	8.16.58,52
ν Ophiuchi	9. 2.35,99	. . .	. . .	8.52.29,70	8.45.56,85	8.42.41,94	8.39.26,94
η Serpentis	9.25.25,99	. . .	. . .	9.15.19,73	9. 8.46,76	9. 5.32,03	9. 2.17,04
α Lyræ	9.44.16,20	. . .	. . .	9.34.10,19	9.27.37,34	9.24.22,52	9.21. 7,43
a	. . .	. . .	. . .	. . .	9.53.22,62	9.50. 7,82	9.46.52,91
b	10.16.29,86	. . .	. . .	. . .	9.59.51,24	9.56.36,52	9.53.21,61
μ Aquilæ	10.38.33,58	. . .	. . .	. . .	. . .	10.18.40,52	10.15.25,11
α Aquilæ	10.55.13,62	. . .	. . .	10.45. 8,14	10.38.35,49	10.35.20,47	10.32. 5,33

From the above data the following rates of the clock were obtained, in the manner which has been before fully particularized.

Rate of the clock at Portsoy, 1st Series.—(*Gaining.*)

Stars.	From 5 to 8.	From 5 to 10.	From 5 to 11.	From 5 to 12.	From 6 to 7.	From 6 to 8.	From 6 to 10.	From 6 to 12.	From 7 to 8.	From 7 to 10.	From 7 to 12.	From 8 to 10.	From 8 to 11.	From 8 to 12.	From 10 to 11.	From 10 to 12.	From 11 to 12.
	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
The Sun	—	—	—	—	32,73	34,22	36,63	38,10	35,71	37,93	39,18	39,03	—	40,04	—	41,05	—
Arcturus	—	—	—	—	—	—	—	—	—	—	—	*39,02	—	*40,05	—	41,09	—
α Opiuchi	—	—	—	—	—	35,44	—	—	—	—	—	39,63	40,07	40,29	40,95	40,96	40,96
ν Ophiuchi	33,90	36,18	37,00	37,57	—	—	—	—	—	—	—	39,59	40,10	40,33	41,12	41,08	41,03
η Serpentis	33,91	36,16	37,02	37,59	—	—	—	—	—	—	—	39,54	40,12	40,35	41,30	41,17	41,04
α Lyræ .	34,00	36,24	37,06	37,61	—	—	—	—	—	—	—	39,59	40,13	40,33	41,21	41,08	40,94
a	—	—	—	—	—	—	—	—	—	—	—	—	—	—	41,23	41,18	41,12
b	—	36,29	37,12	37,69	—	—	—	—	—	—	—	—	—	—	41,31	41,22	41,12
μ Aquilæ	—	—	37,17	37,66	—	—	—	—	—	—	—	—	—	—	—	—	40,62
α Aquilæ	34,17	36,38	37,15	37,68	—	—	—	—	—	—	—	39,69	40,13	40,15	41,01	40,95	40,89
Mean by the Stars	34,00	36,25	37,09	37,63	—	35,44	—	—	—	—	—	39,61	40,11	40,29	41,16	41,09	40,96
Mean by the Sun	—	—	—	—	32,73	34,22	36,63	38,10	35,71	37,93	39,18	39,03	—	40,04	—	41,05	—

* These are rejected.

From the detail of the coincidences observed at Portsoy given in the Appendix, and from the rate of the clock from the 5th to the 12th, is derived the following Table.

Vibrations of the Pendulum at PORTSOY. 1st. Series.
The clock making 86437,63 vibrations in a mean solar day.

Date.		Barometer.	Thermom.	Vibrations in 24 hours.	Correction for Temp.	Vibrations in 24 hours, at 62 degrees.
Aug. 6	A. M.	29,95	64,8°	86085,53	1,18	86086,71
	P. M	30,00	65,2	86084,19	1,35	86085,54
7	A. M	29,89	62,3	86083,09	0,13	86083,22
	P. M	29,88	62,6	86082,30	0,25	86082,55
8	A. M	30,05	58,8	86081,61	1,35	86080,26
	P. M,	30,09	60,5	86081,11	0,63	86080,48
9	A. M.	30,04	60,4	86080,13	0,68	86079,45
	P. M.	30,04	60,5	86078,63	0,63	86078,00
10	A. M.	30,10	58,8	86078,39	1,35	86077,04
	P. M.	30,16	60,3	86077,56	0,72	86076,84
11	A. M.	30,28	56,6	86078,44	2,28	86076,16
	P. M.	30,27	60,0	86077,34	0,85	86076,49
12	A M.	30,26	59,2	86076,92	1,18	86075,74
	P. M.	30,27	61,3	86076,51	0,30	86076,21
Mean . .		30,09	60,8			86079,62

On examining the preceding Table, it appears that the rate of the clock had pretty regularly increased to the surprising amount of $10^s,51$ in the space of 7 days; which is an acceleration of $1^s,5$ in every 24 hours; on this I shall have occasion to remark hereafter. From the foregoing data the following Table of the corrected vibrations of the pendulum in a mean solar day was computed, in the manner which has been before detailed.

By the Stars, PORTSOY—1st Series.							
From	To	Computed Vibrations in a mean solar day.	Mean of Transits B or A coincidences.	Correction.	Corrected Vibrations in a mean solar day.	No. of Stars observed.	Inter. of Transits.
August.	August.		h. m				
6 A.M.	8 P.M.	86079,50	B. 1.17	+0,08	86079,58	4	3
6 A.M.	10 P.M.	86079,63	B. 1.17	+0,08	86079,71	5	5
6 A.M.	11 P.M.	86079,69	B. 1.14	+0,08	86079,77	6	6
6 A.M.	12 P.M.	86079,62	B. 1.13	+0,08	86079,70	6	7
7 A.M.	8 P.M.	86079,44	B. 2.23	+0,16	86079,60	1	2
9 A.M.	10 P.M.	86079,81	B. 1.42	+0,10	86079,91	6	2
9 A.M.	11 P.M.	86079,81	B. 1.49	+0,11	86079,92	5	3
9 A.M.	12 P.M.	86079,65	B. 1.50	+0,11	86079,76	5	4
11 A.M.	11 P.M.	86079,86	B. 1.50	+0,11	86079,97	7	1
11 A.M.	12 P.M.	86079,61	B. 2.18	+0,14	86079,75	8	2
12 A.M.	12 P.M.	86079,30	B. 1.31	+0,09	86079,39	8	1
By the Sun. 1st Series.							
6 P.M.	7 A.M.	86079,48	A. 1.22	—0,08	86079,40	2	1
6 P.M.	8 A.M.	86079,48	A. 1.20	—0,08	86079,40	2	2
6 P.M.	10 A.M.	86079,82	A. 1.21	—0,08	86079,74	2	4
6 P.M.	12 A.M.	86079,78	A. 1.15	—0,08	86079,70	2	6
7 P.M.	8 A.M.	86079,48	A. 1.19	—0,08	86079,40	2	1
7 P.M.	10 A.M.	86079,93	A. 1.19	—0,08	86079,85	2	3
7 P.M.	12 A.M.	86079,85	A. 1.14	—0,08	86079,77	2	5
8 P.M.	10 A.M.	86080.14	A. 1.20	—0,08	86080,06	2	2
8 P.M.	12 A.M.	86079,93	A. 1.13	—0,08	86079,85	2	4
10 P.M.	12 A.M.	86079,73	A. 1. 4	—0,07	86079,66	2	2

By using the number of stars observed and the intervals between the transits, to obtain a mean, in the manner described in the account of the experiments at Unst, we have 86079,74 vibrations by the observations of the stars, and 86079,73 by those of the sun; whence is derived 86079,74 for the final mean number of vibrations in 24 hours.

The height of the pendulum at Portsoy, above low water, was found by levelling to be 94 feet, the correction due to which is $0{,}39 \times \frac{6}{10}$* $= 0{,}23$.

* It may be necessary to remark, that no allowance has been attempted for any variation of density between the different stations, but solely for their form.

The mean height of the barometer during the experiments, was 30,09 inches, and the mean temperature 60°,8, from which data, and the specific gravity of the pendulum, we have 6,04 for the correction, on account of the buoyancy of the atmosphere.

Applying these corrections to the mean number of vibrations before found, we obtain 86086,01 for the final number of vibrations which would be made by the pendulum in a mean solar day, in vacuo, and at the level of the sea.

The rate of the clock having suffered a continual acceleration, as I have before stated, it became a subject of anxious importance to determine what effect this might possibly have on the result of the experiments; particularly as the same curious circumstance had taken place at Unst, at which station however the unfavourable weather prevented the commencement of my observations, until the acceleration had nearly attained its maximum. To satisfy myself on this point, I took down the clock on the 13th August, and having carefully cleaned it, began a new series of observations, which are given at large in the Appendix, and from which the following tables and results are derived:

Transits observed at PORTSOY. 2d Series.

Stars.	August 13.	August 14.	August 15.	August 16.	August 17.	August 18.	August 19.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
The Sun	0.11.47,72	—	0.12.49,27	0.13.19,72	0.13.49,88	—	0.14.49,28
Arcturus	4.48.35,44	—	4.42. 6,66	4.38.53,17	—	4.32.25,84	—
α Ophiuchi	8. 7.17,18	8. 4. 2,83	8. 0.48,78	7.57.34,88	7.54.21,23	—	—
ν Ophiuchi	—	8.26.31,46	8.23.16,94	—	8.16 49,55	8 13.36,30	—
η Serpentis	—	8.49.21,19	8.46. 7, 0	8.42.53,09	8.39.39,77	8.36.26,36	—
α Lyræ	—	9. 8.11,68	9. 4.57,59	9. 1.43,81	8.58.30,19	8.55.16,39	—
μ Aquilæ	—	10. 2.29,88	—	—	9.52.48,21	—	—
α Aquilæ	—	10.19. 9,84	—	—	10. 9.28,18	—	—

Rate of the clock at PORTSOY. 2d Series. *(Gaining.)*

Stars.	From 13 to 14.	From 13 to 15.	From 13 to 16.	From 13 to 17.	From 13 to 18.	From 13 to 19.	From 14 to 15.	From 14 to 16.	From 14 to 17.	From 14 to 18.	From 15 to 16.	From 15 to 17.	From 15 to 18.	From 15 to 19.	From 16 to 17.	From 16 to 18.	From 16 to 19.	From 17 to 18.	From 17 to 19.
		s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
The Sun	—	41,62	41,80	41,91	—	42,18	—	—	—	—	42,15	42,20	—	42,45	42,26	—	42,55	—	42,70
Arcturus	—	41,63	41,93	—	42,10	—	—	—	—	—	42,53	—	42,41	—	—	42,36	—	—	—
α Ophiuchi	41,67	41,82	41,92	42,03	—	—	41,97	42,05	42,15	—	42,12	42,25	—	—	42,37	—	—	—	—
ν Ophiuchi	—	—	—	—	—	—	41,50	—	42,05	42,23	—	42,33	42,47	—	—	—	—	42,77	—
η Serpentis	—	—	—	—	—	—	41,83	41,97	42,21	42,31	42,11	42,41	42,47	—	42,70	42,66	—	42,61	—
α Lyræ	—	—	—	—	—	—	41,93	42,04	42,19	42,20	42,24	42,32	42,29	—	42,40	42,31	—	42,22	—
μ Aquilæ	—	—	—	—	—	—	—	—	42,13	—	—	—	—	—	—	—	—	—	—
α Aquilæ	—	—	—	—	—	—	—	—	42,13	—	—	—	—	—	—	—	—	—	—
Mean by the Stars	41,67	41,72	41,92	42,03	42,10	—	41,81	42,02	42,14	42,25	42,25	42,33	42,41	—	42,49	42,44	—	42,53	—
Mean by the Sun	—	41,62	41,80	41,91	—	42,18	—	—	—	—	42,15	42,20	—	42,45	42,26	—	42,55	—	42,70

Vibrations of the Pendulum at PORTSOY, 2d Series. The clock making 86442,18 Vibrations in a mean solar day.						
Date.		Barometer.	Thermom.	Vibrations in 24 hours.	Correction for Temp.	Vibrations in 24 hours at 62 degrees.
Aug. 13	A. M.	—	—	—	—	—
	P. M.	30,25	61,9	86081,04	0,04	86081,00
14	A. M.	30,25	60,3	86081,11	0,72	86080,39
	P. M.	30,27	62,4	86080,19	0,17	86080,36
15	A. M.	30,25	60,1	86080,85	0,80	86080,05
	P. M.	30,25	61,6	86080,13	0,17	86079,96
16	A. M.	30,18	58,4	86081,19	1,52	86079,67
	P. M.	30,17	60,9	86080,26	0,47	86079,79
17	A. M.	30,15	59,8	86080,60	0,93	86079,67
	P. M.	30,16	61,2	86080,11	0,34	86079,77
18	A. M.	30,14	58,4	86080,79	1,52	86079,27
	P. M.	30,14	60,2	86080,18	0,76	86079,42
19	A. M.	30,10	57,4	86080.85	1,95	86078,90
	P. M.	—	—	—	—	—
Mean		30,19	60,2			86079,85

It appears from the above Table, as well as by the comparisons of the clock with the chronometer, that the rate of the clock had been sufficiently uniform to render any correction on this head unnecessary; in the following Table therefore we have the number of vibrations made by the pendulum in a mean solar day.

By the Stars. 2d Series. PORTSOY.				
From	To	Correct Vibrations in a mean solar day.	No. of stars observed.	Inter. of Transits.
14 A. M.	14 P. M.	86079,86	1	1
14 A. M.	15 P. M.	86079,73	2	2
14 A. M.	16 P. M.	86079,78	2	3
14 A. M.	17 P. M.	86079,81	1	4
14 A. M.	18 P. M.	86079,76	1	5
15 A. M.	15 P. M.	86079,63	4	1
15 A. M.	16 P. M.	86079,71	3	2
15 A. M.	17 P. M.	86079,78	6	3
15 A. M.	18 P. M.	86079,77	3	4
16 A. M.	16 P. M.	86079,80	4	1
16 A. M.	17 P. M.	86079,87	4	2
16 A. M.	18 P. M.	86079,83	4	3
17 A. M.	17 P. M.	86080,03	3	1
17 A. M.	18 P. M.	86079,79	3	2
18 A. M.	18 P M.	86079,69	3	1
By the Sun.			2d. Series.	
13 P. M.	15 A. M.	86079,89	2	2
13 P. M.	16 A. M.	86079,86	2	3
13 P. M.	17 A. M.	86079,84	2	4
13 P. M.	19 A. M.	86079,85	2	6
15 P. M.	16 A. M.	86079,78	2	1
15 P. M.	17 A. M.	86079,79	2	2
15 P. M.	19 A. M.	86079,83	2	4
16 P. M.	17 A. M.	86079,81	2	1
16 P. M.	19 A. M.	86079,84	2	3
17 P. M.	19 A. M.	86079,86	2	2

Employing the numbers of stars observed, and the intervals of the transits, as before, we obtain 86079,78 vibrations by the observations of the stars, and 86079,84 by those of the sun; and the sums of the factors being 96 and 56, we have 86079,80 for the final mean number of vibrations in 24 hours.

The mean height of the barometer was 30,19 inches, and that of the thermometer 60°,2, hence the correction for the buoyancy of the atmosphere is 6,07.

This correction, together with 0,23 (the correction for the height above the sea) being added to the mean number of vibrations, we have 86086,10 for the number of vibrations which would be made in a mean solar day, in vacuo, and at the level of the sea.

The difference between this result and that of the first series of experiments made under the most unfavourable circumstances of acceleration in the rate of the clock, being only 0,09, affords it is presumed a most satisfactory proof that no very important error is to be dreaded from this source in the observations at Unst.

Operations at Leith Fort.

Having completed the requisite observations for the latitude of my station, and for connecting it with Cowhythe, I quitted Portsoy for Edinburgh on the 20th August, leaving the instruments and party to come by sea.

Leith Fort was my next station, and here, as I could procure no lodgings in the neighbourhood, an officer of the Royal Artillery most kindly relinquished to me his quarters in the barracks. The Cherokee arrived on the 28th, and the instruments were landed the same evening.

On my first arrival at Edinburgh to embark for Unst, I had been introduced to Sir HOWARD ELPHINSTONE, the chief engineer of the station, and received from him the assurance of every assistance in my experiments, which his department could furnish. Though to my regret he was now absent on duty, I was promptly supplied with such materials and artificers as were necessary, and on the 29th August my apparatus was firmly put up in one of the public store rooms of the Fort, which was excellently adapted to the purpose, and the

transit instrument placed on a massy stone foundation, erected for it on the ramparts.

On the 31st of August I commenced my observations, the results of which are given in the following Tables, and on the evening of the 7th of September, the transits of the same stars were again observed, but unfortunately the lamp which was attached to the meridian mark, for adjusting the transit instrument by night, not having been properly placed, these observations were of necessity rejected.

Transits observed at LEITH FORT. 1st Series.

Stars.	August 31.	September 2.	September 4.	September 5.	September 6.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
The Sun .	—	0. 9.18,05	—	0. 9.41,66	0. 9.51,50
α Capricorni	9.49.41,04	9.42.40,21	9.35.42,16	—	—
ε Aquarii .	—	10. 1.56,92	9.54.59,09	—	—
α Equulei .	10.37.46,18	10.30.45,31	10.23.47,39	—	—
β Aquarii .	10.52.59,93	10.45.59,62	10.39. 1,37	—	—
ε Pegasi .	11. 6.12,53	—	10.52.13,94	—	—
ο Aquarii .	11.24.50,38	11.17.49,91	11.10.51,95	—	—
γ Aquarii .	11.43. 8,89	—	11.29.10,60	—	—
κ Aquarii .	11.59.11,46	—	11.45.13,07	—	—
η Aquarii .	—	11.55.13,67	—	—	—
ξ Pegasi .	—	12. 1.24,05	11.54.26,26	—	—
				—	—

From these transits the following table was computed.

Rate of the clock at LEITH FORT. 1st Series. (*Gaining.*)

Stars.	From August 31, to Sept. 2.	From August 31, to Sept. 4.	From Sept. 2, to Sept. 4.	From Sept. 2, to 5.	From Sept. 2, to 6.	From Sept. 5, to 6
	s.	s.	s.	s.	s.	s.
The Sun .	—	—	—	27,04	27,69	29,64
α Capricorni	25,56	26,26	26,95	—	—	—
ε Aquarii .	—	—	27,07	—	—	—
α Equulei .	25,55	26,28	27,02	—	—	—
β Aquarii .	25,83	26,34	26,85	—	—	—
ε Pegasi .	—	26,33	—	—	—	—
ο Aquarii .	25,75	26,37	27,00	—	—	—
γ Aquarii .	—	26,41	—	—	—	—
κ Aquarii .	—	26,38	—	—	—	—
η Aquarii .	—	—	—	—	—	—
ξ Pegasi .	—	—	27,09	—	—	—
Mean by the Stars	25,67	26,34	27,00	—	—	—
Mean by the Sun	—	—	—	27,04	27,69	29,64

The steeple of Leith church, being very conveniently situated for the purpose, I was anxious to ascertain with what degree of precision the rate of the clock might be obtained, by observing the disappearance of stars behind the steeple, a method which I understand was employed by M. BIOT, in his late laborious experiments on the length of the pendulum, and which seems capable of great accuracy. For this purpose I used a powerful achromatic telescope, with which I was favoured by Mr. JARDINE from the observatory. The telescope was placed so as to rest against the door way of the room which contained the clock, and was directed towards the side of the steeple. On the evening of the 30th August, I obtained observations of the time of the disappearance of several stars, and on the 6th of September, two of these stars were again observed, but the rest were not visible. By these stars,

the rate of the clock appeared to be 26^s,85; which rate as it was deduced from the longest interval, has been used in computing the following Table.

Vibrations of the Pendulum at Leith Fort. 1st. Series.
The clock making 86426,85 vibrations in a mean solar day.

Date.		Barometer.	Thermom.	Vibrations in 24 hours.	Correction for Temp.	Vibrations in 24 hours at 62 degrees.
Aug. 31	A. M.	29,95	56°,6	86078,34	2,28	86076,06
	P. M.	29,85	58,9	86077,50	1,30	86076,20
Sept. 1	A. M.	29,55	58,7	86076,08	1,40	86074,68
	P. M.	29,49	60,1	86075,72	0,80	86074,92
2	A. M.	29,58	58,4	86075,14	1,52	86073,62
	P. M.	29,68	59,9	86074,55	0,89	86073,66
3	A. M.	29,95	57,4	86075,13	1,95	86073,18
	P. M.	29,97	59,7	86074,13	0,97	86073,16
4	A. M.	29,78	59,5	86074,13	1,06	86073,07
	P. M.	29,76	61,9	86073,16	0,04	86073,12
5	A. M.	29,85	60,3	86072,43	0,72	86071,71
	P. M.	29,83	62,1	86071.57	+0,04	86071,61
6	A. M.	29,60	59,9	86070,85	0,89	86069,96
	P. M.	29,62	61,4	86070,33	0,25	86070,08
Mean		29,75	59,6			86073,21

By the above Table we may perceive, that though the clock had been cleaned so recently, its rate had notwithstanding encreased in seven days, about six seconds, or 0,85 in every 24 hours. On account of this acceleration it becomes necessary to apply a correction, in the manner which has been before explained, in order to obtain the true number of vibrations made by the pendulum in a mean solar day. The results are contained in the following Table.

From	To	Computed Vibrations in a mean solar day.	Mean of Transits B. or A. coin.	Correction.	Corrected vibrations in a mean solar day.	No. of stars observed.	Inter. of Transits.
By the Stars. 1st. Series. Leith Fort.							
			h. m.				
1 A. M.	2 P. M.	86073,04	B. 1.33	+,05	86073,09	4	2
1 A. M.	4 P. M.	86073,16	B. 0.28	+,02	86073,18	7	4
3 A. M.	4 P. M.	86073,28	B. 0.27	+,02	86073,30	6	2
By disappearance of stars behind Leith steeple.		86073,21	A. 0.33	—,02	86073,19	2	7
By the Sun. 1st. Series.							
2 P. M.	5 A. M.	86073,17	A. 0.57	—0,3	86073,14	2	3
2 P. M.	6 A. M.	86073,28	A. 1. 9	—0,3	86073,24	2	4
5 P. M.	6 A. M.	86073,57	A. 0.51	—0,3	86073,54	2	1

Using the number of stars observed and the intervals of the transits, as before, to obtain a mean, we have 86073,19 vibrations by the stars, and 86073,23 by the sun, and the sums of the factors, being 62 and 16, we obtain 86073,20 for the final mean number of vibrations in 24 hours.

The mean height of the barometer was 29,75 inches, and the mean temperature 59°,6. The correction for the buoyancy of the atmosphere is therefore 5,99.

The height of the pendulum above low water, was found by levelling to be 68 feet, whence we have $0{,}28 \times \frac{66}{100} = 0{,}18$ for the correction due to this elevation.

These corrections being applied, we obtain 86079,37 for the number of vibrations made by the pendulum in a mean solar day in vacuo, and at the level of the sea.

The clock was now taken down to be cleaned, as I had resolved to go through a new series of observations. On examining the oil, it was found to all appearance as pure as

when first applied, and I can in no way account for the acceleration in the rate of the clock, but by supposing, that whilst it was at rest, the external surface of the oil had become thickened by some action of the sea air upon it. This would of course occasion the rate to be less, on the clock being first put up, and a gradual acceleration would afterwards take place as the thick coat of the oil became blended with the more fluid particles beneath. These remarks may perhaps warrant the important inference, that no reliance whatever can be placed on results obtained by means of a pendulum attached to a clock, and that until oil can be banished from chronometers, and the maintaining power be such as to be equal under all circumstances, we may spare ourselves the trouble of attending to other sources of error.

The clock being cleaned, the observations were made and the results deduced which are contained in the following Tables.

Transits observed at LEITH FORT. 2d Series.

Stars.	September 8.	September 10.	September 12.	September 14.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.
α Equulei	10. 2.39,48	9.55.54.46	9.49.11,23	9.42.28,05
β Aquarii	10.17.53,83	10.11. 8,88	10. 4.25,60	—
ε Pegasi	10.31. 6,30	10.24.21,36	—	10.10.54,92
ο Aquarii	10.49.44,22	—	10.36.16,20	10.29.32,78
Pegasi	11.14.25,06	11. 7.39,80	11. 0.56,53	10.54.13,42
κ Aquarii	11.24. 5,68	11.17.20,66	11.10.37,38	11. 3.54,32
ζ Pegasi	11.28. 6,69	11.21.21,70	11.14.38,28	11. 7.55,24
ξ Pegasi	11.33.18,73	11.26.33,72	11.19.50,34	11.13. 7,40
α Pegasi	11.51.21,57	11.44.36,50	11.37.53,33	11.31.10,33

Rate of the clock at LEITH FORT. 2d. Series. (*Gaining.*)

Stars.	From September 8 to 10.	From 8 to 12.	From 8 to 14.	From 10 to 12.	From 10 to 14.	From 12 to 14.
	s.	s.	s.	s.	s.	s.
α Equulei	33,49	33,94	34,10	34,39	34,40	34,41
β Aquarii	33,53	33,94	—	34,36	—	—
ε Pegasi	33,53	—	34,10	—	34,39	—
ο Aquarii	—	33,99	34,09	—	—	34,29
Pegasi	33,37	33,87	34,06	34,37	34,41	34,45
κ Aquarii	33,49	33,93	34,11	34,36	34,41	34,47
ζ Pegasi	33,51	33,90	34,09	34,29	34,39	34,48
ξ Pegasi	33,50	33,90	34,11	34,31	34,42	34,53
α Pegasi	33,47	33,94	34,13	34,42	34,46	34,50
Mean -	33,49	33,93	34,10	34,36	34,41	34,45

Vibrations of the Pendulum at LEITH FORT. 2d Series.
The clock making 86434,10 vibrations in a mean solar day.

Date.		Barometer.	Thermom.	Vibrations in 24 hours.	Correction for Temp.	Vibrations in 24 hours at 62 degrees.
Sept. 9	A. M.	29,90	54°,2	86077,10	3,30	86073,80
	P. M.	29,95	55,6	86076,63	2,71	86073,92
10	A. M.	29,94	52,4	86077,45	4,06	86073,39
	P. M.	29,91	54,2	86076,98	3,30	86073,68
12	A. M.	29,92	51,5	86077,16	4,44	86072,72
	P. M.	29,95	53,3	86076,71	3,68	86073,03
12	A. M.	30,14	53,1	86076,64	3,77	86072,87
	P. M.	30,14	54,2	86076,22	3,30	86072,92
13	A. M.	30,28	54,0	86076,05	3,38	86072,67
	P. M.	30,24	55,9	86075,40	2,58	86072,82
14	A. M.	29,89	56,4	86075,35	2,37	86072,98
	P. M.	29,85	57,1	86074,86	2,07	86072,79
Mean		30,01	54,3			86073,13

We may perceive from the above Table, that the rate of the clock had encreased about a second in six days; the error however affecting the final number of vibrations of the pendulum, in consequence of this, is too small to need correction.

By the Stars. LEITH FORT. 2d Series.				
From	To	Correct Vibrations in a Mean solar day.	No. of stars observed.	Interv. of Transits.
9 A. M.	10 P. M.	86073,09	8	2
9 A. M.	12 P. M.	86073,12	8	4
9 A. M.	14 P. M.	86073,13	8	6
11 A. M.	12 P. M.	86073,14	7	2
11 A. M.	14 P. M.	86073,16	7	4
13 A. M.	14 P. M.	86073,17	7	2

Using the number of stars observed, and the intervals between the transits as before, we have 86073,13 for the number of vibrations in 24 hours.

The barometer being at 30,01 inches, and the thermometer at 54°,3 the correction for the buoyancy of the atmosphere is 6,11.

This correction, together with 0,18, the correction for the height above the sea, being applied, we obtain 86079.42 for the number of vibrations made by the pendulum in vacuo, as deduced from the second series, from which the result of the first series differs 0,05 of a vibration. The mean of both is to be preferred.

Operations at Clifton.

On the 17th of September I left Edinburgh, and proceeded to Clifton in Yorkshire; at which place my instruments and party arrived on the 28th. Here I was so fortunate as to meet with a vacant house in the village, perfectly suited to my purpose, belonging to Mr. MILWARD, who is also proprietor of the field in which is the station of the Trigonometrical Survey. Previous to the commencement of my experiments, the clock was carefully cleaned. The observations were then made, and

the results deduced which are contained in the following Tables.

Transits observed at CLIFTON.

Stars.	October 2.	October 3.	October 5.	October 6.	October 8.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
The Sun	—	11.49. 6, 5	11.48. 8,64	11.47.40,36	11.46.45,38
σ Aquilæ	6.46.47,45	6.42.40,48	6.34.27,35	6.30.20,82	6.22. 8,92
α Aquilæ	6.58.27,38	6.54.20,37	6.46. 7,22	6.42. 0,57	—
θ Aquilæ	7.18.23,75	7.14.16,85	7. 6. 3,75	7. 1.57,15	6.53.44,63
ε Aquarii	—	7.50. 4,50	7.41.51,28	7.37.44,75	7.29.32,8
η Capricorni	—	8. 6.13,77	—	—	—
α Equulei	8.23. 2,35	8.18.55,28	—	8. 6.35,35	7.58.23,28
ε Capricorni	8.43. 5,98	8.38.58,87	—	8.26.39,37	8.18.27,2
α Aquarii	9.12.35,95	9. 8.29,15	9. 0.15,68	8.56. 9,23	8.47.57,07
γ Aquarii	9.28.22,38	9.24.15,47	9.16. 2,27	9.11.55,72	—
η Aquarii	—	9.37.58, 1	9.29.44,92	9.25.38,43	9.17.26,37

Rate of the clock at CLIFTON. (*Losing.*)

Stars.	From Oct. 2, to 3.	From 2 to 5.	From 2 to 6.	From 2 to 8.	From 3 to 5.	From 3 to 6.	From 3 to 8.	From 5 to 6	From 5 to 8.	From 6 to 8.
	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
The Sun	—	—	—	—	10,78	10,75	10,62	10,68	10,52	10,44
σ Aquilæ	11,09	10,82	10,78	10,54	10,68	10,67	10,43	10,65	10,26	10,07
α Aquilæ	11,13	10,84	10,82	—	10,69	10,72	—	10,77	—	—
θ Aquilæ	11,03	10,79	10,77	10,64	10,67	10,69	10,56	10,72	10,49	10,38
ε Aquarii	—	—	—	—	10,73	10,70	10,46	10,65	10,28	10,09
η Capricorni	—	—	—	—	—	—	—	—	—	—
α Equulei	11,19	—	10,87	10,63	—	10,76	10,52	—	—	10,15
ε Capricorni	11,23	—	10,77	10,58	—	10,62	10,45	—	—	10,20
α Aquarii	10,92	10,88	10,80	10,60	10,85	10,76	10,54	10,57	10,32	10,20
γ Aquarii	11,03	10,82	10,78	—	10,72	10,70	—	10,67	—	—
η Aquarii	—	—	—	—	10,71	10,68	10,47	10,61	10,30	10,15
Mean by the Stars	11,09	10,83	10,80	10,60	10,72	10,70	10,49	10,66	10,33	10,18
Mean by the Sun	—	—	—	—	10,78	10,75	10,62	10,68	10,52	10,44

Vibrations of the Pendulum at CLIFTON.
The clock making 86389,40 vibrations in a mean solar day.

Date.		Barometer.	Thermom.	Vibrations in 24 hours.	Correctiou for Temp.	Vibrations in 24 hours, at at 62 degrees.
Oct. 3	A. M.	29,22	57,4	86064,52	1,95	86062,57
	P. M.	29,20	58,2	86063,92	1,61	86062,31
4	A. M.	29,18	57,2	86064,44	2,03	86062,41
	P. M.	29,13	57,2	86064,18	2,03	86062,15
5	A. M.	29,10	55,1	86065,26	2,92	86062,34
	P. M.	29,08	55,7	86064,93	2,67	86062,26
6	A. M.	29,01	53,4	86065,75	3,64	86062,11
	P. M.	29,10	54,5	86065,08	3,17	86061,91
7	A. M.	29,30	52,9	86065,47	3,85	86061,62
	P. M.	29,33	53,7	86065,25	3,51	86061,74
8	A. M.	29,52	52,2	86065,36	4,15	86061,21
	P. M.	29,57	52,9	86065,08	3,85	86061,23
	Mean	29,23	55,0			86061,99

From the preceding Tables, the following vibrations in a mean solar day were computed.

By the Stars. CLIFTON.

From	To	Correct Vibrations in a mean solar day.	No. of Stars observed	Interv. of Transits.
3 A. M.	3 P. M.	86061,95	7	1
3 A. M.	5 P. M.	86062,11	5	3
3 A. M.	6 P. M.	86062.06	7	4
3 A. M.	8 P. M.	86061,99	5	6
4 A. M.	5 P. M.	86062,17	7	2
4 A. M.	6 P. M.	86062,10	9	3
4 A. M.	8 P. M.	86062,01	7	5
6 A. M.	6 P. M.	86061,95	7	1
6 A. M.	8 P. M.	86061,91	5	3
7 A. M.	8 P. M.	86061,87	7	2
By the Sun.				
3 P. M.	5 A. M.	86062,12	2	2
3 P. M.	6 A. M.	86062,11	2	3
3 P. M.	8 A. M.	86061,99	2	5
5 P. M.	6 A. M.	86062,10	2	1
5 P. M.	8 A. M.	86061,89	2	3
6 P. M.	8 A. M.	86061,78	2	2

The number of stars observed, and the intervals between the transits being employed as before to obtain a mean, we have 86062,02 vibrations by the stars, and 86061,99 by the sun, whence we obtain 86062,01 for the final mean number of vibrations in 24 hours.

The height of the barometer being 29,23 inches, and the thermometer 55°,0 the resulting correction for the buoyancy of the atmosphere is 5,94.

The height of Clifton Beacon, above the level of the sea is stated in the "Account of the Trigonometrical Survey" to be 417 feet; and by levelling, the pendulum was found to be 78 feet below Clifton Beacon, the height of the pendulum therefore above the level of the sea was 339 feet, the correction for which is $1,40 \times \frac{68}{100} = 0,95$.

Applying these corrections, we obtain 86068,90 for the number of vibrations at Clifton, in a mean solar day, in vacuo and at the level of the sea.

Operations at Arbury Hill.

On the 13th of October I left Clifton, having previously made some important observations for the latitude, which will be detailed in the proper place, and proceeded to Arbury Hill, where my party and instruments arrived on the 15th. Here I procured accommodations at a house belonging to Mr. GOSSAGE, situated on the side of an eminence, to the south of Arbury Hill. The season was now so far advanced, and the weather in consequence so variable, that it was not until the 21st that I was able to commence my observations. These though few in number, were made with such minute precautions, and under such favourable circumstances, as to be perfectly satisfactory to me. The following Tables contain the results.

Transits observed at ARBURY HILL.

Stars.	October 21.	October 25.	October 26.
	h. m. s.	h. m. s.	h. m. s.
The Sun	11.44.28,39	—	11.43.17,93
σ Aquilæ	5.31.39,53	5.15.30,75	5.11.29,10
α Aquilæ	5.43.19,17	5.27.10,42	5.23. 8,78
θ Aquilæ	6. 3.16,55	5.47. 7,78	5.43. 6,05

Rate of the clock at ARBURY HILL. (*Losing.*)

Stars.	From 21 to 25.	From 21 to 26.	From 25 to 26.
	s.	s.	s.
The Sun .	—	6,23	—
σ Aquilæ .	6,30	6,20	5,76
α Aquilæ .	6,30	6,19	5,75
θ Aquilæ .	6,30	6,21	5,84
Mean by the Stars . .	6,30	6,20	5,78
Mean by the Sun . .	—	6,23	—

Vibrations of the Pendulum at ARBURY HILL.
The clock making 86393,80 vibrations in a mean solar day.

Date.		Barometer.	Thermom.	Vibrations in 24 hours.	Correction for Temp.	Vibrations in 24 hours, at 62 degrees.
Oct.			°			
21	A. M.	—	—	—	—	—
	P. M.	29,65	56,7	86059,25	2,24	86057,01
22	A. M.	29,52	54,2	86060,66	3,30	86057,36
	P. M.	29,50	54,4	86060,52	3,22	86057,30
23	A. M.	29,50	52,8	86061,07	3,89	86057,18
	P. M.	29,52	53,2	86060,88	3,72	86057,16
24	A. M.	29,57	50,8	86061,40	4,74	86056,66
	P. M.	29,55	50,6	86061,28	4,82	86056,46
25	A. M.	29,56	50,9	86061,40	4,70	86056,70
	P. M.	29,54	52,3	86061,00	4,10	86056,90
26	A. M.	29,55	52,2	86060,63	4,15	86056,48
	P. M.	29,55	53,7	86060,12	3,51	86056,61
Mean		29,55	52,9			86056,83

From the preceding Tables were deduced the following vibrations in a mean solar day.

By the Stars. ARBURY HILL.				
From	To	Correct Vibrations in a mean solar day.	No. of Stars observed.	Interv. of Transits.
22 A. M.	25 P. M.	86056,86	3	4
22 A. M.	26 P. M.	86056,88	3	5
26 A. M.	26 P. M.	86056,96	3	1
By the Sun.				
21 P. M.	26 A. M.	86056,89	2	5

From the number of stars observed, and the intervals of the transits, we derive 86056,88 for the mean by the stars, 86056,89 by the sun, and 86056,88 for the final mean number of vibrations in 24 hours.

The barometer being at 29,55 inches, and the thermometer at 52°,9 we have 6,04 for the correction on account of the buoyancy of the atmosphere.

The angle of elevation of the top of the tent on Arbury Hill, taken by the repeating circle from the station where the clock was placed, was found to be 1°.28′.21″,4; and as it will appear in the Appendix, that the distance from the station on Arbury Hill to the clock, was 3048 feet, we have 78 feet very nearly for the elevation of the top of the tent above the pendulum. The elevation of Arbury Hill above the sea, as determined by the Trigonometrical Survey, is 804 feet, from which deducting 67 feet, (the height of the tent being 11 feet,) we obtain 737 feet for the elevation of the pendulum above the

level of the sea, the correction for which is $3,04 \times \frac{7}{10} = 2,13$. These corrections being applied, we have 86065,05 for the number of vibrations which would be made by the pendulum in a mean solar day in vacuo and at the level of the sea.

On leaving Arbury Hill, I hastened to Dunnose in the Isle of Wight, anxious to complete my experiments before the winter; but on arriving there, I found the weather so bad, that after a short stay I was reluctantly obliged to postpone my observations at that station until the following spring.

Operations at London.

Before I left London in June, I took four series of vibrations of the pendulum at a high temperature, at Mr. BROWNE's house in Portland Place; chiefly with a view to afford me the means of checking my expansion of the pendulum by a comparison with other series of vibrations, which I purposed to observe at a low temperature on my return, and also to enable me to form some idea of the acceleration, when I should arrive at Unst. For the rate of the clock I am indebted to the observations of Mr. BROWNE. The results are contained in the following Table.

Vibrations of the Pendulum at LONDON.—1st Series.

Date, 1818.	Barometer.	Thermom.	Vibrations in 24 hours.	Correction for Temp.	Correct Vibrations in a mean solar day at 62 degrees.
June 13	29,90	71°,6	86051,32	4,06	86055,38
14	30,00	70,1	86051,90	3,43	86055,33
15	30,05	69,9	86051,99	3,34	86055,33
16	29,95	70,5	86051,82	3,60	86055,42
Mean	29,98	70,5			86055,36

The barometer being at 29,98 inches, and the thermometer

at 70°,5 the correction for the buoyancy of the atmosphere is 5,91.

The height of the pendulum above the level of the sea was 83 feet, the correction for which is $0,34 \times \frac{66}{100} = 0,22$.

These corrections being applied, we have 86061,49 vibrations in a mean solar day, at the temperature of 62° in vacuo, and at the level of the sea.

Various causes prevented me from repeating my experiments in London, until the month of March, when the following results were obtained, the observations on which they are founded being detailed in the Appendix.

Vibrations of the Pendulum at LONDON.—2nd Series.

Date. 1819.	Barometer.	Thermom.	Vibrations in 24 hours.	Correction for Temp.	Correct Vibrations in a mean solar day, in vacuo at 62°
March 8	30,10	° 50,0	86060,12	5,08	86055,04
9	30,10	50,1	86060,21	5,03	86055,18
15	30,14	51,8	86059,41	4,32	86055,09
16	30,00	52,7	86058,98	3,93	86055,05
17	30,10	53,5	86058,92	3,60	86055,32
18	30,21	52,8	86058,93	3,89	86055,04
Mean	30,11	51,8			86055,12

The correction for the buoyancy of the atmosphere is 6,18, and that for the height above the level of the sea, 0,22. We have therefore 86061,52 for the number of vibrations at 62° in vacuo, and at the level of the sea.

So very near an agreement with my former observations, after an allowance for a difference of temperature amounting to 18°,7 I could scarcely have dared to hope for, and it afforded me a most satisfactory assurance, not only that the

knife edge of the pendulum had suffered no injury from use, but that my allowance for expansion was correct, a circumstance of the greatest importance to the truth of my results, and respecting which there might have been most reason to apprehend error.

Operations at the Isle of Wight.

On the 8th May 1819, I again left London for the Isle of Wight. Dunnose, the most southern station of the meridional arc of the Trigonometrical Survey, is marked by an iron gun, sunk in the ground on the summit of a hill near the village of Shanklin, a little to the north of a signal post.* The nearest house to this station is Shanklin Farm, in the occupation of Mr. JOLLIFFE, from whom and from the proprietor, the Rev. Mr. WHITE, I most readily received permission to make use of a summer house, well suited to the purpose, for my experiments.

The observations made at this station are detailed in the Appendix. The weather was very favourable after the 12th; and though before that period I was not able to obtain the transit of more than one star and of the sun, these observations were satisfactory. The results are contained in the following Tables.

Transits observed at SHANKLIN FARM.

Stars.	May 10.	May 11.	May 12.	May 13.	May 14.	May 15.	May 16.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
The Sun	—	0.0.49,49	—	0.0.26,89	0.0.16,44	0. 0. 6,51	11.59.57,71
Regulus	6.52.37,32	—	—	6.40.21,23	—	6.32.10,35	6.28. 5,65
x.	—	—	9.11.21,26	—	—	—	8.55. 0,74
ε Virginis	—	—	9.38.24,16	—	—	—	9.22. 2,83
α Virginis	—	—	10. 0.49,30	—	—	—	9.44.28,08
τ Bootæ	—	—	10.23.46,29	—	—	—	10. 7.25,28
η Bootæ	—	—	10.31. 9,37	—	—	—	10.14.38,58
Arcturus	—	—	10.52.26,25	—	—	—	10.36. 5,44

* The height on which the station is situated, is properly called *Shanklin Down*; Dunnose is the next projecting point to the southward.

Rate of the clock at SHANKLIN FARM.—(*Losing.*)

Stars.	From 10 to 13.	From 10 to 15.	From 10 to 16.	From 11 to 13.	From 11 to 14.	From 11 to 15.	From 11 to 16.	From 12 to 16.	From 13 to 14.	From 13 to 15.	From 13 to 16.	From 14 to 15.	From 14 to 16.	From 15 to 16.
	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.	s.
The Sun .	—	—	—	9,35	9,38	9,42	9,34	—	9,45	9,49	9,33	9,53	9,26	9,00
Regulus .	9,48	9,51	9,40	—	—	—	—	—	—	9,56	9,31	—	—	8,82
x .	—	—	—	—	—	—	—	9,25	—	—	—	—	—	—
α Virginis .	—	—	—	—	—	—	—	9,40	—	—	—	—	—	—
ζ Virginis .	—	—	—	—	—	—	—	9,42	—	—	—	—	—	—
τ Bootæ .	—	—	—	—	—	—	—	9,37	—	—	—	—	—	—
η Bootæ ,	—	—	—	—	—	—	—	9,32	—	—	—	—	—	—
Arcturus .	—	—	—	—	—	—	—	9,32	—	—	—	—	—	—
Mean by Regulus	9,48	9,51	9,40	—	—	—	—	—	—	9,56	9,31	—	—	8,82
Mean by the other Stars	—	—	—	—	—	—	—	9,35	—	—	—	—	—	—
Mean by the Sun . .	—	—	—	9,35	9,38	9,42	9,34	—	9,45	9,49	9,33	9,53	9,26	9,00

Vibrations of the Pendulum at SHANKLIN FARM,

The clock making 86390,60 vibrations in a mean solar day.

Date.		Barometer.	Thermom.	Vibrations in 24 hours.	Correction for Temp.	Vibrations in 24 hours at 62 degrees.
May 11	A. M.	30,17	60,9°	86052,14	0,47	86051,67
	P. M.	30,16	61,8	86051,73	0,08	86051,65
12	A. M.	30,10	61,0	86051,96	0,42	86051,54
	P. M.	30,09	61,3	86051,85	0,30	86051,55
13	A. M.	30,08	60,8	86051,73	0,51	86051,22
	P. M.	30,08	61,0	86051,64	0,42	86051,22
14	A. M.	30,14	60,5	86052,14	0,63	86051,51
	P. M.	30,10	60,8	86051,97	0,51	86051,46
15	A. M.	30,05	60,9	86051,44	0,47	86050,97
	P. M.	30,05	61,3	86051,28	0,30	86050,98
16	A. M.	30,03	60,1	86051,70	0,80	86050,90
	P. M.	30,03	60,7	86051,34	0,55	86050,79
Mean		30,09	60,9			86051,29

From the preceding tables were deduced the following vibrations in a mean solar day.

By Regulus., SHANKLIN FARM.				
From	To	Correct vibrations in a mean solar day.	No. of stars observed.	Interv. of Trans.
11 A. M.	13 P. M.	86051,39	1	3
11 A. M.	15 P. M.	86051,27	1	5
11 A. M.	16 P. M.	86051,29	1	6
14 A. M.	15 P. M.	86051,17	1	2
14 A. M.	16 P. M.	86051,19	1	3
16 A. M.	16 P. M.	86051,42	1	1
By other Stars.				
13 A. M.	16 P. M.	86051,18	6	4

By the Sun.				
From	To	Correct vibrations in a mean solar day.	No. of stars observed.	Inter. of Transits.
11 P. M.	13 A. M.	86051,54	2	2
11 P. M.	14 A. M.	86051,47	2	3
11 P. M.	15 A. M.	86051,37	2	4
11 P. M.	16 A. M.	86051,36	2	5
13 P. M.	14 A. M.	86051,31	2	1
13 P. M.	15 A. M.	86051,20	2	2
13 P. M.	16 A. M.	86051,24	2	3
14 P. M.	15 A. M.	86051,08	2	1
14 P. M.	16 A. M.	86051,22	2	2
15 P. M.	16 A. M.	86051,34	2	1

The number of stars observed and the intervals between the transits being employed as before to obtain a mean, we have 86051,28 vibrations by Regulus, 86051,18 by the other stars, and 86051,34 by the sun; and the sum of the respective factors being 20, 24, and 48, we obtain 86051,28 for the final mean number of vibrations in 24 hours.

The mean height of the barometer being 30,09 inches, and that of the thermometer 60°,9, the correction for the buoyancy of the atmosphere is 6,09.

It may be seen in the Appendix, that the height of Dunnose above the summer house, deduced from the distance and angle of elevation of the signal post, is 539 feet; and as Dunnose is stated, in the Trigonometrical Survey, to be 792 feet above the level of the sea, this would give 253 feet for the elevation of the pendulum above the sea. But by observations made with a barometer of Sir HARRY ENGLEFIELD'S construction, on three several days, the greatest difference of the results being eight feet, the mean elevation of the summer house above high water mark appeared to be 221 feet; and if 10 feet be allowed for the fall of the tide, we have 231 feet, for the height of the pendulum above low water, differing

from the former result 22 feet. The height of Dunnose above the summer house, was also deduced barometrically, and appeared to be 513 feet, differing from the trigonometrical determination 26 feet in defect. If this difference be attributed to error in the barometer, as is most probably the fact, the proportional error in the elevation of the summer house, determined barometrically, will be 11 feet, and this being added to 231 feet, we have 242 feet for the height of the pendulum above the level of the sea, which is probably within eleven feet of the truth.

The correction due to an elevation of 242 feet, is $0,997 \times \frac{7}{10} = 0,70$; and this, together with the correction for the buoyancy of the atmosphere being added to the number of vibrations before found, we obtain 86058,07 for the number of vibrations which would be made by the pendulum in a mean solar day, in vacuo, and at the level of the sea.

Of the Latitudes and Longitudes of the different Stations.

The daily rate of Mr. BROWNE's chronometer before I left London, was $-0^s,2$ the chronometer being too slow for Greenwich time on the 15th June $1^m.15^s,75$; but this rate, as might have been expected, varied from the motion of the waggon or other causes, so that at Unst, its mean rate was $-1^s,32$, at Portsoy $-1^s,7$, and at Leith $-2^s,42$, which rates are deduced from the column headed " chronometer," in the table of transits given in the Appendix.

The meridian of my station at Leith Fort, passed within 40 feet of that of the observatory on the Calton Hill, the longitude of which Mr. JARDINE, who has the care of the observatory, informed me, is $12^m.46^s,7$ west of Greenwich, which may also be considered as the longitude of my station. At Leith Fort, on the 17th September, by two sets of altitudes of the sun, taken with the repeating circle and given in the Appendix, the chronometer was found to be $8^m.41^s,6$ too fast, and as it was slow at Greenwich on the 15th June $1^m.15,75$, it had lost between that period and the 17th September, $2^m.49^s,35$, which is at the rate of $1^s,8$ daily.

At Unst, by four series of altitudes of the sun, taken on the 22d July with the repeating circle, (which I conceive it is unnecessary to detail, as the results differed very little from each other) the chronometer appeared to be $50^s,2$ fast, to which $1^m.15^s,75$ being added, and also $1^m.6^s,6$ (the loss of the chronometer in 37 days) we obtain $3^m.12^s,55$ for the longitude of Unst in time, west of Greenwich.

Again. Taking Leith for the point of departure, we have the chronometer fast on the 17th September $8^m.41^s,6$, and at

Unst, on the 22d July, $50^s,2$. The mean of the rates of the chronometer at Unst, Portsoy, and Leith, gives $1^s,81$ for the mean daily rate, which being multiplied by 57, the number of days between the 22d of July and the 17th September, we have $1^m.43^s,17$ for the loss of the chronometer during that period. This being added to $8^m.41^s,6$, we obtain $10^m.24^s,77$ for the error of the chronometer on the 22d July, for the meridian of Leith, and subtracting $50^s,2$ (the error at Unst) the remainder $9^m.34^s,57$ will be the longitude of Unst, east of Leith. Now the longitude of Leith being $12^m.46^s,7$ west, the difference $3^m.12^s,13$ will be the longitude of Unst, west of Greenwich. This agreeing so nearly with the preceding result, may perhaps be considered as not very far from the truth.

At Portsoy on the 3d August, the chronometer was found to be $7^m.52^s,3$ too fast, by altitudes of the sun, which are detailed in the Appendix. The loss of the chronometer from the 15th June to the 3d August, at the daily rate of $1^s,8$ is $1^m.28^s,2$; which, together with $1^m.15^s,75$ (the error of the chronometer at Greenwich on the 15th June) being added to $7^m.52^s,3$, we obtain $10^m.36^s,25$ for the longitude of Portsoy, west of Greenwich.

In order to deduce the longitude of Portsoy from that of Unst, we have the chronometer fast at Unst on the 22d July $50^s,2$, and at Portsoy on the 3d August $7^m.52^s,3$. The mean of the daily rates at Unst and Portsoy is $1^s,51$, and the loss from the 22d July to the 3d August, at this rate, is $18^s,12$. Hence we have Portsoy west of Unst $7^m.20^s,22$, and the longitude of Unst from Greenwich being $3^m.18^s,87$, we have the

longitude of Portsoy 10^m.39^s,09 west of Greenwich. The mean of this, and the preceding result being 10^m.37^s,67, is perhaps not many seconds distant from the truth. I must however remark, that from the variation in the rate of the chronometer, I do not rely upon these longitudes beyond the purpose to which they are to be applied, that of finding the sun's declination at apparent noon.

The instrument used for determining the latitudes, was the repeating circle, of one foot diameter, mentioned at the commencement of this Paper. Of the power of the repeating circle I had ever entertained the most favourable opinion; and I had now an opportunity of bringing it to the test of experiment, by connecting my stations with those of the trigonometrical survey, and comparing the latitudes obtained by the repeating circle with those deduced from observations made with the zenith sector.

As an error in latitude amounting to one minute, would not occasion a difference of one tenth of a vibration of the pendulum in 24 hours, I conceived it would have been an expense of time, which I could ill afford, to have waited for multiplied observations, except at certain stations, the latitudes of which I was anxious to ascertain with particular accuracy.

By the mean of numerous readings, I found the correction for the index error of my instrument to be + 18″; and the value of each division of the large level to be 2,″4.

In order to deduce the meridional zenith distance, from observations made near the meridian, I availed myself of a very convenient formula, for which I was indebted to Dr. Young, and which has since been published, together with a small table of verse sines, by order of the Commissioners of

Longitude. The refractions and corrections for the barometer and thermometer, are taken from Dr. BRINKLEY'S Tables, published with the observations made at the Royal Observatory at Greenwich.

In observations of the sun, the horary angle is estimated in solar time, but in those of the stars it must be expressed in sidereal time. It is most convenient, however, to employ the angle given by the chronometer in finding the correction of the apparent zenith distance, and afterwards to apply a further correction in the following manner.

Let r, be the daily loss of the chronometer on solar or sidereal time, according as the sun or star is observed; and let $r' = \frac{r}{86400 - r}$. Then calling the correction before found C, the final correction will be $(C + 2r'C)$. If the clock gain upon the star, C must be diminished by the quantity $2r'C$.

In using the repeating circle, it is of great importance that its plane should be truly vertical, or that its deviation should be known, in order to find the correction to be added on this account to the observed zenith distance. On my return to London, I found the error of my circle in this respect to be $4'.48''$, the correction for which may be obtained by the following formula:

$$\text{Sin.}\ \tfrac{1}{2}(z - z') = \frac{\text{sin.}^2\ \tfrac{1}{2}\ I.}{\text{tang.}\ z'}$$

where z is the true zenith distance, z' the observed zenith distance, and I, the angle of inclination of the plane of the circle. In the second member of the equation, z may be taken $= z'$ without error. These formulæ, as well as many others respecting the repeating circle, is demonstrated by M. BIOT, in his valuable "Traité élémentaire d'Astronomie Physique."

At Unst, the following series of observations for the zenith distance of the sun's upper limb was made under the most favourable circumstances. The calculation of the latitude of this, as well as of the other stations, is given at length, to afford the opportunity of any examination that may be thought desirable.

UNST. 23d July, 1818. Barometer 30 inches, thermometer 61°. Time of apparent noon 0ʰ.6ᵐ.2ˢ,3. The chronometer too fast 47ˢ,9. Time by the chronometer at apparent noon 0ʰ.6ᵐ.50ˢ,2.

Chronometer.	Level.		Time from Noon.	N. v. Sines.
h. m s.			m. s.	
23.49.39	+ 4	− 5	17.11	2809
23.51.46	+ 5	− 2	15. 4	2160
23.54.11	+ 3	− 3	12.39	1523
23.56.36	+ 2	− 3	10.14	0997
23.59.11	+ 4	− 1	7.39	0557
0. 1. 2	+ 4	− 0	5.48	0320
0. 3.29	+ 5	+ 2	3.21	0107
0. 6. 5	+ 3	− 1	0.45	0005
0. 9.41	+ 3	− 1	2.51	0077
0.11.23	+ 4	+ 3	4.33	0197
0.13.26	+ 4	+	6.36	0415
0.14.59	+ 4	+ 3	8. 9	0632
Mean	+ 45	− 5		0817

$\frac{(+45-5)}{2} \times 2'',4 = +48'',0$ correct. for the level.

Lat. 60°.45'.26" cosine	-	9.6888746
Dec. 20.10.57 cosine	-	9.9724798
Alt. 49.26.33 cos. co. ar.	-	0.1869458
Log. sine 1 co. ar.	- -	5.3144251
Const. log.		5.1627253
Log. 817 (+4)		6.9122221
Corr. —118",83 log.		2.0749474

Readings, &c. ☉'s U.L.

		° ' "
First Vernier	-	123.58.30,00
Second	- - -	58. 0,00
Third	- -	57.55,00
Fourth	- -	58.10,00
Mean	- -	123.58. 8,70
	+	360. 0. 0
Level	- - +	0.48
Index	- - +	0.18
		12)483.59.14,70
Observed Z. D.		40.19.56,22
Refract.	+	0.48,43
Paral.	- - —	0. 5,67
Semidiam.	+	15.46,50
Correct.	- —	1.58,83
Change of Dec.	+	0.2,16
(Z—Z')	- +	0,24
True Z. D.		40.34.29,05
Dec.	- - +	20.10.57,36
Lat. of Unst.	-	60.45.26,41

The spot where the above observations were taken, was that selected by M. Biot, the distance from which to the clock, measured on the meridian northward, was 182 feet $= 1,''79$.

Adding this to the observed latitude, we have 60°.45'.28",2 for the latitude of the station where the experiments with the pendulum were made.

The latitude of the spot where M. Biot's apparatus was fixed, and which was on the same parallel with mine, was determined by Lieut. Col. Mudge, by connecting it with his station on the island of Balta, where the zenith sector was erected, to be 60°.45'.29",6. But this latitude is dependent on that of Greenwich, which was taken at 51°. 28'. 40". By the observations however of the present Astronomer Royal, and the use of the French refractions, which are very nearly the same as those of Dr. Brinkley, the latitude of Greenwich appears to be 51°.28'.38",01, or 1",99 less than by former observations. This quantity being subtracted from Col. Mudge's determination, we have 60°.45'.27",61 for the latitude of the pendulum at Unst, deduced from the Trigonometrical Survey, and 60°.45'.28",2 by one series of zenith distances of the sun, taken with the repeating circle.

Latitude of Portsoy.

The following series of zenith distances of the sun's upper limb, was taken at the bottom of Mr. Watson's garden.

PORTSOY, 3d Aug. 1818. Barometer 30 inches, thermometer 65°. Time of apparent noon $0^h.5^m.51^s$. The chronometer too fast $7^m.52^s.58$. (See Appendix.) Time by the Chronometer at apparent noon $0^h.13^m.43^s,58$.

Chronometer.	Level.		Time from Noon.	N. v. Sines.
h. m. s.			m. s.	
0. 5.23	+ 3	+ 6	8.21	0664
0. 7.16	+ 4	+ 5	6.28	0398
0. 9. 8	+ 5	+ 7	4.36	0201
0.10. 7	+ 2	+ 3	3.37	0124
0.12.17	+ 4	+ 7	1.27	0020
0.13.36	— 5	— 3	0. 8	0000
0.15.43	— 10	— 6	1.59	0037
0.17.38	— 6	— 4	3.54	0145
0.20.36	+ 7	+ 9	6.52	0449
0.22.30	— 9	— 7	8.46	0732
0.24.58	+ 1	+ 3	11.14	1201
0.26.42	— 7	— 4	12.58	1600
Mean .	— 11	+ 16		464

$\frac{(-11+16)}{2} \times 2'',4 = +6''$ correction for the level.

Lat. 57°.40'.57"	cosine	-	9.7280375
Dec. 17.37.50	cosine	-	9.9791062
Alt. 49.56.53	cos. co. ar.	-	0.1914637
Log. sin. 1	co. ar.	-	5.3144251
	Const. Log.		5.2130325
	Log. 464 (+4)		6.6665180
	Cor. —75",78 Log.		1.8795505

Readings, &c. ☉'s U. L.		
		° ' "
1st Vernier	-	117.35.15,00
Second	- -	34.35,00
Third	- -	34.20,00
Fourth	- -	34.35,00
Mean	- -	117.34.41,25
	+	360. 0. 0,00
Level	- +	0. 0. 6,00
Index	- - +	0. 0.18,00
	12)	477.35. 5,25
Observed Z. D.	-	39.47.55,44
Refract.	- +	0.46,43
Paral.	- —	0. 5,61
Semidiam.	- +	15.47,77
Correct	- —	1.15,78
Change of Dec.	—	0. 1,15
(Z—Z')	+	0,26
True Z. D.		40. 3. 7,36
Dec.	+	17.37.50,03
Lat. of Portsoy.		57.40.57,39

The distance from the place where the latitude was determined to the pendulum, measured on the meridian, was 129 feet, which is equal to 1",26.

This being added to the observed latitude we obtain 57°.40'.58",65 for the latitude of the pendulum.

In order to deduce my latitude from that of Cowhythe, a station was chosen on a small eminence called Portsoy Hill,

294 feet north of the spot where my observations for latitude were made. At this station the oblique angle between Cowhythe and Knock Hill was observed by four repetitions

to be - - - - -	117°.56′.50″,44
The zenith distance of Cowhythe -	88. 38. 40
——— of Knock Hill -	83. 8. 51
Whence the angle between Cowhythe and Knock Hill, reduced to the horizon, is - -	118.°21′.35″,64
Cor. for the excentricity of the telescope +	1, 70
True horizontal angle -	118. 21. 37, 34

The station at Cowhythe is marked by a conical mass of masonry, which obliged me to place the instrument at the distance of eight feet from its centre, in the direction of Portsoy Hill.

The oblique angle at this spot between Knock Hill and

Portsoy Hill, was - - -	54°.23′. 3″
The zenith distance of Knock Hill - -	88. 30. 25
——— of Portsoy Hill -	91. 23. 30
Hence the angle between Knock Hill and Portsoy Hill, reduced to the horizon, is - - -	54°.18′.49″
Reduction to the centre of the station -	— 31,5
Cor. for the excentricity of the telescope	— 1,7
True horizontal angle -	54. 18. 15,8

The distance from Cowhythe to Knock Hill, by the trigonometrical survey, is 42633 feet, Knock Hill being to the south west 31°.57′.8″. We have then the following triangle to determine the distance from Cowhythe to Portsoy Hill:

Cowhythe	54°.18'.15",8	to Portsoy Hill	6182
Knock Hill	7.20. 6,9		——
Portsoy Hill	118.21.37,3		

If the angle at Cowhythe be added to 31°.57'.8", we have 86°.15'.23",8 for the bearing of Portsoy Hill, to the south-west from Cowhythe, from which and the distance of Cowhythe from Portsoy Hill, we obtain 404 feet for the distance of Portsoy Hill to the south on the meridian.

The latitude of Cowhythe, by the Trigonometrical Survey, is 57°.41'.11" from which deducting 4",02 for the distance on the meridian, 1",99 the error of the former latitude of Greenwich, and 2",92 the arc due to 294 feet, we obtain 57°.41'.2",07 for the latitude of my station, deduced from that of Cowhythe, and differing 4",68 in excess from the latitude given by the Repeating Circle.

These observations for connecting my station with Cowhythe were made under various unfavourable circumstances, and indeed I am not quite sure that the object I took on Knock Hill was in fact the station; for a pole originally placed in the centre of a cone of masonry, as at Cowhythe, has been taken away, and it was some time before I could decide which to choose among two or three eminences resembling each other, which happen to be upon the hill. The preceding result therefore can be considered only as a proof that no error of consequence is to be feared in my determination of the latitude of Portsoy.

Latitude of Leith Fort.

At Leith Fort, the two following series of observations were made, the sun being frequently obscured by flying clouds.

The first station was at the Flag staff, the second station 43 feet to the south of it.

LEITH FORT, 13th September 1818. Barometer 30,25 inches, thermometer 62°. Time of apparent noon $23^h.55^m57^s,2$. The chronometer too fast $8^m.49^s,58$. (See Appendix.) Time by the chronometer at apparent noon $0^h.4^m.46^s,78$.

Chronometer.	Level.		Time from Noon.	N. v. sines.
h. m. s.			m. s.	
23.55.25	+ 3	— 5	9.22	0835
23.58.39	+ 1	— 7	6. 8	0358
0. 1.47	+ 7	— 0	3. 0	0086
0. 4.20	+ 5	— 3	0.27	0002
0.14.16	+ 6	— 7	9.29	0856
0.16.17	+ 7	— 6	11.30	1259
Mean	+ 29	— 28		566

$\frac{(+29-28)}{2} \times 2'',4 = -1'',2$ correct. for the level.

Lat. 55°.58'.41" cosine	-	9.7478082
Dec. 3.56.28 cosine	-	9.9989718
Alt. 37.57.47 cosine co. ar.		0.1032492
Log sin, 1 co. ar.	-	5.3144251
Const. log.		5.1644574
Log. 566 (+4)		6.7528164
Cor. — 82"66 Log.		1.9172738

Readings, ☉'s U. L.

			° ' "
1st. Vernier	-		310.39.15
Second	-	-	38.50
Third	-	-	38.50
Fourth	-	-	38.55
Mean	-	-	310.38.57,50
Level	-	—	1,23
Index	-	+	18,00
			6)310.39.14,30
Observed Z. D.		-	51.46.32,38
Refract.		+	1.12,78
Paral.	-	—	6,88
Semidiam.	-	+	15.56,20
Correct.	-	—	1.22,66
Change of Dec.		+	0. 1,28
(Z—Z')		+	0,16
True Z. D.	-		52. 2.13,26
Dec.	-	+	3.56.27,74
Lat. of the Flag Staff.			55.58.41,00

LEITH FORT, 17th Sept. 1818. Barometer 30,05 inches, thermometer 66°. Time of apparent noon 23^{h}.54^{m}.32^{s},8. The Chronometer too fast 8^{m}.42^{s},18 (see Appendix.) Time by the chronometer at apparent noon 0^{h}.3^{m}.14^{s},98.

Chronometer.	Level.		Time from Noon.	N. v. Sines.
h. m. s.			m. s.	
23.52.28	+ 14	— 7	10.47	1107
23.54.21	+ 10	— 10	8.54	0754
0.10. 6	+ 25	— 0	6.51	0447
0.11.26	+ 10	— 15	8.11	0637
0.13. 6	+ 23	— 0	9.51	0923
0.14.19	+ 7	— 15	11. 4	1166
Mean .	+ 89	— 47		839

$\frac{(+89-47)}{2} \times 2'',4 = +50'',4$ correct. for the level.

	° ′ ″		
Lat.	55.58.41	cosine -	9.7478082
Dec.	2.24. 2	cosine - -	9.9996187
Alt.	36.25.20	cosine co. ar. -	0.0943857
Log. sin.	1	co. ar. -	5.3144251
		Const. Log.	5.1562377
		Log. 839 (+4)	6.9237620
		Corr, —120″,23 Log.	2.0799997

Readings, &c. ☉'s U. L.		
		° ′ ″
1st Vernier -		319.56.45
Second - -		30
Third - -		30
Fourth - -		15
Mean - -		319.56.30
Level - -	+	50,40
Index - -	+	18,00
	6)	319.57.38,40
Observed Z. D.	-	53.19.36,40
Refract. -	+	1.15,85
Paral. - -	—	7,03
Semidiam - -	+	15.57,27
Correct. - -	—	2. 0,23
Change of Dec.	—	2,63
(Z—Z′)	+	0,15
True Z. D.		53.34.39,76
Dec.	+	2.24. 1,63
		55.58.41,39
Deduct. for diff. of Stations, (43 ft.)	—	0,43
Lat. of the Flag Staff		55.58.40,96

By the Trigonometrical Survey, the latitude of the Flag staff of Leith Fort, is 55°.58′.41″, but from this 1″,99 must be subtracted as before. We have then 55°.58′.39″,01 for the latitude of the Flag staff, from which that obtained by the repeating circle under unfavourable circumstances differs 1″,97 in excess.

The distance of the clock from the Flag staff was 180 feet to the north, and the corresponding arc 1″,8 being added

to 55°.58'.39", we have 55°.58'.40",8 for the latitude of the pendulum.

Latitude of Clifton.

In "an account of the measurement of an arc of the meridian," by Lieut. Col. MUDGE, a singular anomaly presents itself, which since the year 1802, when this measurement was made, has been considered with much interest, and in various points of view by the scientific world. Instead of the degrees of the meridian *increasing* with the latitude, as is the case in an oblate spheroid, they appear by this measurement to *decrease*. This remarkable circumstance was examined by Don JOSEPH RODRIGUEZ, in an ingenious paper published in the Philosophical Transactions for 1812. The author proceeding according to a method of verification given by M. DELAMBRE in the "Base Métrique," calculates upon the elliptic hypothesis the length of the whole arc and of each of its parts in seconds, and from the observed latitude of Clifton, the northern extremity of the arc, deduces that of Dunnose, the southern extremity, and of Arbury Hill, an intermediate station which divides the total arc into two nearly equal parts. Don JOSEPH RODRIGUEZ then compares the celestial arcs given by Col. MUDGE's observations, with those resulting from his own calculations, and concludes that the total *observed* arc between Clifton and Dunnose is in excess 1",38; that, between Clifton and Arbury 4",77; and that the southern portion of the arc between Arbury Hill and Dunnose, is 3",39 in defect. The author adds, that "it seems almost beyond a "doubt, that it is to errors in the observations of latitude, "that the appearance of progressive augmentation of degrees "towards the equator is to be ascribed," and that "it is espe-

"cially at the intermediate station at Arbury Hill, that the "observations of the stars are erroneous nearly 5″, notwith-"standing the goodness of the instruments and the skill and "care of the observer."

An error at Arbury Hill amounting to 5″, could scarcely be supposed possible with such an instrument as the zenith sector, in the hands of Col. MUDGE; and the less so, from its appearing that the latitude of Blenheim, deduced trigonometrically from that of Arbury Hill, differed only a fraction of a second from the latitude obtained by the observations made with RAMSDEN's quadrant at Blenheim observatory. On the other hand, it is not surprising that so great a deviation of the plumb line from the vertical as 5″,* which would indicate the existence of a disturbing force very nearly equal to that exerted by the mountain Schehallion, should be received with much caution. It became therefore very desirable to endeavour to throw some light on this interesting question, by additional observations at Clifton, Arbury Hill, and Dunnose, for the latitudes of those important stations, an operation to which I felt confident that my repeating circle would not be found inadequate.

Before I proceed to detail the observations made at Clifton, I must observe, that in the repeating circle, as usually constructed in England, the level turns on the axis, and when clamped, is carried with the circle, which renders an additional operation necessary at each repetition, to bring back the level to its former horizontal position. Imagining that if I could obviate this, it would be a considerable saving of time, I had a

* The weight of the plumb line is drawn towards the *north* and not to the *south*, as is stated by Col. MUDGE, who probably meant to express the direction of the inclination from the vertical.

contrivance executed at Edinburgh, by which I could fix the level very firmly in its horizontal position to the pillar of the instrument. This being done, the following observations were made for the zenith distance of the pole star. The corrections for precession, &c. are those used at the Royal Observatory at Greenwich, and the mean polar distance of the pole star is that resulting from the latest observations of the Astronomer Royal.

The transit instrument was within one second in time of the meridian, the error of the chronometer was therefore deduced from the passage of the sun.

CLIFTON, 3d October, 1818. Barometer 29,20 inches, thermometer 44°, chronometer too fast 5ˢ,15. Pole star on the meridian by the chronometer 12ʰ.8ᵐ.48ˢ,5.

Chronometer.	Level		Time from the meridian.	N. v. Sines.
h. m. s.			m. s.	
11.54.24	+ 20	— 16	14.25	1978
11.58. 9	+ 7	— 30	10.40	1083
12. 1.17	+ 9	— 31	7.32	0540
12. 6.12	+ 20	— 20	2.37	0065
12.10.16	+ 18	— 20	1.27	0020
12.14.15	+ 11	— 26	5.26	0281
12.16.55	+ 16	— 23	8. 6	0624
12.20. 0	+ 7	— 30	11.11	1190
12.24.12	+ 19	— 20	15.23	2252
12.27.10	+ 4	— 33	18.21	3204
Mean -	+131	—249		1124

$\frac{+131-249}{2} \times 2'',4 = -1'.41'',6$ correct. for level.

Lat. 53°.27'.41''	cosine	- -	9.7747828
Dec. 88.20.28	cosine	- -	8.4616340
Alt. 55. 7.13	cosine co. ar.	-	0.2427136
Log. sin.	1 co. ar.	-	5.3168000
		Const. Log.	3.7959304
		Log. 1124(+4)	7.0507663
		Correct. —7'',026 Log.	0.8466967

Readings, &c.

1st Vernier	-		348°.44'. 0''
Second	- -		43.50
Third	- -		43.37
Fourth	- - -		43.25
Mean	- -		348.43.43
Level	- -	—	1.41,6
Index	- -	+	0.18,0
		10)	348.42.19,5
Observed Z. D.	-		34.52.13,94
Refract.	-	+	40,14
Correct.	-	—	7,03
2r'C.		—	0,04
(Z—Z')		+	0,30
True Z. D.			34.52.47,31
Mean PD. for 1818		+	1.39.44,15
Precession, &c.	-	—	12,40
Co. Lat.			36.32.19,06
Lat. of Clifton			53.27.40,94

CLIFTON, 5th October, 1818. Barometer 29,0 inches, thermometer 42°, chronometer too fast 2s,8. Pole star on the meridian by the chronometer, 12h.0m.54s,4.

Chronometer.	Level.		Time from the meridian.	N. v. Sines.
h. m. s.			m. s.	
11.39.20	+ 32	— 24	21.34	4424
11.45.11	+ 16	— 39	15.43	2350
11.51.10	+ 26	— 33	9.44	0902
11.55.13	+ 30	— 29	5.41	0307
11.58.10	+ 26	— 34	2.44	0071
12. 1.50	+ 31	— 29	0.56	0008
12. 5.28	+ 25	— 36	4.34	0198
12. 8.17	+ 32	— 29	7.23	0519
12.12.55	+ 36	— 24	12. 1	1374
12.16.10	+ 23	— 37	15.16	2218
12.18.50	+ 24	— 38	17.56	3060
12.25.10	+ 27	— 34	24.16	5600
	+328	—386		175

$\frac{(+328-386)}{2} \times 2'',4 = -69'',6$ cor. for the level.

Const. Log.	- -	3.7959304
Log. 1753 (+4)	- -	7.2437819
Cor. —10″,96 Log.	-	1.0397123

Readings, &c.

		° ′ ″
1st Vernier	-	58.27.50
Second	- - -	40
Third	- -	10
Fourth	- -	35
Mean	- -	58.27.33,75
	+	360. 0. 0
Level	- - —	1. 9,60
Index .	- +	0.18,00
	12)	418.26.42,15
Observed Z. D.	-	34.52.13,51
Refract.	- - +	40,03
Correct.	- - —	10,96
2 r′C.	- —	0,06
(Z—Z′)	- +	0,30
True Z. D.	-	34.52.42,82
Mean P. D. for 1818	+	1.39.44,15
Precession, &c.	- —	13,17
Co. Lat.		36.32.13,80
Lat. of Clifton		53.27.46,20

Clifton, 6th October, 1818. Barometer 29,20 inches, thermometer 42°, chronometer too fast 1ˢ,0. Pole star on the meridian by the chronometer 11ʰ.56ᵐ.56ˢ,7.

Chronometer.	Level.		Time from the meridian.	N. v. Sines.	Readings, &c.	
h. m. s.			m. s.			° ′ ″
11.33.50	+ 30	— 21	23. 7	5083	1st Vernier -	197.55.50
11.38.33	+ 24	— 29	18.24	3221	Second - -	25
11.41.25	+ 4	— 53	15.32	2296	Third - -	20
11.44.25	+ 43	— 12	12.32	1495	Fourth - -	50
11.46.53	+ 17	— 39	10. 4	0964		
11.50.15	+ 41	— 15	6.42	0427	Mean - -	197.55.36,25
11.53. 5	+ 24	— 30	3.52	0142		+ 360. 0. 0
11.56.25	+ 37	— 19	0.32	0003	Level - -	+ 52,80
11.59.23	+ 30	— 25	2.26	0056	Index - -	+ 18,00
12. 1.55	+ 32	— 25	4.58	0235		
12. 5.25	+ 36	— 18	8.28	0682		16) 557.56.47,05
12. 8. 5	+ 27	— 30	11. 8	1180		
12.11.15	+ 14	— 44	14.18	1946	Observed Z. D. -	34.52.17,94
12.14.43	+ 41	— 15	17.46	3003	Refract. - -	+ 40,31
12.17.25	+ 26	— 30	20.28	3985	Correct. - -	— 11,80
12.21. 0	+ 40	— 17	24. 3	5501	2 r′C. -	— 0,06
					(Z—Z′) -	+ 0,30
Mean -	+466	—422		1888		
					True Z. D. -	34.52.46,69
					Mean P. D. for 1818	+ 1.39.44,15
					Precession, &c. -	— 13,56
					Co. Lat.	36.32.17,28
					Lat. of Clifton -	53.27.42,72

$\frac{(+466''-422'')}{2} \times 2,4'' = +52,8$ cor. for the level.

Const. Log. - -	3.7959304
Log. 1888 (+4) - -	7.2760020
Correct.—11″,80 Log. -	1.0719324

On comparing the three preceding results, a difference may be perceived between them amounting to 5″,24; and as I felt assured that the principle of the repeating circle was too perfect to allow of an error of this magnitude, a little reflection led me to discover the cause, to be my fancied improvement in fixing the level to the pillar of the instrument. For in turning the telescope on its axis, the friction, however slight it may be, tends to disturb the relative position of the circle

and level, and thus to introduce error. In the usual construction the level may be clamped to the circle, and then it moves with it without any risk of derangement. This construction was indispensable, in order that the instrument might be used for taking terrestrial angles, and it is to this, perhaps originally accidental circumstance, that the repeating circle is indebted for its very near approach to perfection. After I had restored the instrument to its former state, the following observations were made.

CLIFTON, 8th October, 1818. Barometer 29,60 inches, thermometer 46°. Chronometer too slow 2s,9. Pole star on the meridian by the chronometer 11.h49m.1s.

Chronometer.	Level.		Time from the meridian.	N. v. Sines.
h. m. s.			m. s.	
11.22.10	+ 23	— 24	26.51	6855
11.25.35	+ 26	— 23	23.26	5223
11.30.20	+ 24	— 24	18.41	3321
11.33.12	+ 24	— 24	15.49	2380
11.37.10	+ 21	— 27	11.51	1336
11.40.12	+ 24	— 25	8.49	0740
11.44. 7	+ 22	— 28	4.54	0229
11.48.10	+ 24	— 25	0.51	0007
11.53.30	+ 24	— 25	4.29	0191
11.57. 0	+ 26	— 24	7.59	0607
12. 0.10	+ 29	— 19	11. 9	1183
12. 3. 8	+ 22	— 28	14. 7	1896
12. 6.37	+ 27	— 22	17.36	2947
12. 9.23	+ 23	— 28	20.22	3946
	+339	—346		2204

Readings, &c.		° ′ ″
1st Vernier		128.13. 0
Second		12,30
Third		12.25
Fourth		12.35
Mean		128.12.37,5
	+	360. 0. 0
Level	—	8,4
Index	+	18,0
	14)	488.12.47,1
Observed Z. D.		34.52.20,51
Refract.	+	40,52
Correct.	—	13,78
2r′C.	—	0,08
(Z—Z′)	+	0,30
True Z. D.		34.52.47,47
Mean P. D. for 1818	+	1.39.44,15
Precession, &c.	—	14.34
Co. Lat.		36.32.17,28
Lat. of Clifton		53.27.42,72

$\frac{(+339-346)}{2} \times 2'',4 = -8'',4$ cor. for the level.

Const. Log.	3.7959304
Log. 2204 (+4)	7.3432116
Correct.—13″,78 Log.	1.1391420

CLIFTON, 12th October, 1818. Barometer 29,56 inches, thermometer 47°, chronometer too slow 9s,0. Pole star on the meridian by the chronometer 11h.33m.11,6.

Chronometer.	Level.		Time from the meridian.	N. v. Sines.
h. m. s.			m. s.	
11.12.40	+ 22	— 26	20.32	4011
11.16.55	+ 26	— 22	16.17	2523
11.21.10	+ 24	— 24	12. 2	1378
11.24.25	+ 25	— 24	8.47	0734
11.27.45	+ 25	— 23	5.27	0283
11.31. 0	+ 25	— 25	2.12	0046
11.34.15	+ 28	— 21	1. 3	0010
11.37.25	+ 25	— 24	4.13	0169
11.41.12	+ 24	— 24	8. 0	0609
11.43.15	+ 25	— 24	10. 3	0961
11.47.47	+ 25	— 22	13.35	1756
11.50.38	+ 25	— 25	17.26	2892
11.54. 5	+ 25	— 23	20.53	4149
11.56.16	+ 26	— 24	23. 4	5061
	+350	—331		1755

$\frac{(+350-331)}{2} \times 2'',4 = +22'',8$ cor. for the level.

Const. Log. - -	3.7959304
Log. 1755 (+4) - -	7.2442771
Correct.—10″,97 Log. -	1.0402075

Readings, &c.		
		° ′ ″
1st. Vernier - -		128.12. 0
Second - -		11.30
Third - -		11.35
Fourth - -		11.25
Mean - - -		128.11.37,5
-	+	360. 0. 0
Level - -	+	22,8
Index - -	+	18,0
14)		488.12.18,3
Observed Z. D. -		34.52.18,45
Refract. - -	+	40,38
Correct. - -	—	10,97
2 r′C. -	—	0,06
(Z—Z′) -	+	0,30
True Z. D. -		34.52.48,10
Mean P. D. for 1818	+	1.39.44,15
Precession, &c. -	—	15,92
Co. Lat. -		36.32.16,33
Lat. of Clifton		53.27.43,67

The preceding results in one view are as follow:

	° ′ ″
	53.27.40,94
	53.27.46,20
	53.27.42,72
	53.27.42,72
	53.27.43,67
Mean	53.27.43,25

The difference between the two last results which were obtained after the instrument was restored to its original state, is not one second, and the mean of the three first differs only 0″,05, and of the two last results 0″,06 from the mean of the whole.

The station where the latitude was observed, was nine feet to the north of the chimney of the room in which the clock was placed; and allowing four feet for the distance of the clock from the chimney, we have 53°.27′.43″,12 for the latitude of the pendulum.

The distance of Laughton Spire from Clifton Beacon, by the Trigonometrical Survey, is 25409 feet, and its bearing 1°.56′.12″ to the south-west. With these data, and the angles observed on the azimuth circle of my instrument, and given in the Appendix, the distance on the meridian, from Clifton Beacon to the chimney of the room where the clock was placed, was found to be 1346 feet, to which nine feet being added, and the arc 13″,36 corresponding to this distance subtracted from the latitude before found, we have 53°.27′.29″,89 for the latitude of Clifton Beacon.

Before I availed myself of the distance of Laughton spire from Clifton Beacon, I had measured a base of 797 feet for the same purpose, and this gave the distance of the chimney from Clifton Beacon on the meridian 1323 feet; but as I could not see the same part of the chimney from both ends of the base, this determination serves merely to check that before given, and to render it highly probable that there cannot be an error of 10 feet, and perhaps not near so much in the distance first stated.

The observed arc between Greenwich and Clifton Beacon,

by the Trigonometrical Survey, is 1°.58.′51″,59, and this being added to 51°.28′.38″,01 (the latitude of Greenwich) gives 53°.27′.29″,60 for the latitude of Clifton Beacon, differing only 0″,29 in defect, from the result obtained by the repeating circle, and affording, it is presumed, a satisfactory proof (as far as this instrument is entitled to credit) of the accuracy of the observations made with the zenith sector, both at Clifton Beacon and at Greenwich.

Latitude of Arbury Hill.

The season was so far advanced when I arrived at this important station, that I could not expect numerous observations for the latitude; but from the near agreement of the results at Clifton, I was encouraged to hope that the observations at Arbury Hill, though few in number, might prove satisfactory.

The bell tent was pitched on the *old* station of the Trigonometrical Survey, where the theodolite was placed. This spot may be readily ascertained from Col. Mudge's description, to within 10 feet. Pickets were driven into the ground, on which rested the legs of a very stout triangular stand, which served as a support to the Repeating Circle. Every precaution which I could think of was used to ensure accuracy. The instrument was adjusted, the telescope directed to the star, and the whole left for nearly half an hour before the commencement of the observations, in order that it might acquire an equal temperature. When the wire was brought very nearly to bisect the star, the tangent screw was turned a little in an opposite direction to release it from any strain, and the hand being withdrawn, the star was watched until its bisection was perfect. The time was then noted, and the level carefully

read off by the non-commissioned officer and myself, without either of us moving from the place where we stood. In this manner the three following series of observations were made. The error of the chronometer was determined by altitudes of the sun given in the Appendix, and its daily rate was 1^s,26.

ARBURY HILL, 18th October, 1818. Barometer 29,40 inches, thermometer 48°,5. Chronometer too slow 14^s,7. Pole star on the meridian by the chronometer 11^h.9^m.29^s,9.

Chronometer.	Level.		Time from the meridian.	N. v. Sines.
h. m. s.			m. s.	
10.48.35	+ 22	— 22	20.55	4162
10.53. 5	+ 23	— 22	16.25	2564
10.57.40	+ 21	— 24	11 53	1344
11. 1.38	+ 24	— 21	7.52	0589
11. 5. 2	+ 24	— 21	4.28	0190
11. 8. 0	+ 21	— 24	1.30	0021
11.11.23	+ 25	— 19	1.53	0034
11.14.22	+ 20	— 25	4.52	0226
11.18.55	+ 24	— 21	9.25	0844
11.21.55	+ 18	— 26	12.25	1467
11.24.55	+ 23	— 21	15.25	2262
11.27.10	+ 21	— 25	17.40	2970
11.30.47	+ 24	— 21	21.17	4309
11.33.30	+ 22	— 23	24. 0	5478
	+312	—315		1890

$\frac{(+312-315)}{2} \times 2'',4 = -3'',6$ cor. for the level.

Lat. 52 13.26 cosine	-	9.7871611
Dec. 88.20.30 cosine	-	8.4614886
Alt. 53.52.50 cosine co. ar.		0.2295379
Log. sin. 1 co. ar.	- -	5.3168000
Const. Log.		3.7949876
Log. 1890 (+4)		7.2764618
Correct. —11″,79 Log.		1.0714494

Readings, &c.			
			° ′ ″
1st. Vernier	- -		145.32.57
Second	- -		20
Third	- -		30
Fourth	- -		35
Mean	- -		145.32.35,5
		+	360, 0. 0
Level	- -	—	3,6
Index	- -	+	18,0
		14)	505.32.49,90
Observed Z. D.	-		36. 6.37,85
Refract.	- -	+	41,90
Correct.	- -	—	11,79
2 r′C.	-	—	0,05
(Z—Z′	-	+	0,28
True Z. D.	-	+	36. 7. 8,19
Mean P. D. for 1818		+	1.39.44,15
Precession, &c.	-	—	18,23
Co. Lat.	-		37.46.34,11
Lat. of Arbury Hill			52.13.25,89

Arbury Hill, 22d October, 1818. Barometer 29,40 inches, thermometer 45° Chronometer too slow 19s,7. Pole star on the meridian by the chronometer $10^h.53^m.40^s,7$.

Chronometer.	Level.		Time from the meridian.	N. v. Sines.
h. m. s.			m. s.	
10.37. 5	+ 24	— 24	16.36	2622
10.40.15	+ 23	— 25	13.26	1717
10.44.45	+ 25	— 23	8.56	0760
10.49.27	+ 24	— 24	4.14	0171
10.53.25	+ 28	— 19	0.16	0001
10.57.45	+ 26	— 23	4. 4	0157
11. 1.18	+ 28	— 19	7.37	0552
11.14.45	+ 24	— 24	21. 4	4222
11.17.25	+ 27	— 21	23.44	5357
11.19.30	+ 25	— 24	25.49	6338
	+254	—226		2190

$\frac{(+254-226)}{2} \times 2{,}4'' = +33{,}6''$ cor. for the level.

Const. Log.	- -	3.7949876
Log. 2190 (+4)	- -	7.3404441
Correct. —13″,66 Log.		1.1354317

Readings, &c.

			° ′ ″
1st Vernier	-	-	361. 6.30
Second	-	-	6.25
Third	-	-	6. 0
Fourth	-	-	5.55
Mean	-	-	361. 6.12,5
Level	-	+	33,6
Index	-	+	18,0
			10) 361. 7. 4,10
Observed Z. D.	-		36. 6.42,04
Refract.	-	+	42,23
Correct.	-	—	13,66
2 r′C.	-	—	0,08
(Z—Z′)	-	+	0,28
True Z. D.	-		36. 7.10,81
Mean P. D. for 1818		+	1.39.44,15
Precession, &c.	-	—	19,72
Co. Lat.	-		37.46.35,24
Latitude of Arbury Hill			52.13.24,76

The night very clear, but flying clouds.

ARBURY HILL, 26th October, 1818. Barometer 29,52 inches, thermometer 47°,5. Chronometer too slow 24ˢ,74. Pole star on the meridian by the chronometer 10ʰ.37ᵐ.52ˢ,02

Chronometer.	Level.		Time from the meridian.	N. v. Sines.
h. m. s.			m. s.	
10.15.15	+ 22	— 22	22.37	4865
10.18.40	+ 20	— 24	19.12	3507
10.23. 0	+ 23	— 21	14.52	2103
10.25.43	+ 23	— 21	12. 9	1405
10.30.27	+ 21	— 23	7.25	0524
10.34. 5	+ 22	— 23	3.47	0136
10.37.20	+ 22	— 22	0.32	0003
10.39.50	+ 22	— 22	1.58	0037
10.43.15	+ 24	— 20	5.23	0276
10.47. 5	+ 20	— 24	9.13	0809
10.50.52	+ 24	— 20	13. 0	1608
10.53.25	+ 20	— 24	15.33	2301
10.57.32	+ 24	— 20	19.40	3680
11. 0.32	+ 20	— 24	22.40	4887
	+307	—310		1867

$\frac{(+307-310)}{2} \times 2'',4 = -3'',6$ cor. for the level.

Const. Log. - -	3.7949876
Log. 1867 (+4) -	7.2711443
Correct. -11″,64 Log. -	1.0661319

Readings, &c.		
		° ′ ″
1st Vernier - -		145.33.38
Second - -		33. 3
Third - -		33.15
Fourth - -		33.18
Mean - -		145.33.18,50
		+360. 0. 0
Level - -	—	3,60
Index - -	+	18,00
		14) 505.33.32,90
Observed Z. D. -		36. 6.40,92
Refract. - -	+	42,15
Correct. - -	—	11,64
2 r′C. -	—	0,06
(Z—Z′) -	+	0,28
True Z. D. -		36. 7.11,65
Mean P. D. for 1818	+	1.39.44,15
Precession, &c. -	—	21,30
Co. Lat.		37.46.34,50
Latitude of Arbury Hill		52.13.25,50

The mean of the three preceding results is 52°.13′.25″,38, and the greatest difference 1″,13.

In the "Account of the Trigonometrical Survey," Col. MUDGE states, that the zenith sector was put up 34 feet to the north, and 28 feet to the west of the old station at Arbury Hill; therefore 0,34″ must be added, on this account, to obtain 52°.13′.25″,72, the latitude of the spot where the zenith sector was placed.

The observed arc between Greenwich and Arbury Hill, is 0°.44′.48″,19, which being added to the latitude of Greenwich, gives 52°.13′.26″,20 for the latitude of Arbury Hill by the Trigonometrical Survey, which differs 0″,48 *in excess*, from the latitude given by the Repeating Circle.

We cannot then but conclude, that the observations made with the zenith sector, both at Clifton and Arbury Hill, are free from any material error; and as the difference between the latitudes of Clifton by the Zenith Sector, and by the Repeating Circle, was 0″,29, that by the Zenith Sector being *in defect*, and of Arbury Hill 0″,48 *in excess*, it is extremely probable that the error of observation at either of these stations does not amount to so much as four-tenths of a second.

A base of 906 feet was carefully measured near the foot of Arbury Hill, for the purpose of finding the distance on the meridian of this station from the pendulum; which distance, as appears in the Appendix, was 3048 feet, the pendulum being so nearly in the meridian of the station, that no deduction on account of its bearing is necessary. The arc corresponding to 3048 feet, is 30″,06, which being subtracted from 52°.13′.25′,32, leaves 52°.12′.55″,32 for the latitude of the pendulum.

Latitude of the Station at London.

The latitude of Mr. Browne's house in Portland Place, deduced from the Trigonometrical Survey, as detailed in the Philosophical Transactions for 1818, is 51°.31′.8″,4.

Latitude of Shanklin Farm.

Having observed for the latitude of Arbury Hill, at the station itself, it was my intention to have done the same at Dunnose, but this, from the distance of the station, and the difficulty of the ascent, I found impracticable. My observations therefore were made on a spot which was 20 feet south of the chimney of the summer-house in which the pendulum was placed. Previously to quitting London, the transverse level of the repeating circle was adjusted so as to render any correction unnecessary, and the axis carrying the telescope having been tightened, the index error was again carefully determined, and found to be 13″. The observations were made under circumstances peculiarly favourable, and though those forming the second series are few in number, in consequence of the pole star having been frequently obscured by light clouds, I consider them as unexceptionable. The correction of the mean polar distance for precession, &c. was kindly supplied by the Astronomer Royal.

By altitudes of the sun, given in the Appendix, the chronometer was fast on the 10th of May $4^{m}.39^{s},7$, its daily rate being $-1'',78$.

Shanklin Farm, May 13th, 1819. Barometer 30,14 inches, thermometer 47°,0. Chronometer too fast $4^{m}.45^{s}$. Pole star on the northern meridian by the chronometer $9^{h}.37^{m}.32^{s}$. Mean polar distance for 1819, 1°.39′.24″,70.

Chronometer.	Level.		Time from the meridian.	N. v. Sines.
h. m. s.			m. s.	
9.13.15	+ 31	— 10	24.17	5608
9.16.40	+ 8	— 34	20.52	4142
9.21.21	+ 21	— 22	16.11	2492
9.33.55	+ 17	— 24	3.37	0124
9.36.44	+ 21	— 21	0.48	0006
9.39.55	+ 21	— 21	2.23	0054
9.42.27	+ 22	— 19	4.55	0230
9.45.40	+ 23	— 20	8.08	0630
9.48.56	+ 20	— 22	11.24	1237
9.51.53	+ 25	— 18	14.21	1960
9.54.40	+ 20	— 21	17.08	2793
9.56.48	+ 19	— 22	19.16	3531
9.59.40	+ 21	— 21	22.08	4660
10. 2.20	+ 24	— 18	24.48	5849
	+293	+293		2379

Readings, &c.		
		° ′ ″
1st Vernier - -		214.14.32
Second - -		20
Third - -		10
Fourth -		40
Mean -	-	214.14.25,5
	+	360. 0. 0
Level - -		0
Index -	+	13,0
		4)574.14.38,5
Observed Z. D.	-	41. 1. 2,75
Refract. -	+	51,35
Correct. -	+	13,80
2 r′C. -	+	0,08
True Z. D. -		41. 2. 7,98
App. P. D. -	—	1.39.31,13
Co. Lat.		39.22.36,85
Latitude of Shanklin Farm		50.37.23,15

° ′ ″	
Lat. 50.37.24 cosine - -	9.8023740
Dec. 88.20.29 cosine - -	8.4615613
Alt.. 48.57.52 cosine co. ar. -	0.1827472
Log. sin. 1 co. ar. - -	5.3168000
Const Log. -	3.7634825
Log. 2379 (+4) -	7.3763944
Correct. +13″,80 Log.	1.1398769

SHANKLIN FARM, May 14th, 1819. Barometer 30,08 inches, thermometer 50°,0. Chronometer too fast $4^{m}.43^{s}$. Pole star on the northern meridian by the chronometer $9^{h}.33^{m}.35^{s}$.

Chronometer.	Level.		Time from the meridian.	N. v. Sines.
h. m. s.			h. m.	
9.10.30	+ 20	− 16	23.05	5068
9.13.18	+ 19	− 18	20.17	3914
9.18. 0	+ 11	− 26	15.35	2311
9.26.45	+ 17	− 19	6.50	0444
9.44. 6	+ 24	− 10	10.31	1053
9.46.10	+ 13	− 22	12.35	1507
9.48.15	+ 25	− 10	14.40	2047
9.51. 6	+ 15	− 20	17.31	2919
	+144	−141		2408

$\frac{(+144-141)}{2} \times 2'',4 = +3'',6$ cor for the level.

Const. Log.	- -	3.7634825
Log. 2408 (+4)	-	7.3816565
Correct. + 13″,97 Log	-	1.1451390

Readings, &c.			° ′ ″
1st Vernier	-		328. 8.15
Second	- -		8. 2
Third	- -		8. 2
Fourth	- -		7.55
Mean	- -		328. 8. 3,5
Level	-	+	3,6
Index	-	+	13,0
		8)	328. 8.20,1
Observed Z. D.	-		41. 1. 2,51
Refract.	-	+	50,92
Correct.	- -	+	13,97
$2r'C$.	-	+	0,08
True Z. D.	-		41. 2. 7,48
App. P. D.	-	—	1.39.31,32
Co. Lat.	-		39.22.36,16
Latitude of Shanklin Farm			50.37.23,84

Shanklin Farm, May 15th, 1819. Barometer 30,02 inches, thermometer 43°,5. Chronometer too fast $4^{m}.41^{s}$. Pole star on the northern meridian by the chronometer $9^{h}.29^{m}.38^{s}$.

Chronometer.	Level.		Time from the meridian.	N. v. Sines.
h. m. s.			m. s.	
9. 6. 3	+ 24	— 28	23.35	5215
9.10. 3	+ 24	— 28	19.35	3648
9.13.50	+ 22	— 30	15.48	2375
9.16.52	+ 26	— 27	12.46	1551
9.20.33	+ 27	— 23	9. 5	0785
9.24.35	+ 24	— 27	5. 3	0243
9.27.54	+ 25	— 25	1.44	0029
9.30.25	+ 23	— 27	0.47	0006
9.33.18	+ 24	— 26	3.40	0128
9.36.17	+ 23	— 27	6.39	0421
9.39. 5	+ 25	— 25	9.27	0850
9.42.16	+ 24	— 26	12.38	1519
9.44.32	+ 23	— 27	14.54	2113
9.47.30	+ 25	— 25	17.52	3037
9.50.33	+ 21	— 28	20.55	4162
9.54. 0	+ 26	— 24	24.22	5647
	+386	—423		1983

Readings, &c.		
		° ′ ″
1st. Vernier - -		296.17.43
Second - -		30
Third - -		40
Fourth - -		35
Mean - -		296.17.37
	+	360. 0. 0
Level - -	—	44,40
Index - -	+	13,0
		16)656.17. 5,60
Observed Z. D. -		41. 1. 4,10
Refract. -	+	51,54
Correct. -	+	11,50
2 r′C. -	+	0,06
True Z. D. -		41. 2. 7,20
App. P. D.	—	1.39.31,51
Co. Lat. -		39.22.35,69
Latitude of Shanklin Farm		50.37.24,31

$\frac{(+386-423)''}{2} \times 2{,}4 = -44{,}4''$ cor. for the level

Const. Log. - -	3.7634825
Log. 1983 (+4) - -	7.2973227
Correct. + 11″,50 Log. -	1.0608052.

The mean of the three preceding results is 50°.37′.23″,77, and the greatest difference 1″,16. If to this mean 0″,17 be added we have 50°.37′.23″,94 for the latitude of the pendulum.

I had now to connect my station with that of Dunnose; a work attended with some difficulty, as Shanklin farm could not be seen from it, and the nature of the ground was very

unfavourable to the measurement of a base. The signal post however was visible from the farm, and I selected the most level part of the hill I could find, on which, with the assistance of Mr. FRANKS, I measured a line of 1140 feet. The angles were taken with the greatest care, and are given with the other necessary data in the Appendix, from which the distance from Dunnose to the chimney of the summer house appears to be 3901 feet, and its bearing 60° 58′ 11″ to the north east; whence the distance on the meridian is 1893 feet, or 18″,67. The distance from the signal post was also calculated, and found to differ only one foot from that of the station.

Fearing from the nature of the ground on which the base was measured, that this determination might be erroneous, I was anxious to verify it by some other method. For this purpose I chose a spot on the side of the hill, which was very level, on which I measured with great care a distance of 100 yards. The direction of this base was perpendicular to a line joining the summer house and the signal post, in which line was also its commencement. I then measured the distance from the signal post to the commencement of the base. By means of eight repetitions with the Repeating Circle, the angle subtended by this base, at a spot 22 feet from the chimney of the summer house towards the signal post, was determined with great precision; and having also the angle of elevation, the horizontal distance from the commencement of the base was obtained, to which 22 feet being added, and also the measured distance from the base to the Signal Post, the result was 3896 feet, for the distance from the Signal Post, to the chimney of the summer house, differing only four feet from the former determination.

If from 50°.37′.23″,94 (the latitude of the summer house) 18″,67 be subtracted, we have 50°.37′.5″,27 for the latitude of Dunnose by the Repeating Circle.

The latitude of Dunnose is stated in the "Account of the Trigonometrical Survey," to be 50°.37′.8″,6, on the supposition of that of Greenwich being 51°.28′.40″. But this latitude, as before stated, is found from the more recent observations of the present Astronomer Royal, to be 1″,99 in excess, if the French refractions be employed; therefore 50°.37′.6″,61 is the latitude of Dunnose by the Trigonometrical Survey, differing 1″,34 in excess from the result obtained by the Repeating Circle.

I may here remark, that the latitude of Dunnose deduced from the observations made with the Repeating Circle, differs only 0″,05 from the latitude of that station given in the first volume of the account of the survey, and which appears to have been derived trigonometrically from the latitude of Greenwich.

Results of the preceding Operations.

It now remains to give in one view, the results of the operations that have been detailed. These are comprised in the following table. It would have been desirable to have expressed the length of the pendulum vibrating seconds, in parts of the scale which forms the basis of the Trigonometrical Survey of Great Britain, the Commissioners of Weights and Measures having agreed to recommend, that "the standard "used in the Trigonometrical Survey of Great Britain should "be considered as affording the most authentic determination "of the linear measure of the United Kingdom." But as experiments are yet wanting to enable me to do this with sufficient accuracy, I have given the length of the pendulum in parts of Sir George Shuckburgh's standard scale, the correction for the difference between which, and the national standard of linear measure, may be readily applied hereafter.

The length of the pendulum vibrating seconds in the latitude of London, is stated in the Phil. Trans. for 1818, *to be* 39,13860 *inches. But I have here to notice a very important omission, which I am obliged to Mr.* Troughton *for having pointed out in the first number of the Edinburgh Philosophical Journal. It may be seen that in computing the specific gravity of the pendulum, I have neglected to include the deal ends.* Anxious to supply this omission in the most unexceptionable manner, I thought it best to take the specific gravity of the whole pendulum, and for this purpose requested Mr. Barton, Comptroller of his Majesty's Mint, to allow me the use of the fine balance lately constructed under his directions, a request with which he

most obligingly complied, and favoured me with his assistance, and with every requisite for making the experiment.

A deal trough was prepared seven feet long, nine inches wide, and the same depth. The pendulum was slung horizontally from the scale pan, by a fine iron wire. The weight of the whole was carefully determined in air, and found to be 66904 grains. The trough which had been previously placed beneath the pendulum, was then filled with distilled water, and the weight of water displaced was found to be 9066 grains. The small portion of iron wire which was immersed in the water was carefully noted; the weight of the wire by which the pendulum was suspended was 56 grains, and the weight of water equal in bulk to that part of the wire which was immersed was 2,5 grains. The temperature of the water was 68°, and that of the atmosphere 62°; the barometer 29,9 inches. Hence we have the weight of the pendulum 66858,8 grains in vacuo, at the temperature of 62°; the weight of an equal bulk of water at the same temperature, 9068,4 grains; and the resulting specific gravity of the pendulum, 7,3727.

Employing this specific gravity in computing the allowance for the mean buoyancy of the atmosphere, we obtain ,00624 *for this correction instead of* ,00545, *the former erroneous conclusion. Besides this, the allowance* + ,00031 *for the height of the pendulum above the level of the sea, should, according to Dr.* Young's *investigation, have been multiplied by* $\frac{66}{100}$, *making* + ,00021 *of an inch. These corrections being applied, we have* 39,13929 *inches of Sir* G. Shuckburgh's *standard scale, for the length of the pendulum vibrating seconds in the latitude of London.*

Wishing to compare with this, the result which would have been obtained by means of the weights and specific gravities of the different parts of the pendulum, I carefully measured

the deal ends, and found them to contain 3,956 cubic inches. The weight of the knife edges was 370 grains, and their specific gravity 7,84.

With these data, and taking the specific gravity of deal at 0,49; the specific gravity of the whole pendulum will be found to vary from the more accurate determination above given, a quantity which would have occasioned a difference in the length of the seconds pendulum of only $\frac{1}{50000}$ of an inch.

Place of observation.	Latitude.	Vibrations in a mean solar day.	Length of the Pendulum vibrating seconds in parts of Sir George Shuckburgh's scale.
	° ′ ″		Inches.
Unst - -	60.45.28,01	86096,90	39,17146
Portsoy - -	57.40.58,65	86086,05	39,16159
Leith Fort -	55.58.40,80	86079,40	39,15554
Clifton -	53.27.43,12	86068,90	39,14600
Arbury Hill	52.12.55,32	86065,05	39,14250
London -	51.31. 8,40	86061,52	39,13929
Shanklin Farm	50.37.23,94	86058,07	39,13614

Of the Figure of the Earth.

The deviation of the figure of the earth from a perfect sphere, is expressed by a fraction, having for its numerator the difference between the equatorial and polar diameters, and for its denominator the diameter at the equator; this is termed the *compression* or *ellipticity*.

If the earth were a perfect sphere, composed of homogeneous materials, as a fluid, and at rest, gravity at every point in its surface would be the same. But if this sphere were made to revolve about an axis, its particles would endeavour to fly off with a centrifugal force proportionate to the distance from the axis of rotation; the equatorial parts would become elevated, those at the pole and its vicinity depressed, and the sphere would assume the form of a spheroid, the centrifugal force thus generated acting in opposition to gravity, and diminishing it more and more from the Pole, where the centrifugal force is nothing, to the Equator where it is a maximum.

But besides this diminution of gravity from centrifugal force, in proceeding from the pole to the equator, a farther reduction takes place in consequence of the elliptical form which the earth has now assumed. For the parts about the Pole being nearer to the centre of the spheroid than those at the Equator, will be more strongly attracted, and this farther reduction of gravity, whatever it may be, varies with the figure of the earth, and as we shall presently see, with a variation in the density of the strata of which it is composed.

If we conceive two fluid columns meeting in the centre of such a spheroid, the one proceeding from the Pole and the

other from the Equator, it follows in order that the spheroid may preserve a state of equilibrium, that the pressure of the equatorial and polar columns on the centre must be equal. The equatorial column then has been lengthened in proportion to the diminution of its gravity. The ellipticity therefore, and the diminution of gravity from the Pole to the Equator, will, on this supposition of a homogenous spheroid, be expressed by the same fraction, which NEWTON has demonstrated to be $\frac{1}{230}$.

If now we suppose new matter to be added to the centre of such homogeneous spheroid, or its density there to be increased, this matter, by its additional attraction, will cause a greater increase of gravitation at the Pole than at the Equator, in consequence of the distance from the Pole to the centre being the less; but the equatorial column being the longer, and therefore consisting of a greater quantity of matter, its gravity or pressure on the centre will be more increased by this new attraction than that of the polar column; and in order to restore the equilibrium thus destroyed, the polar column must become longer, and the equatorial column shorter than before. Thus the ellipticity of the spheroid will be diminished, but the difference of gravitation at the Pole and at the Equator will, at the same time, be increased.

HUYGENS considered the whole attractive force to reside in the centre, or the earth to be infinitely dense there, and on this supposition, computing its ellipticity, he found it to be $\frac{1}{578}$.

But experiments with the pendulum soon sufficiently proved that the earth was neither homogeneous, nor, it is scarcely necessary to say, infinitely dense at its centre; but that it

probably increased in density from the surface to the centre, the ellipticity being consequently somewhere between $\frac{1}{578}$ and $\frac{1}{230}$.

As it appears then that the ellipticity of the earth varies with any difference in the diminution of gravitation from the Pole to the Equator, and that this last depends in its turn on the ellipticity; it might have been supposed that any attempt to arrive at the figure of the earth in this way must have been hopeless.

But it was reserved for CLAIRAUT to remove this difficulty. He found that however the density of the earth be supposed to vary, the fraction expressing its ellipticity increases as the fraction expressing the diminution of gravity from the pole to the equator diminishes, and vice versa; and in his admirable work on the figure of the earth, he has demonstrated this beautiful and important theorem; that *the sum of the two fractions expressing the ellipticity and the diminution of gravity from the Pole to the Equator, is always a constant quantity, and equal to* $\frac{5}{2}$ *of the fraction expressing the ratio of centrifugal force to that of gravity at the equator.*

If then the decrease of gravity from the Pole to the Equator can be discovered, and it be subtracted from this constant quantity, the remainder will be the fraction expressing the ellipticity of the spheroid.

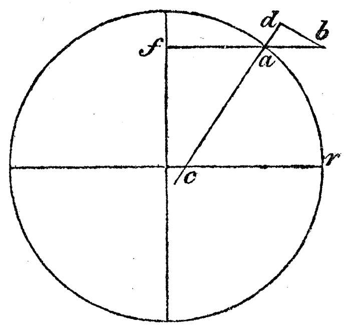
The diminution of gravity may be known by finding the difference of the lengths of the two pendulums vibrating in equal times at the Pole and at the Equator, as it may be easily demonstrated that the lengths of such pendulums are to each other directly as gravitation; or, if an invariable pendulum, such as I have used, be employed, the squares of the observed

number of vibrations in 24 hours, in different latitudes, will be to each other as gravitation in such latitudes.

But as experiments on the pendulum cannot be made at the Pole, it remains to describe the manner in which the diminution of gravity from the Pole to the Equator, may be obtained by observations made at intermediate stations.

I have remarked, that the centrifugal force varies as the distance from the axis of rotation; that is as the cosine of the latitude; thus at the Equator it is the greatest, at the Poles it is nothing.

But the whole of the centrifugal force does not act in opposition to gravity except at the Equator; for let *cd* be the direction of gravity, *fb* that of centrifugal force, and let the centrifugal force for the latitude *a*, be expressed by the line *ab*; if this be resolved into two forces *ad* and *db*, that portion which acts in opposition to gravity will be expressed by *ad*. But if *ab* be made the radius, *ad* is the cosine of the angle *dab*, = *acr*, the latitude of the point *a*. The effect then of the centrifugal force at *a*, in counteracting gravity, is still farther diminished in the proportion of the cosine of the latitude to the radius; whence it follows, that the



diminution of gravity from this cause, in proceeding from the Pole to the Equator, will be as the difference of the squares of the cosines of the latitudes.

From the expression for the force of gravity at the surface of a spheroid,* we may readily perceive that that part of the

* $f = \frac{4\pi b}{3}\left(1 + \frac{c}{b} \cdot \frac{4 - \sin^2 \varphi}{5}\right)$ in which the $\sin^2 \varphi$ is the only variable quantity, φ being the angle of the terrestrial radius with the Equator.

diminution which depends on the elliptical form of the earth, follows very nearly the same law; therefore the increase of gravitation in proceeding from the Equator to the Pole, may be taken as the increase of the square of the sine of the latitude; * and this will also express the corresponding variation in the length of the pendulum.

Let $E =$ The length of the pendulum vibrating seconds at the Equator.

$d =$ The difference between the length at the Equator and at the Pole.

$m =$ The length of the pendulum in the latitude L.

$n =$ The length of the pendulum in the latitude L′.

Then from what has been stated,

$$m = E + d . \sin^2 L$$

$$n = E + d . \sin^2 L'$$

$$m - n = (E + d \sin^2 L) - (E + d \sin^2 L') = d(\sin^2 L - \sin^2 L')$$

Hence $d = \frac{m - n}{\sin (L + L') \times \sin (L - L')}$

and $E = m - (d \sin^2 L.)$

Therefore $\frac{d}{E}$ expresses the diminution of gravity from the Pole to the Equator, which being subtracted from $\frac{5}{2}$ of the proportion of centrifugal force to gravity at the Equator, will give the ellipticity of the spheroid.

The centrifugal force at the Equator is expressed by the deflection of a point on its surface from the tangent, in one second of mean solar time. This is equal to the versed sine of 15″,0418, the arc which the earth describes in its diurnal revolution in one second; and taking the radius of the Equator at 3967,5 miles, is found to be ,055696 of a foot.

* The $\sin^2$ + the cosine^2 is a constant quantity, equal to the radius^2, consequently as the cosine^2 diminishes, the sine^2 must increase, and vice versa.

If g, be the space a body falls through in one second of time at the Equator, L the length of the seconds pendulum, and c the circumference of a circle, the diameter being 1,

$$g = \frac{1}{2} L \times c^2.$$

The length of the pendulum vibrating seconds at the equator, deduced from the observations at Unst and Dunnose, by the preceding formula, appears to be 39,00734 inches, and g, or gravitation at the Equator, to be equal to 16,0412 feet. Hence the centrifugal force at the equator is $\frac{1}{288,013}$ of gravitation, or $\frac{1}{289,014}$ of gravity; which last being multiplied by $\frac{5}{2}$, we have ,0086501 for the sum of the fractions expressing the ellipticity of the earth and the diminution of gravity, from the Pole to the Equator.

In the following Table are given the diminution of gravity from the Pole to the Equator, and the resulting compression, deduced in the manner which has been described, by comparing the observations at each station, successively with those at all the others.

	Diminution of gravity from the Pole to the Equator.	Compression.
Unst and Portsoy - -	,0053639	$\frac{1}{304,3}$
Leith Fort - -	,0054840	$\frac{1}{315,8}$
Clifton - -	,0056340	$\frac{1}{331,5}$
Arbury Hill -	,0054282	$\frac{1}{310,3}$
London - -	,0055510	$\frac{1}{322,7}$
Dunnose - -	,0055262	$\frac{1}{320,1}$
Portsoy and Leith Fort -	,0056920	$\frac{1}{338,0}$
Clifton - -	,0058194	$\frac{1}{353,2}$
Arbury Hill -	,0054620	$\frac{1}{313,7}$
London - -	,0056382	$\frac{1}{332,0}$
Dunnose - -	,0055920	$\frac{1}{326,9}$
Leith Fort and Clifton -	,0059033	$\frac{1}{364,0}$
Arbury Hill -	,0053615	$\frac{1}{304,1}$
London - -	,0056186	$\frac{1}{329,8}$
Dunnose -	,0055614	$\frac{1}{323,7}$
Clifton and Arbury Hill -	,0042956	$\frac{1}{229,6}$
London -	,0052590	$\frac{1}{294,9}$
Dunnose -	,0052616	$\frac{1}{295,1}$
Arbury Hill and London -	,0069767	$\frac{1}{597,5}$
Dunnose -	,0060212	$\frac{1}{380,3}$
London and Dunnose -	,0052837	$\frac{1}{297,0}$

From the experiments given in the former part of this

Report, it appears probable, that if the uncertainty which must exist in the allowance for the height above the level of the sea be excepted, the error in the number of vibrations of the pendulum at any particular station, does not amount to so much as one tenth of a vibration, which is nearly equivalent to $\frac{1}{4000000}$ part of the length of the seconds pendulum. To this degree of accuracy consequently may gravitation be determined by the apparatus I have employed; and in passing through a country composed of materials of various densities, the pendulum may be expected to indicate such variation with very considerable precision.

The diminution of gravity from the Pole to the Equator is derived from the decrease which is observed to take place between any two given latitudes; consequently if no irregular attraction occurred, the results, computed from different portions of the meridian, should be the same. But it may be seen in the preceding table, that the number expressing the diminution of gravity, from the observations at Unst and Portsoy, is less than that deduced from the arc between Unst and Leith, and that this number goes on increasing to Clifton, diminishes at Arbury Hill, and increases again at London. It may also be remarked, that the diminution of gravity, derived from Unst and Dunnose, is less than that deduced from Portsoy and Dunnose; from all which it seems probable that in advancing southward, gravity decreases more than it ought to do from theory; that there exists an assemblage of materials of greater density than common in the vicinity of Portsoy, and that the density of the strata to the southward becomes less and less until we arrive at Clifton, where it seems to be considerably in defect.

At Arbury Hill, a sudden increase of gravitation is percep-

tible, and at the short distance of London, this additional force is no longer sensible. From its intensity, and the limited sphere of its action, it might perhaps be inferred that the disturbing material is of considerable density, and not very distant from the surface.

It must be evident that nothing very decisive respecting the general ellipticity of the Meridian can be deduced from the present experiments. For this purpose it is requisite that the extreme stations should comprise an arc of sufficient length to render the effect of irregular attraction insensible; and this effect might be diminished, if not wholly prevented, by selecting stations of similar geological character, and which should differ as little as possible in elevation above the level of the sea.

If however some deduction be made for the superior density which it has been remarked exists at Portsoy, the compression $\frac{1}{304}$ deduced from that station and Unst, may perhaps be considered as not far distant from the truth, both being situated on rocks of a similar nature; Unst consisting chiefly of serpentine, and Portsoy, of serpentine, slate, and granite; and as $\frac{1}{310}$ the ellipticity given by the experiments at Unst and Arbury Hill, is nearly the same as that resulting from Unst and Portsoy, it would be no improbable conjecture that the sudden increase of gravitation observed at Arbury Hill, may be occasioned by a rock of primitive formation, approaching the surface of the earth in the vicinity of that station.*

These facts appear sufficient to explain the anomalies which

* Since the above was written, I find the conjecture I have hazarded remarkably supported by fact; for on consulting SMITH's Geological Map of England, it appears that Mount Sorrel, a mass of granite, is situated, together with other rocks of primitive formation, about 30 miles to the north of Arbury Hill.

have been remarked in the Trigonometrical Survey of Great Britain. For if the disturbing force in the neighbourhood of Arbury Hill, were supposed to be situated to the north of that station, the plumb line would be attracted northward, the observed latitude would be less than the true, and the length of the degree deduced from the arc between Dunnose and Arbury would be in excess, and that derived from the arc between Clifton and Arbury in defect. This last error will be augmented, if we suppose the attraction of the matter near Arbury Hill to be felt at Clifton, and the plumb line at that station to be drawn towards the south.

M. BIOT, by a comparison of his numerous experiments at Unst with those made at Formentara and Dunkirk, in conjunction with M. ARAGO, obtains $\frac{1}{310}$ for the resulting compression. But if the allowance for the elevation of Formentara above the level of the sea, be corrected in the manner suggested by Dr. YOUNG, the ellipticity should be about $\frac{1}{319}$. The details of M. BIOT's experiments have not yet been published, but it affords me much gratification to learn, that the acceleration of the pendulum between London and Unst, computed by M. BIOT, from his observations at Unst and those at Formentara, using $\frac{1}{310}$ for the compression, differs only $0^s,6$ from the result of my experiments; a difference which may probably be referred to the superior density of Unst, compared with that of the substrata of London.

London, June, 1819.

APPENDIX.

CONTAINING THE OBSERVATIONS FROM WHICH THE PRECEDING RESULTS WERE COMPUTED.

Observations for determining the rate of the clock.

WITH respect to the following Table of Transits it may be necessary to remark that the results in the column headed "Mean Chronometer," were obtained by taking the mean of the 1st and 5th wires, of the 2d and 4th, and again taking the mean of these means and the third wire, instead of taking the mean of the five wires, which is the usual method. This was done for the sake of comparing the result of each pair of wires with that of the meridian wire.

Transits observed at UNST.

Date.	Stars.	1	2	Merid. wire. 3	4	5	Mean Chronometer.	Clock.
1818.		h. m. s.	m. s.	m. s.	m. s.	m. s.	h. m. s.	h. m. s
July 22	Arcturus	6. 8.14,0	8.36,5	8.59,0	9.21,5	9.44,0	6. 8.59	6.14.18,14
	γ Ophiuchi	9. ——	—	50. 9,5	—	—	9.50. 9,5	9.55.36,41
	η Serpentis	10.12.15,0	12.36,0	12.57,0	13.18,5	13.39,5	10.12.57,17	10.18.25,08
	α Lyræ	10.30.42,5	31. 9,5	31.36,5	32. 4,0	32.30,5	10.31.36,58	10.37. 5
	α Orionis	21.43.41	44. 2,5	44.23,5	44.45,0	45. 6,5	21.44.23,67	21.50.15,3
24	☉'s centre	0. 6.27	6.49,5	7.12,25	7.35	7.57	0. 7.12,17	0.13.59,32
25	α Ophiuchi	9.15. 2,5	15.24	15.45,5	16. 7,5	16.29	9.15.45,62	9.23.43,56
	γ Ophiuchi	9. ——	37.57,5	38.19	38.40,5	—	9.38.19	9.46.18,11
	η Serpentis	10. 0.23,5	0.45,5	1. 6,5	1.27,5	1.49	10. 1. 6,41	10. 9. 6,1
	α Lyræ	10.18.50,5	19.17,5	19.44	20.12	20.38,5	10.19.44,41	10.27.44,82
26	☉'s centre.	0. 6.24,5	6.46,75	7. 9,25	7.31,75	7.54,5	0. 7. 9,33	0.15.41,63

Oil was applied to the scapement without stopping the clock.

Date.	Stars.	1.	2.	Merid. wire. 3.	4.	5.	Mean Chronometer.	Clock.
		h. m. s.	m. s.	m. s.	m. s.	m s.	h. m. s.	h. m. s.
July. 27	α Orionis	21.23.55,5	—	—	—	—	21.24.38,17	21.34.48,69
28	☉'s centre	0. 6.23,75	6.46,25	7. 8,5	7.31	7.53,5	0. 7. 8,58	0.17.25,41
	Arcturus	5.44.31	44.53	45.15,5	—	—	5.45.15,66	5.55.45,27
	α Ophiuchi	9. 3.10	3.32	3.53,5	4.15,5	4.37	9. 3.53,58	9.14.30,51
	ν Ophiuchi	9.25.43,5	26. 5	26.26,5	26.48,5	27. 9,5	9.26.26,58	9.37. 4,48
	η Serpentis	9.48.32	48.53,5	49.14	49.35,5	49.57,0	9.49.14,03	9.59.52,73
	α Lyræ	10. 6.58,5	7.25,5	7.52,5	8.20	8.47	10. 7.52,67	10.18.32,11

Transits observed at PORTSOY—1st. Series.

Date.	Stars.	1.	2.	Merid. wire. 3.	4.	5.	Mean Chronometer.	Clock.
Aug. 5.	ν Ophiuchi	9. 0.51	1.12,5	1.34	1.56	2.17	9. 1.34,06	9. 2.35,99
	η Serpentis	9. ——	24. 2	24.23,5	24.44,5	25. 5,5	9.24.23,30	9.25.25,99
	α Lyræ	9.42.19,5	42.46	43.13	43.40,5	44. 7,5	9.43.13,27	9.44.16,20
	b	10.14.42,5	15. 4,5	15.26	15.48	16. 9,5	10.15.26,08	10.16.29,86
	μ Aquilæ	10.36.46,5	37. 8	37.29	37.51	38.12	10.37.29,25	10.38.33,58
	α Aquilæ	10.53.26	—	54. 9	54.30,5	54.51,5	10.54. 8,88	10.55.13,62
6	☉'s centre	0.12.35,25	12.57,5	13.19,75	13.41,75	14. 4	0.13.19,66	0.14.41,62
	α Ophiuchi	8.34.25,5	34.47,5	35. 9,0	35.30,5	35.52	8.35. 8,92	8.36.42,60
7	☉'s centre	0.12.28	12.50,25	13.12,25	13.34,5	13.56,5	0.13.12,29	0.15. 7,95
8	☉'s centre	0.12.19,75	12.41,75	13. 3,50	13.26	13.47,5	0.13. 3,66	0.15.36,56
	Arcturus	5. 7.54	8.16,5	8.39	9. 2	9.24,5	5. 8.39,17	5.11.20,51
	α Ophiuchi	8.26.31,5	26.53	27.14,5	27.37	27.58	8.27.14,56	8.30. 1,45
	ν Ophiuchi	8.48.59,5	49.21	49.42	50. 4	50.25	8.49.42,25	8.52.29,70
	η Serpentis	9.11.49	12.10,5	12.31,5	12.53	13.14,5	9.12.31,66	9.15.19,73
	α Lyræ	9.30.27,5	30.54	31.21,5	31.49	32.16	9.31.21,58	9.34.10,19
	α Aquilæ	10.41.35	41.56	42.17,5	42.39	43. 0,5	10.42.17,58	10.45. 8,14
10	☉'s centre	0.12. 2,25	12.23,75	12.45,75	13. 8,25	13.29,75	0.12.45,92	0.16.38,83
	Arcturns	5. 0. 0	0.22,5	0.45	1. 7,5	1.30	5. 0.45	5. 4.46,51
	α Ophiuchi	8.18.38	18.59,5	19.21	19.43	20. 4,5	8.19.21,16	8.23.28,67
	ν Ophiuchi	8.41. 6	41.27	41.48,5	42.10,5	42.31,5	8.41.48,66	8.45.56,85
	η Serpentis	9. 3.55,5	4.16,5	4.37,5	4.59,5	5.20,5	9. 4.37,83	9. 8.46,76
	α Lyræ	9.22.34	23. 1	23.27,5	23.55,5	24.22	9.23.27,92	9.27.37,34
	a	9.48.30	48.51,5	49.12	49.34	49.55	9.49.12,42	9.53.22,62
	b	9.54.57,5	55.19	55.40,5	56. 3	56.24,5	9.55.40,83	9.59.51,24
	α Aquilæ	10.33.41	34. 2	34.23,5	34.45,5	35. 6,5	10.34.23,66	10.38.35,49
11	α Ophiuchi	8.14.39	15. 0,5	15.22	15.44	16. 5,5	8.15.22,17	8.20.13,59
	ν Ophiuchi	8.37. 7	37.28,5	37.49,5	38.11,5	38.32,5	8.37.49,75	8.42.41,94
	η Serpentis	8.59.57	60.18	0.39	1. 0,5	1.21,5	9. 0.39,17	9. 5.32,03
	α Lyræ	9.18.35,5	19. 2	19.29	19.56,5	20.23,5	9.19.29,10	9.24.22,52
	a	9.44.31	44.52,5	45.13,5	45.35	45.56	9.45.13,58	9.50. 7,82
	b	9.50.58,5	51.20,5	51.42	52. 4	52.25,5	9.51.42,08	9.56.36,52
	μ Aquilæ	10.13. 3	13.24	13.45	14. 7	14.28	10.13.45,33	10.18.40,52
	α Aquilæ	10.29.42	30. 3,5	30.25	30.46,5	31. 7,5	10.30.24,92	10.35.20,47

Date.	Stars.	1.	2.	Merid. wire. 3.	4.	5.	Mean Chronometer.	Clock.
		h. m. s.	m. s.	m. s.	m. s.	m. s.	h. m. s.	h. m. s.
Aug. 12	⊙'s centre	0.11.38,5	12. 0	12.22	12.44,25	13. 6	0.12.22,12	0.17.42,63
	Arcturus	4.52. 3	52.25,5	52.48	53.10,5	53.33	4.52.48	4.58.16,63
	α Ophiuchi	8.10.40,5	11. 2	11.24	11.45,5	12. 7	8.11.23,83	8.16.58,52
	ν Ophiuchi	8.33. 8,5	33.30	33.51,5	34.13	34.34,5	8.33.51,5	8.39.26,94
	η Serpentis	8.55.58,5	56.19,5	56.40,5	57. 2	57.23	8.56.40,67	9. 2.17,04
	α Lyræ	9.14.36,5	15. 3,5	15.30,5	15.58	16.24,5	9.15.30,58	9.21. 7,43
	a	9.40.33	40.54	41.15	41.36,5	41.57,5	9.41.15,17	9.46.52,91
	b	9.47. 0,5	47.22	47.43,5	48. 5,5	48.27	9.47.43,67	9.53.21,61
	μ Aquilæ	10. 9. 4	9.25	9.46,5	10. 8,5	10.29,5	10. 9.46,67	10.15.25,11
	α Aquilæ	10.25.43,5	26. 5	26.26	26.48	27. 9	10.26.26,25	10.32. 5,33
Transits observed at PORTSOY—2d Series.								
Aug. 13	⊙'s centre	0.11.17	11.48,75	12.10,5	12.32,5	12.54,5	0.12.10,62	0.11.47,72
	Arcturus	4.48. 5	48.27,5	48.50	49.12,5	49.35	4.48.50	4.48.35,44
	α Ophiuchi	8. 6.42,5	7. 4	7.25,5	7.47,5	8. 9	8. 7.25,67	8. 7.17,18
14	α Ophiuchi	8. 2.45	3. 6,5	3.28	3.50	4.11,5	8. 3.28,17	8. 4. 2,83
	ν Ophiuchi	8.25.13,5	25.34,5	25.56	26.17,5	26.39	8.25.56,08	8.26.31,46
	η Serpentis	8.48. 3,5	48.24	48.45	49. 6,5	49.27,5	8.48.45,25	8.49.21,19
	α Lyræ	9. 6.41	7. 8	7.35	8. 2,5	8.29,5	9. 7.35,17	9. 8.11,68
	μ Aquilæ	10. 1. 9	1.30	1.51,5	2.13	2.34	10. 1.51,5	10. 2.29,88
	α Aquilæ	10.17.48	18. 9,5	18.31	18.52,5	19.13,5	10.18.30,92	10.19. 9,84
15	⊙'s centre	0.11. 0,5	11.22,25	11.44	12. 6,25	12.27,75	0.11.44,12	0.12.49,27
	Arcturus	4.40. 9	40.31	40.53,5	41.16	41.39	4.40.53,5	4.42. 6,66
	α Ophiuchi	7.58.46,5	59. 8	59.29,5	59.51,5	60.13	7.59.29,67	8. 0.48,78
	ν Ophiuchi	8.21.14	21.35,5	21.57	22.18,5	22.40	8.21.57	8.23.16,94
	η Serpentis	8.44. 4,5	44.25	44.46	45. 7,5	45.29	8.44.46,33	8.46. 7
	α Lyræ	9. 2.42	3. 9	3.36	4. 3,5	4.30,5	9. 3.36,17	9. 4.57,59
16	⊙'s centre	0.10.47,75	11. 9,25	11.31	11.53	12.14,5	0.11.31,08	0.13.19,72
	Arcturus	4.36.11,5	36.33,5	36.56	37.19	37.41	4.36.56,17	4.38.53,17
	α Ophiuchi	7.54.48,5	55.10	55.31,7	55.53,7	56.15	7.55.31,73	7.57.34,88
	η Serpentis	8.40. 6,5	—	40.48,7	41.10	—	8.40.48,67	8.42.53,09
	α Lyræ	8.58.44,7	59.11,8	59.38,5	60. 6	60.32,9	8.59.38,73	9. 1.43,81
17	⊙'s centre	0.10.33,55	10.55,25	11.16,75	11.38,65	12. 0,45	0.11.16,9	0.13.49,88
	α Ophiuchi	7.50.50,7	51.12,3	51.34	51.56	52.17,3	7.51.34	7.54.21,23
	ν Ophiuchi	8.13.19	13.40,1	14. 1,5	14.23,2	14.44,5	8.14. 1,61	8.16.49,55
	η Serpentis	8.36. 9	36.29,9	36.51	37.12,3	37.33,3	8.36.51,08	8.39.39,77
	α Lyræ	8.54.46,6	55.13,7	55.40,7	56. 8	56.35	8.55.40,77	8.58.30,19
	μ Aquilæ	9.49.14,7	49.35,8	49.57	50.18,7	50.39,8	9.49.57,17	9.52.48,21
	α Aquilæ	10. 5.54	6.15,3	6.36,6	6.58,2	7.19,3	10. 6.36,67	10. 9.28,18
18	Arcturus	4.28.16,7	28.39,3	—	—	29.46,7	4.29. 1,70	4.32.25,84
	ν Ophiuchi	8. ——	9.43,7	—	10.26,8	10.48	8.10. 5,18	8.13.36,30
	η Serpentis	8.32.12	32.33,3	32.54,3	—	33.36,8	8.32.54,42	8.36.26,36
	α Lyræ	8. ——	—	51.44	52.11,3	52.38	8.51.43,95	8.55.16,39

Date.	Stars.	1.	2.	Merid. wire. 3.	4.	5.	Mean Chronometer.	Clock.
		h. m. s.	m. s.	m. s.	m. s.	m. s.	h. m. s.	h. m. s.
Aug. 19	⊙'s 1st limb	0. 9. 0,7	9.22,2	—	10. 6,0	—	0.10.49,15	0.14.49,28
	⊙'s 2d limb	—	11.32,5	11.54	—	12.37,5		
	Transits observed at LEITH FORT.—1st Series.							
31	κ Capricorni	9.49.25,1	49.47,5	50. 9,5	50.32	50.54,3	9.50. 9,65	9.49.41,04
	α Equulei	10.37.31,7	—	38.14	38.35	38.56,3	10.38.14	10.37.46,18
	β Aquarii	10.52.45	53. 6,2	53.27,3	53.49	54.10	10.53.27,47	10.52.59,93
	ε Pegasi -	11. 5.57	6.18,5	6.39,5	7. 1	7.22,7	11. 6.39,7	11. 6.12,53
	ο Aquarii	11.24.35,1	24.56	25.17	25.38,3	26. 0	11.25.17,25	11.24.50,38
	γ Aquarii -	11.42.53,4	43.14,2	43.35,3	43.56,5	44.18	11.43.35,45	11.43. 8,89
	κ Aquarii -	11. ——	59.16,7	59.37,8	59.59	—	11.59.37,85	11.59.11,46
Sept. 2	⊙'s 1st limb	—	7.32,7	7.54	8.15,8	8.37	0. 8.58,43	0. 9.18,05
	⊙'s 2d limb	0. 9.20	9.41,5	10. 2,5	10.24	10.45,5		
	α Capricorni	9.41.24,5	41.46,8	42. 9	42.31,4	42.53,7	9.42. 9,07	9.42.40,21
	ε Aquarii -	10. 0.42,4	1. 3,8	1.25,3	1.47	2. 8,4	10. 1.25,37	10. 1.56,92
	α Equulei -	10.29.30,9	29.51,9	30.13	—	—	10.30.13,1	10.30.45,31
	β Aquarii -	10.44.45	45. 5,5	45.27	45.48,3	46. 9,7	10.45.27,07	10.45.59,62
	ο Aquarii -	11.16.34,5	16.55,7	17.16,5	17.38	17.59	11.17.16,7	11.17.49,91
	η Aquarii -	11.53.57,1	54.18,3	54.39,5	55. 0,8	55.22	11.54.39,53	11.55.13,67
	ξ Pegasi -	12. 0. 6,8	0.28,3	0.49,8	1.11,5	1.33	12. 0.49,87	12. 1.24,05
4	α Capricorni	9. ——	—	34.12	34.34,3	34.56,6	9.34.11,98	9.35.42,16
	ε Aquarii -	9.52.45,5	53. 7	53.28,3	53.50	54.11,4	9.53.28,42	9.54.59,09
	α Equulei -	10.21.33,6	21.54,8	22.16	22.37	22.58,3	10.22.15,95	10.23.47,39
	β Aquarii -	10.36.47,3	37. 8,5	37.29,5	37.51	38.12,3	10.37.29,68	10.39. 1,37
	ε Pegasi -	10.49.59,2	50.20,5	50.41,8	51. 3,5	51.25	10.50.41,99	10.52.13,94
	ο Aquarii -	11. 8.37,1	8.58,3	9.19,4	9.40,8	10. 2	11. 9.19,5	11.10.51,95
	γ Aquarii -	11.26.55,6	27.16,5	27.37,5	27.59	28.19,9	11.27.37,67	11.29.10,60
	κ Aquarii -	11. ——	43.18,8	43.39,9	44. 1	44.22,3	11.43.39,9	11.45.13,07
	ξ Pegasi -	11. ——	52.31,7	52.52,5	53.14,5	53.36	11.52.52,82	11.54.26,26
5	⊙'s 1st limb	—	—	6.47,8	7. 9,2	7.30,2	0. 7.51,93	0. 9.41,66
	⊙'s 2d limb	0. 8.13,3	8.34,9	8.56,2	9.17,5	9.38,8		
6	⊙'s 1st limb	0. 5.42,8	6. 4	6.25	6.46,4	7. 8	0. 7.29,35	0. 9.51,50
	⊙'s 2d limb	0. 7.51	8.12	8.33,3	8.55	9.16		
	Transits observed at LEITH FORT.—2d Series.							
8	α Equulei -	10. 5.41	6. 2,4	6.23,4	6.45	7. 6	10. 6.23,53	10. 2.39,48
	β Aquarii -	10.20.55	21.16	21.37,4	21.59	22.20	10.21.37,47	10.17.53,83
	ε Pegasi -	10.34. 7	34.28,3	34.49,6	35.11	35.32,4	10.34.49,65	10.31. 6,30
	ο Aquarii -	10.52.45	53. 6	53.27	53.48,4	54. 9,6	10.53.27,17	10.49.44,22
	Pegasi -	11.17.25	17.46	18. 7,3	18.29	18.50	11.18. 7,43	11.14.25,06
	κ Aquarii -	11.27.5,5	27.26,5	27.47,6	28. 9,3	28.30,3	11.27.47,8	11.24. 5,68
	ζ Pegasi -	11.31. 6	31.27,3	31.48,5	32.10,3	32.31,5	11.31.48,68	11.28. 6,69
	ξ Pegasi -	11.36.17,5	36.39,1	37. 0,5	37.22	37.44	11.37. 0,6	11.33.18,73
	α Pegasi -	11.54.19,5	54.41,3	55. 3	55.25	55.46,6	11.55. 3,07	11.51.21,57

Date.	Stars.	Merid. wire 1.	2.	3.	4.	5.	Mean Chronometer.	Clock.
		h. m. s.	m. s.	m. s.	m. s.	m. s.	h. m. s.	h. m. s.
10	α Equulei -	9.57.45	58. 6	58.27	58.48,5	59. 9,4	9.58.27,15	9.55.54,46
	β Aquarii -	10.12.59	13.20	13.41	14. 2,5	14.23,7	10.13.41,2	10.11. 8,88
	ε Pegasi -	10.26.10,8	26.32	26.53,3	27.15	27.36,2	10.26.53,43	10.24.21,36
	Pegasi - -	11. 9.28,3	9.49,6	10.10,5	10.32	10.53,2	11.10.10,68	11. 7.39,80
	ϰ Aquarii -	11.19. 9	19.30	19.51,2	20.12,4	20.34	11.19.51,3	11.17.20,66
	ζ Pegasi -	11.23. 9,4	23.31	23.52	24.13,7	24.35,2	11.23.52,22	11.21.21,70
	ξ Pegasi -	11.28.21,3	28.42,5	29. 4	29.25,6	29.47,3	11.29. 4,12	11.26.33,72
	α Pegasi -	11.46.23	46.44,6	47. 6,3	47.28,3	47.50,3	11.47. 6,47	11.44.36,50
12	α Equulei -	9.49.47,4	50. 8,7	50.29,4	50.51	51.15,5	9.50.29,73	9.49.11,23
	β Aquarii -	10. 5. 1,3	5.22,5	5.43,5	6. 5	6.26,2	10. 5.43,67	10. 4.25,60
	ο Aquarii -	10.36.51,4	37.12,4	37.33,4	37.54,6	38.16	10.37.33,53	10.36.16,20
	Pegasi - -	11. 1.31,2	1.52,2	2.13,3	2.34,5	2.55,5	11. 2.13,33	11. 0.56,53
	ϰ Aquarii -	11.11.11,5	11.33	11.53,7	12.15,3	12.36,4	11.11.53,93	11.10.37,38
	ζ Pegasi -	11.15.12	15.33,4	15.54,5	16.16,4	16.37,5	11.15.54,72	11.14.38,28
	ξ Pegasi - -	11.20.23,6	20.45,1	21. 6,5	21.28,2	21.49,8	11.21. 6,65	11.19.50,34
	α Pegasi -	11.38.25,5	38.47,4	39. 9	39.31	39.53	11.39. 9,15	11.37.53,33
14	α Equulei -	9.41.54,6	42.15,7	42.37	42.58,3	43.19,4	9.42.37	9.42.28,05
	ε Pegasi -	10.10.20,2	10.41,5	11. 3	11.24,6	11.46,1	10.11. 3,07	10.10.54,92
	ο Aquarii -	10.28.58,4	29.19,4	29.40,5	30. 1,7	30.23	10.29.40,58	10.29.32,78
	Pegasi - -	10.53.38,2	53.59,2	54.20,3	54.41,8	55. 3	10.54.20,47	10.54.13,42
	ϰ Aquarii -	11. 3.18,6	3.40	4. 1	4.22,4	4.43,5	11. 4. 1,08	11. 3.54,32
	ζ Pegasi -	11. 7.19	7.40,3	8. 1,9	8.23,4	8.45	11. 8. 1,92	11. 7.55,24
	ξ Pegasi -	11.12.31	12.52,3	13.14	13.35,4	13.57	11.13.13,95	11.13. 7,40
	α Pegasi -	11.30.32,7	30.54,4	31.16,2	31.38,3	32. 0	11.31.16,3	11.31.10,33

Transits observed at CLIFTON.

Date.	Stars.	1.	2.	3.	4.	5.	Mean Chronometer.	Clock.
Oct. 2	σ Aquilæ -	6.46. 8	46.29	46.50,1	47.11,3	47.32,7	6.46.50,2	6.46.47,45
	α Aquilæ -	6.57.47,4	58. 8,7	58.30	58.51,7	59.13	6.58.30,13	6.58.27,38
	θ Aquilæ -	7.17.44,4	18. 5,5	18.26,5	18.47,6	19. 8,8	7.18.26,55	7.18.23,75
	α Equulei -	8.22.23,4	22.44,4	23. 5,4	23.27	23.48	8.23. 5,6	8.23. 2,35
	ε Capricorni	8.42.24	42.47	43. 9,1	43.32	43.54,5	8.43. 9,28	8.43. 5,98
	α Aquarii -	9.11.57	12.18,1	12.39,4	13. 0,5	13.21,7	9.12.39,35	9.12.35,95
	γ Aquarii -	9.27.43,8	28. 5	28.25,7	28.47	29. 8,1	9.28.25,88	9.28.22,38
3	☉'s 1st limb	11.47.29	—	—	—	48.53,7	11.49.15,8	11.49. 6,5
	☉'s 2d limb	—	—	50.20	50.41,2	51. 2,7		
	σ Aquilæ -	6.42.10,3	42.31,4	42.52,7	43.14	43.35,3	6.42.52,73	6.42.40,48
	α Aquilæ	6.53.50	54.11,4	54.32,4	54.54	55.15,5	6.54.32,62	6.54.20,37
	θ Aquilæ	7.13.47	14. 8,1	14.29,1	14.50,5	15.11,7	7.14.29,25	7.14.16,85
	ε Aquarii -	7.49.34	49.55,5	50.16,9	—	51. 0	7.50.17	7.50.04,50
	η Capricorni	8. 5.41,6	6. 3,9	6.26,3	6.49,2	7.11,8	8. 6.26,52	8. 6.13,77
	α Equulei -	8.18.25,7	18.47	19. 8	19.29,4	19.50,4	8.19. 8,08	8.18.55,28
	ε Capricorni	8.38.26,9	38.49	39.11,8	39.34,2	39.56,9	8.39.11,77	8.38.58,87
	α Aquarii -	9. 8. 0	8.21	8.42	9. 3,1	9.24,2	9. 8.42,05	9. 8.29,15
	γ Aquarii -	9.23.46,3	24. 7,4	24.28,5	24.49,7	25.11	9.24.28,57	9.24.15,47
	η Aquarii -	9.37.29,2	37.50,3	38.11,2	38.32,4	38.53,8	9.38.11,35	9.37.58,10

Date.	Stars.	1.	2.	Merid. wire. 3.	4.	5.	Mean Chronometer.	Clock.
		h. m. s.	m. s.	m. s.	m. s.	m. s.	h. m. s.	h. m. s.
5	☉'s 1st limb	11.46.50,7	47.12	47.33	47.545	48.15,7	11.48.37,54	11.48. 8,64
	☉'s 2d limb	11.48.59,5	49.20,6	49.41,8	50. 3 1	50.24,5		
	σ Aquilæ -	6. ——	—	34.59	35.20,5	35.41,5	6.34.59,05	6.34.27,35
	α Aquilæ -	6.45.56,4	46.17,7	46.39	47. 0,5	47.21,8	6.46.39,07	6.46. 7,22
	θ Aquilæ -	7. 5.53,4	6.14,5	6.35,6	6.56,8	7.18	7. 6.35,65	7. 6. 3,75
	ε Aquarii -	7.41.40,6	42. 2	42.23,2	42.45	43. 6,3	7.42.23,38	7.41.51,28
	α Aquarii -	9. 0. 6	0.27,2	0.48	1. 9,1	1.30,5	9. 0.48,13	9. 0.15,68
	γ Aquarii	9.15.52,7	16.13,7	16.34,9	16.56	17.17	9.16.34,87	9.16. 2,27
	η Aquarii -	9.29.35,3	29.56,5	30.17,4	30.38,9	31. 0	9.30.17,62	9.29.44,92
6	☉'s 1st limb	11.46.30,5	46.51,9	47.13	47.34,[illegible]	47.55,9	11.48.17,66	11.47.40,36
	☉'s 2d limb	11.48.39,7	49. 1	49.22	49.43,4	50. 4,7		
	σ Aquilæ -	6.30.18,8	30.39,9	31. 1	31.22,3	31.43,4	6.31. 1,07	6.30.20,82
	α Aquilæ -	6.41.58,3	42.19,5	42.40,7	43. 2,2	43.23,8	6.42.40,87	6.42. [illegible],57
	θ Aquilæ -	7. 1.55,4	2.16,3	2.37,5	2.58,7	3.19,9	7. 2.37,55	7. 1.57,15
	ε Aquarii -	7.37.42,4	38. 4	38.25,2	38.47	39. 8,3	7.38.25,35	7.37.44,75
	α Equulei -	8. 6.33,8	6.55	7.16	7.37,4	7.58,7	8. 7.16,15	8. 6.35,35
	ε Capricorni	8.26.35,3	26.57,8	27.20	27.43	28. 5,5	8.27.20,27	8.26.39,37
	α Aquarii -	8.56. 8	56.29,4	56.50,2	57.11,4	57.32,8	8.56.50,33	8.56. 9,23
	γ Aquarii -	9.11.54,8	12.16	12.36,9	12.58	13.19,2	9.12.36,97	9.11.55,72
	η Aquarii -	9.25.37,7	25.58,7	26.19,5	26.41	27. 2	9.26.19,73	9.25.38,43
8	☉'s 1st limb	11.45.52,8	46.14	46.35	46.56,8	47.17,9	11.47.39,78	11.46.45,38
	☉'s 2d limb	11.48. 1,8	48.23	48.44	49. 5,5	49.27		
	σ Aquilæ -	6. ——	—	—	23.27	23.48	6.23. 5,67	6.22. 8,92
	θ Aquilæ -	6.53.58,9	54.20,5	54.41,4	55. 3	55.24	6.54.41,53	6.53.44,63
	ε Aquarii -	7.29.47	—	30.30	—	31.13	7.30.30	7.29.32,8
	α Equulei -	7. ——	—	—	59.42	60. 2,9	7.59.20,58	7.58.23,28
	ε Capricorni	8.18.39,7	19. 2,2	19.24,5	19.47,2	20. 9,8	8.19.24,65	8.18.27,2
	α Aquarii -	8.48.12,7	48.33,5	48.54,7	49.16	49.37	8.48.54,77	8.47.57,07
	η Aquarii -	9.17.42	18. 3	18.24	18.45,4	19. 6,5	9.18.24,17	9.17.26,37

Transits observed at ARBURY HILL.

Date.	Stars.	1.	2.	3.	4.	5.	Mean Chronometer.	Clock.
Oct. 21	☉'s 1st limb	11.42.46,8	43. 8,2	43.29,9	43.51,1	44.13	11.44.35,39	11.44.28,39
	☉'s 2d limb	11.44.58	45.19,4	45.41	46. 2,5	46.24		
	σ Aquilæ -	5.31. 5,5	31.26,5	31.47,7	32. 9	32.30,2	5.31.47,73	5.31.39,53
	α Aquilæ -	5.42.44,5	43. 6	43.27,3	43.49	44.10,1	5.43.27,37	5.43.19,17
	θ Aquilæ -	6. 2.42,4	3. 3,8	3.24,8	3.46	4. 7	6. 3.24,8	6. 3.16,55
25	σ Aquilæ -	5.15.17	15.38,4	15.59,3	16.21	16.42	5.15.59,5	5.15.30,75
	α Aquilæ -	5.26.56,4	27.18	27.39	28. 0,6	28.22	5.27.39,17	5.27.10,42
	θ Aquilæ -	5.46.54,3	47.15,4	47.36,4	47.58	48.19	5.47.36,58	5.47. 7,78
26	☉'s 1st limb	11.42. 0,5	42.22	42.43,6	43. 5,5	43.27	11.43.49,83	11.43.17,93
	☉'s 2d limb	11.44.12,5	44.34,3	44.56	45.17,7	45.39,2		
	σ Aquilæ -	5.11.19,5	11.40,6	12. 1,9	12.23,1	12.44,4	5.12. 1,9	5.11.29,1
	α Aquilæ -	5.22.59	23.20,3	23.41,4	24. 3	24.24,4	5.23.41,58	5.23. 8,78
	θ Aquilæ -	5.42.56,5	43.18	43.39	44. 0	44.21,2	5.43.38,95	5.43. 6,05

Transits observed at SHANKLIN FARM.

Date.	Stars.	1.	2.	Merid. wire. 3.	4.	5.	Mean Chronometer.	Clock.
		h. m. s.	m. s.	m. s.	m. s.	m. s.	h. m. s.	h. m. s.
1819. May 10	Regulus -	6.51.42,2	52. 4	52.25,5	52.47,2	—	6.52.25,55	6.52.37,32
11	⊙'s 1st limb	11.58.51,7	59.14	59.36,2	59.58,5	60.20,5	0. 0.42,86	0. 0.49,49
	⊙'s 2d limb	0. 1. 5	1.27,3	1.49,6	2.11,8	2.34		
12	*d* -	9. 10.41	11. 3,3	11.25,5	11.48	12.10,5	9.11.25,63	9.11.21,26
	ε Virginis -	9. 37.45	38. 6,8	38.28	38.49,8	39.11,3	9.38.28,15	9.38.24,16
	α Virginis -	10. 0.10,7	0.32,2	0.53,5	1.15	1.36,5	10. 0.53,57	10. 0.49,30
	τ Bootæ -	10.23. 6,5	23.28,7	23.51	24.13,2	24.35,5	10.23.50,98	10.23.46,29
	η Bootæ -	10.30.29,3	30.51,8	31.14	31.36,5	31.59	10.31.14,1	10.31. 9,37
	Arcturus -	10.51.46	52. 9	53.31	53.58,8	53.16	10.52.31,13	10.52.26,25
13	⊙'s 1st limb	11.58.44,6	59. 7	59.29,2	59.51,8	60.14	0. 0.36,11	0. 0.26,89
	⊙'s 2d limb	0. 0.58,3	1.20,5	1.43	2. 5,2	2.27,5		
	Regulus -	6.39.49	40.11	40.32,5	40.54,2	41.15,8	6.40.32,5	6.40.21,23
14	⊙'s 1st limb	11.58.41,8	59. 4	59.26,5	59.48,8	60.11,0	0. 0.33,31	0. 0.16,44
	⊙'s 2d limb	0. 0.55,5	1.18	1.40	2. 2,5	2.25		
15	⊙'s 1st limb	11.58.39,2	59. 2	59.24	59.46,7	60. 9	0. 0.31,18	0. 0. 6,51
	⊙'s 2d limb	0. 0.53,4	1.15,8	1.38,2	2. 0,5	2.23		
	Regulus -	6.31.53,8	32.15,5	32.37	32.58,7	33.20,2	6.32.37,03	6.32.10,35
16	⊙'s 1st limb	11.58.37,5	59. 0	59.22,5	59.45	60. 7	0. 0.29,43	11.59.57,71
	⊙'s 2d limb	0. 0.51,5	1.14	1.36,5	1.59	2.21,3		
	Regulus -	6.27.56,0	28.17,8	28.39,5	29. 1	29.22,5	6.28.39,28	6.28. 5,65
	d -	8.54.50,3	55.13	55.35	55.57,5	56.20	8.55.35,13	8.55. 0,74
	ε Virginis -	9.21.54,3	22.16	22.37,3	22.59,1	23.20,5	9.22.37,41	9.22. 2,83
	α Virginis -	9.44.20	44.41,5	45. 2,8	45.24,2	45.45,6	9.45. 2,82	9.44.28,08
	τ Bootæ -	10. 7.15,7	7.37,7	8. 0	8.22,2	8.44,5	10. 8. 0,02	10. 7.25,28
	η Bootæ -	10.14.38,7	15. 1	15.23,3	15.45,7	16. 8,2	10.15.23,37	10.14.48,58
	Arcturus -	10.35.55,4	36.18	36.40,2	37. 3	37.25,2	10.36.40,33	10.36. 5,44

Comparisons of the Clock with the Chronometer.

Date.	Chronometer.	Clock.	Clock fast.
	h. m. s.	h. m. s.	m. s.
July 22, P. M.	5.19.10,25	5.24.28	5.17,75
	6.10.40,8	6.16. 0	5.19,20
	9.53.20	9.58.47	5.27
	10.16.10	10.21.38	5.28
	10.34.31,5	10.40. 0	5.28,5
	21.49.45,5	21.55.37,3	5.51,8
	22.41. 0,25	22.46.54	5.53,75
24	0.10.50,75	0.17.38	6.47,25
25	9.17.40	9.25.38	7.58
	9.41. 0,8	9.49. 0	7.59,2
	10. 3.25,25	10.11.25	7.59,75
	10.22.20,5	10.30.21	8. 0,5
26	0.13.28,5	0.22. 1	8.32,5
28	9.31.49,25	9.42. 0	10.10,75
	0.12. 6	0.22.23	10.17
	5.49.30,25	6. 0. 0	10.29,75
	9. 6.30	9.17. 7	10.37
	9.29.50	9.40.28	10.38
	9.51. 0,25	10. 1.39	10.38,75
	10.10. 5,5	10.20.45	10.39,5
August 5.	9. 4.40	9. 5.42	1. 2
	9.27.40,25	9.28.43	1. 2,75
	9.46.20	9.47.23	1. 3
	10.24.41	10.25.45	1. 4
	10.44. 0,5	10.45. 5	1. 4,5
	11. 5. 0	11. 6. 5	1. 5
6	0.22.59,8	0.24.22	1.22,2
	8.38. 5,25	8.39.39	1.33,75
7	0.16.40,25	0.18.36	1.55,75
8	0.16.45	0.19.18	2.33
	5.15.18,5	5.18. 0	2.41,5
	8.31. 0	8.33.47	2.47
	8.52.15,5	8.55. 3	2.47,5
	9.34.20,3	9.37. 9	2.48,7
	10.48.50,25	10.51.41	2.50,75
10	0.16.15	0.20. 8	3.53
	5. 3.35,4	5. 7.37	4. 1,6
	8.22.20,4	8.26.28	4. 7,6
	8.44. 0,75	8.48. 9	4. 8,25
	9. 7. 0	9.11. 9	4. 9
	9.26.15,5	9.30.25	4. 9,5
	9.58.45,5	10. 2.56	4.10,5
	10.40.10	10.44.22	4.12
11	8.18. 0,5	8.22.52	4.51,5
	8.40.14,75	8.45. 7	4.52,25
	9. 5. 0	9. 9.53	4.53
	9.22. 0,5	9.26.54	4.53,5

Date.	Chronometer.	Clock.	Clock fast.
	h. m. s.	h. m. s.	m. s.
August 11	9.54. 6,5	9.59. 1	4.54,5
	10.16.19,75	10.21.15	4.55,25
	10.36.50,25	10.41.46	4.55,75
12	0.15.45,4	0.21. 6	5.20,6
	4.57. 0,25	5. 2.29	5.28,75
	8.13.25,25	8.19. 0	5.34,75
	8.36. 0,5	8.41.36	5.35,5
	9. 1. 0,5	9. 6.37	5.36,5
	9.20.20	9.25.57	5.37
	9.50. 5	9.55.43	5.38
	10.11.55,5	10.17.34	5.38,5
	10.31.49,75	10.37.29	5.39,25
			Slow.
13	0.17.30,75	0.17. 8	0.22,75
	4.51. 0,5	4.50.46	0.14,5
	8.10.20,4	8.10.12	0. 8,4
			Fast.
14	0.15.51,5	0.16.12	0.20,5
	8. 6.25,25	8. 7. 0	0.34,75
	8.29.41,5	8.30.17	0.35,5
	8.51.20	8.51.56	0.36
	9.10.15,4	9.10.52	0.36,6
	10. 5.32,5	10. 6.11	0.38,5
	10.21.10	10.21.49	0.39
15	0.15.29,75	0.16.35	1. 5,25
	4.43.51,75	4.45. 5	1.13,25
	8. 3.54,75	8. 5.14	1.19,25
	8.24. 0	8.25.20	1.20
	8.47.15,25	8.48.36	1.20,75
	9. 6.15,5	9. 7.37	1.21,5
16	0.15. 0,25	0.16.49	1.48,75
	4.40.29,9	4.42.27	1.57,1
	7.58.56,75	8. 1. 0	2. 3,25
	8.43.19,5	8.45.24	2. 4,5
	9. 3.34,8	9. 5.40	2. 5,2
	10.13. 0,5	10.15. 8	2. 8,5
17	0.15.24,9	0.17.58	2.33,1
	7.56.41,12	7.59.28,5	2.47,38
	8.16. 5	8.18.53	2.48
	8.39.10,25	8.41.59	2.48,75
	8.58.11,5	9. 1. 1	2.49,5
	9.51.59,9	9.54.51	2.51,1
	10. 9.30,4	10.12.22	2.51,6
18	4.32.49,75	4.36.14	3.24,25
	8.12.34,8	8.16. 6	3.31,2
	8.35. 5	8.38.37	3.32
	8.54. 0,5	8 57.33	3.32,5
19	0.14.34,75	0.18.35	4. 0,25
			Slow.
31	7.47.49, 9	7.47.19	0.30,9

Date.	Chronometer.	Clock.	Clock slow.
	h. m. s.	h. m. s.	m. s.
August 31	9.56. 5,5	9.55.37	0.28, 5
	10.41.39,75	10.41.12	0.27,75
	10.56. 0,5	10.55.33	0.27,5
	11.16. 0	11.15.33	0.27
	11.29. 9,8	11.28.43	0.26,8
	11.46.40,5	11.46.14	0.26,5
			Fast.
September 2	0.13.15,3	0.13.35	0.19,7
	9.45. 0,8	9.45.32	0.31,2
	10. 4. 0,4	10. 4.32	0.31,6
	10.33.49,75	10.34.22	0.32,25
	10.48.10,4	10.48.43	0.32,6
	11.19.44,75	11.20.18	0.33,25
	12. 4.24,75	12. 4.49	0.34,25
4	9.38. 4,75	9.39.35	1.30,25
	9.58. 0,25	9.59.31	1.30,75
	10.24.45,5	10.26.17	1.31,5
	10.40.40,25	10.42.12	1.31,75
	10.53. 0	10.54.32	1.32
	11.12. 0,5	11.13.33	1.32,5
	11.31. 0	11.32.33	1.33
	11.48. 9,75	11.49.43	1.33,25
	11.56. 5,5	11.57.39	1.33,5
5	0.11.15,2	0.13. 5	1.49,8
6	0.11.49,8	0.14.12	2.22,2
			Slow.
8	10. 8.30	10. 4.46	3.44
	10.28. 5,5	10.24.42	3.43,5
	10.37.15,3	10.33.32	3.43,3
	10.55.49,9	10.52. 7	3.42,9
	11.21. 0,3	11.27.18	3.42,3
	11.40. 9,8	11.36.28	3.41,8
	11.58.41,4	11.55. 0	3.41,4
10	10. 6. 0,5	10. 3.28	2.32,5
	10.16.30,25	10.13.58	2.32,25
	10.30. 5	10.27.33	2.32
	11.13.30,8	11.11. 0	2.30,8
	11.32.50,3	11.30.20	2.30,3
	11.50. 9,9	11.47.40	2.29,9
12	9.54.20,4	9.53. 2	1.18,4
	10. 8.50	10. 7.32	1.18
	10.41. 0,25	10.39.43	1.17,25
	11. 4. 0,75	11. 2.44	1.16,75
	11.23.40,25	11.22.24	1 16,25
	11.42. 0,75	11.40.45	1.15,75
14	9.45. 4,9	9.44.56	0. 8,9
	10. 5.40,2	10. 5.32	0. 8,2
	10.17.40	10.17.32	0. 8
	10.32. 4,75	10.31.57	0. 7,75
	10.56 30	10.56.23	0. 7
	11.15.26,5	11.15.20	0. 6,5

Date.	Chronometer.	Clock.	Clock slow.
	h. m. s.	h. m. s.	m. s.
September 14	11.34.19,9	11.34.14	0. 5,9
October 2	6.49. 9,75	6.49. 7	0. 2,75
	7. 1. 2,75	7. 1. 0	0. 2,75
	7.21. 2,8	7.21. 0	0. 2,8
	8.27. 3,25	8.27. 0	0. 3,25
	8.48. 3,3	8.48. 0	0. 3,3
	9.15. 3,4	9.15. 0	0. 3,4
	9.31. 3,5	9.31. 0	0. 3,5
3 A. M.	11.54. 9,3	11.54. 0	0. 9,3
P. M.	6.45.12,25	6.45. 0	0.12,25
	6.57.12,25	6.57. 0	0.12,25
	7.16.12,4	7.16. 0	0.12,4
	7.54.12,5	7.54. 0	0.12,5
	8. 9.12,75	8. 9. 0	0.12,75
	8.22.12,8	8.22. 0	0.12,8
	8.42.12,9	8.42. 0	0.12,9
	9.11.30	9.11.17,1	0.12,9
	9.29.13,1	9.29. 0	0.13,1
	9.41.13,25	9.41. 0	0.13,25
5 A. M.	11.52.28,9	11.52. 0	0.28,9
P. M	6.37.31,7	6.37. 0	0.31,7
	6.43.31,8	6.43. 0	0.31,8
	7. 9.31,9	7. 9. 0	0.31,9
	7.46.32	7.46. 0,1	0.32,1
	8. 1.32,25	8. 1. 0	0.32,25
October 5	9. 4.32,45	9. 4. 0	0.32,45
	9.18.32,6	9.18. 0	0.32,6
	9.32.32,7	9.32. 0	0.32,7
6 A. M.	11.51.37,3	11.51. 0	0.37,3
P. M.	6.32.40,25	6.32. 0	0.40,25
	6.44.40,3	6.44. 0	0.40,3
	7. 3.40,4	7. 3. 0	0.40,4
	7.40.40,6	7.40. 0	0.40,6
	8. 9.40,8	8. 9. 0	0.40,8
	8.29.40,9	8.29. 0	0.40,9
	8.59.41,1	8.59. 0	0.41,1
	9.14.41,25	9.14. 0	0.41,25
	9.28.41,3	9.28. 0	0.41,3
7 A. M.	11.51.45,6	11.51. 0	0.45,6
8 A. M.	11.51.54,4	11.51. 0	0.54,4
P. M.	6.24.56,75	6.24. 0	0.56,75
	6.57.56,9	6,57. 0	0.56,9
	7.33.57,2	7.33. 0	0.57,2
	8. 1.57,3	8. 1. 0	0.57,3
	8.21.57,45	8.21. 0	0.57,45
	8.50.57,7	8.50. 0	0.57,7
	9.22. 57,8	9.22. 0	0.57,8
21 A. M.	11.49. 7	11.49. 0	0. 7
P. M.	5.35. 8,2	5.35. 0	0. 8,2
	5.46. 8,2	5.46. 0	0. 8,2

Date.	Chronometer.	Clock.	Clock slow.
	h. m. s.	h. m. s.	m. s.
October 21	6. 6. 8,25	6. 6. 0	0. 8,25
	6.19. 8,25	6.19. 0	0. 8.25
October 25	5.19.28,75	5.19. 0	0.28,75
	5.30.28,75	5.30. 0	0.28,75
	5.50.28,8	5.50. 0	0.28,8
	6.55.28,95	6.55. 0	0.28,95
	7.10.29,05	7.10. 0	0.29,05
	7.44.29,2	7.44. 0	0.29,2
	7.59.29,2	7.59. 0	0.29,2
	8.14.29,25	8.14. 0	0.29,25
26 A. M.	11.48.31,9	11.48. 0	0.31,9
P. M.	5.15.32,8	5.15. 0	0.32,8
	5.26.32,8	5.26. 0	0.32,8
	5.50.32,9	5.50. 0	0.32,9
			Fast.
1819. May 10	6.56.48,25	6.57. 0	0.11,75
11	0. 4.53,4	0. 5. 0	0. 6,6
			Slow.
12	8.28. 4,25	8.28. 0	0. 4,25
	9.16. 4,4	9.16. 0	0. 4,4
	9.46. 4,4	9.46. 0	0. 4,4
	10. 4. 4,3	10. 4. 0	0. 4,3
	10.34. 4,75	10.34. 0	0. 4,75
	10.55. 4,9	10.55. 0	0. 4,9
13	0. 5. 9,25	0. 5. 0	0. 9,25
	6.45.11,3	6.45. 0	0.11,3
14	0. 4.16,9	0. 4. 0	0.16,9
15	0. 4.24,7	0. 4. 0	0.24,7
	6.35.26,7	6 35. 0	0.26,7
16	0. 4.31,75	0. 4. 0	0.31,75
	6.31.33,75	6.31. 0	0.33,75
	8.57.34,4	8.57. 0	0.34,4
	9.25.34,6	9.25. 0	0.34,6
	9.47.34,75	9.47. 0	0.34,75
	10.17.34,8	10.17. 0	0.34,8
	10.38.34,9	10.38. 0	0.34,9

Observations for the error of the Chronometer.

Unst, 1818, 23d July, P. M. ☉'s U. L.

Chronometer.		Level.		Readings, &c.		
	h. m s.					° ′ ″
	4.21 24,5	+ 7	— 3	First Vernier		239.32.15
	4.24.29,5	+ 5	— 5	Second		5
	4.26.46,0	+10	+ 4	Third		5
	4.28. 1,5	+ 9	+ 0	Fourth		10
Mean	4.25.10.4	+31	— 4	Mean		239.32. 8,7
True time	4.24.23,3			Level	+	32,4
				Index	+	18,0
Chron. fast	47,1					4)239.32.59,1
$\frac{(+31-4)}{2}\times 2'',4 = +32'',4$				Observed Z. D.		59.53.14,8
				Ref. and Parall.	+	1.32,3
				Semidiam.	+	15.46,4
				True Z. D.		60.10.33,5

Unst, 23rd July, P. M. ☉'s U. L.

Chronometer.		Level.		Readings, &c.		
	h. m. s.					° ′ ″
	4.31.55	+ 6	— 1	First Vernier		243.58.10
	4.33.16	+ 4	— 2	Second		58. 0
	4.35.32,5	+ 9	+ 4	Third		57.50
	4.37. 0,5	+ 5	+ 0	Fourth		58.15
Mean	4.34.26,0	+24	+ 1	Mean		243.58 3,7
True time	4.33.37,9			Level	+	30,0
				Index	+	18,0
Chron. fast	48,1					4)243.58.51,7
$\frac{(+24+1)}{2}\times 2'',4 = +30'',0$				Observed Z. D.		60.59.42,9
				Ref. and Parall.	+	1.36,8
				Semidiam.	+	15.46,4
				True Z. D.		61.17. 6,1

From the mean of the above observations, the chronometer appears to be 47ˢ,6 too fast, and the rate being —1ˢ,81, we have 47ˢ,9 for its error too fast at noon.

PORTSOY, 1818, 3rd August, P. M. ☉'s U. L.

Chronometer.		Level.		Readings, &c.		
	h. m. s.					° ′ ″
	4. 8.35	+ 4	— 2	First Vernier	-	234.26.55
	4. 9.50,5	— 1	— 6	Second	-	45
	4.11. 7	+ 2	— 4	Third	-	40
	4.12. 4,5	+ 5	— 0	Fourth	-	60
Mean	4.10.24,2	+10	—12	Mean	-	234.26.50
True time	4. 2.31,3			Level	—	2,4
Chron. fast	7.52,9			Index	+	18,0
					4)	234.27. 5,6
$\frac{(10-12)}{2}\times 2'',4 = -2'',4$				Observed Z. D.	-	58.36.46,4
				Ref. and Parall.	+	1.24,7
				Semidiam.	+	15.47
				True Z. D.	-	58.53.58,1

PORTSOY, 3rd August, P. M. ☉'s U. L.

Chronometer.		Level.		Readings, &c.		
	h. m. s.					° ′ ″
	4.15.56,5	+ 4	+ 2	First Vernier	-	238.18.40
	4.17. 9	+ 4	+ 1	Second	-	25
	4.18.29,5	+ 5	+ 3	Third	-	30
	4.20. 5,5	+ 1	— 2	Fourth	-	50
Mean	4.17.55,1	+14	+ 4	Mean	-	238.18.36,6
True time	4.10. 3,4			Level	+	21,6
Chron. fast	7.51,7			Index	+	18,0
					4)	238.19.16,2
$\frac{(+14+4)}{2}\times 2'',4 = 21'',6$				Observed Z. D.	-	59.34.49,0
				Ref. and Parall.	+	1.30,4
				Semidiam	+	15.47
				True Z. D.	-	59.52. 6,4
				Sun rather obscure during some of these observations.		

From the mean of the above observations, the chronometer appears to be $7^m.52^s,3$ too fast, and the rate being — $1^s,7$ we have the chronometer $7^m.52^s,58$ too fast at apparent noon.

LEITH FORT, 1818, 17th September, A. M. ☉'s U. L.

Chronometer.		Level.		Readings, &c.		
	h. m. s.					° ′ ″
	7.36.34	+24	—17	First Vernier -		297.25.25
	7.38.26	+22	—19	Second - -		25.40
	7.41.16	+20	—21	Third - -		25.25
	7.43. 1	+22	15	Fourth - -		25.15
Mean - -	7.39.49,2	+88	—72	Mean - - -		297.25.26,2
True time -	7.31. 7,6			Level - -	+	19,2
				Index - -	+	18
Chron. fast -	8.41,6					4) 297.26.3,4
				Observed Z. D.		74.21.30,85
$\frac{(+88-72)}{2}\times 2'',4 = +19'',2$				Ref. and Parall.	+	3.16,6
				Semidiam. -	+	15.57,3
				True Z. D. -		74.40.44,75

LEITH FORT, 17th September, A. M. ☉'s U. L.

Chronometer.		Level.		Readings, &c.		
	h. m. s.					° ′ ″
	7.49. 4	+20	—20	First Vernier -		291.19.55
	7.50.19	+18	—20	Second - -		19.45
	7.52.19,5	+25	—13	Third - -		19.55
	7.54.16,5	+16	—22	Fourth - -		19.55
Mean - -	7.51.29,8	+79	—75	Mean - -		291.19.52,5
True time -	7.42.48,2			Level - -	+	4,8
				Index -	+	18
Chron. fast -	8.41,6					4)291.20.15,3
				Observed Z. D.		72.50. 3,85
$\frac{(+79-75)}{2}\times 2'',4 = +4'',8$				Ref. and Parall.	+	2.58
				Semidiam. - -	+	15.57,3
				True Z. D. -		73. 8.59,15

From the above observations the chronometer appears to be $8^m.41^s,6$ too fast, and the rate being—$1^s,85$, we have the chronometer $8^m.42^s,18$ too fast at apparent noon.

Arbury Hill, at the Pendulum Station, 1818, August 18th, P. M. ☉'s U. L.

Chronometer.		Level		Readings, &c.		
	h. m. s.					° ′ ″
	3.4. 7	+ 9	—17	First Vernier	-	299.46.55
	3.5.31	+11	—12	Second	- -	40
	3.7.34	+14	— 9	Third	- -	50
	3.8.51	+11	—13	Fourth	- -	45
Mean - -	3.6.30,7	+45	—51	Mean - -		299.46.47,5
True time -	3.6.44,5			Level - -	—	7,2
				Index - -	+	18,0
Chronom. slow -	13,8					4)299.46.58,3
				Observed Z. D.	-	74.56.44,6
$\frac{(+45-51)}{2} \times 2'',4 = -7'',2$				Ref. and Parall.	+	3.24,3
				Semidiam. -	+	16. 6,0
				True Z. D.	-	75.16.14,9

Arbury Hill, at the Pendulum Station, August 18th, P. M. ☉'s U. L.

Chronometer.		Level.		Readings, &c.		
	h. m. s.					° ′ ″
	3.13.48	+14	— 7	First Vernier	-	151.57. 5
	3.16.12	+12	— 9	Second	- -	56.30
				Third	- -	56.35
Mean -	3.15. 0	+26	—16	Fourth	- -	56.45
True time -	3.15.14,8					
				Mean -	-	151.56.43,7
Chronom. slow -	14,8			Level -	- +	12,0
				Index -	- +	18,0
						2)151.57.13,7
$\frac{(+26-16)}{2} \times 2'',4 = +12'',0$				Observed Z. D.	-	75.58.36,8
				Ref. and Parall.	- +	3.48,2
				Semidiam. -	+	16. 6,0
				True Z. D.	-	76.18.31,0

From the mean of the above observations the chronometer appears to be 14ˢ,3 too slow; the daily rate being — 1ˢ,26.

SHANKLIN FARM, 10th May, 1819, A. M, O's U. L.

Chronometer.		Level.		Readings, &c.		
	h. m. s.					° ′ ″
	8.39.32	+18	—15	First Vernier -		204.40.35
	8.41. 3	+11	—19	Second - -		20
	8.42.56	+12	—19	Third - -		10
	8.44.44	+13	—17	Fourth - -		30
Mean - -	8.42. 3,75	+54	—70	Mean - -		204.40.23,7
True time -	8.37.24,90			Level - -	—	19,2
				Index - -	+	13,0
Chron. fast -	4.38,85					4) 204.40.17,5
				Observed Z. D. -		51.10. 4,35
$\frac{(+54-70)}{2} \times 2'',4 = -19'',2$				Ref. and Parall.	+	1. 5,0
				Semidiam. -	+	15.51,4
				True Z. D. -		51.27. 0,75

SHANKLIN FARM, 10th May, A. M. O's U. L.

Chronometer.		Level.		Readings, &c.		
	h. m. s.					° ′ ″
	8.50.33	+20	—10	First Vernier -		197.31.50
	8.52.14	+17	—13	Second - -		35
	8.56.23	+22	— 5	Third - -		30
	8.57.57	+14	—14	Fourth - -		50
Mean - -	8.54.16,75	+73	—42	Mean - -		197.31.41,2
True time -	8.49.36,90			Level - -	+	37,2
				Index - -	+	13,0
Chron. fast -	4.39,85					4) 197.32.31,4
				Observed Z. D. -		49.23. 7,85
$\frac{(+73-42)}{2} \times 2'',4 = +37'',2$				Ref. and Parall.	+	1. 1,2
				Semidiam. -	+	15.51,4
				True Z. D. -		49,40. 0,45

SHANKLIN FARM, 10th May, A.M. O's U. L.

Chronometer.		Level.		Readings, &c.		
	h. m. s.					° ′ ″
	9.3. 1	+21	— 6	First Vernier -		191.30. 0
	9.4. 9	+ 9	—20	Second - -		29.30
	9.5.37	+21	— 6	Third - -		29.40
	9.6.36	+20	— 6	Fourth - -		30. 0
Mean - -	9.4.50,75	+71	—38	Mean - -		191.29.47,5
True time -	9.0.10,40			Level - -	+	39,6
				Index -	+	13,0
Chron. fast. -	4.40,35					4)191.30.40,1
$\frac{(+71-38)}{2}\times 2''{,}4=+39''{,}6$				Observed Z. D. -		47.52.40,05
				Ref. and Parall.	+	58,5
				Semidiam. -	+	15.51,4
				True Z. D. -		48. 9.30,0

Observations of Coincidences.

1818, June 13, A. M. at Mr. Browne's house, Portland-place, LONDON. Barometer 29,9 inches, clock gaining 1",5 in a mean solar day.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed Vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
71,2	10. 5. 9	1,38	1,35	489			2,98	
	13.18	1,33	1,30	490			2,77	
	21.28	1,27	1,25	491			2,56	
	29.39	1,23	1,20	490			2,36	
	37.49	1,17	1,15	491			2,17	
	46. 0	1,13	1,10	491			1,98	
	54.11	1,08	1,05	490			1,80	
	11. 2.21	1,03	1,00	493			1,64	
	10.34	0,98	0,96	490			1,51	
	19.44	0,95	0,93	490			1,42	
72,0	26.56	0,92						
71,6	Mean			490,5	488,5	86049,20	2,12	86051,32
June 14, A. M.				**Barometer 30,0 inches.**				
° 69,3	10.27.30	1,39	1,36	490			3,03	
	35.40	1,33	1,30	491			2,77	
	43.51	1,28	1,25	491			2,56	
	52. 2	1,23	1,20	490			2,36	
70,3	11. 0.12	1,17	1,15	492			2,17	
	8.24	1,13	1,10	491			1,98	
	16.35	1,08	1,05	492			1,80	
	24.47	1,03	1,01	491			1,67	
	32.58	0,99	0,97	422			1,54	
	41.10	0,96	0,94	493			1,45	
70,6	49.23	0,92						
70,1	Mean			491,3	489,3	86049,77	2,13	86051,90

June 15, A. M. LONDON.

Barometer 30,05 inches, clock gaining 1^s,5.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
69,6	10. 3.10	1.34						
	11.20	1.29	1,31	490			2,81	
	19.31	1.23	1,26	491			2,60	
	27.42	1.18	1,20	491			2,36	
	35.54	1.13	1,15	492			2,17	
	44. 5	1.09	1,11	491			2,02	
70,3	52.17	1.05	1,07	492			1,88	
69,9	Mean			491,17	489,17	86049,68	2,31	86051,99

June 16, A. M. Barometer 29,95 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
70,3	9.58.13	1,26						
	10. 6.24	1,22	1,24	491			2,52	
	14.34	1,16	1,18	490			2,28	
	22.46	1,12	1,14	492			2,13	
	30.57	1,06	1,09	491			1,95	
	39. 9	1,02	1,04	492			1,77	
	47.21	0,98	1,00	492			1,64	
	55.33	0,94	0,96	492			1,51	
	11. 3.45	0,90	0,92	492			1,39	
	11.58	0,87	0,88	493			1,27	
70,8	20.10	0,82	0,84	492			1,15	
70,5	Mean			491,7	489, 7	86050,06	1,76	86051,82

July 23, P. M. at Unst.

Clock gaining 50^s,63 in a mean solar day. Barometer 30,0 inches.

Temp.	Time of Coincidence.	Arc of vibration.	Mean Arc.	Interval in Seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
58,0	0.44.47	1,25						
	52.48	1,18	1,21	481			2,40	
	1. 0.49	1,14	1,16	481			2,20	
	8.52	1,08	1,11	483			2,02	
	16.54	1,03	1,05	482			1,80	
	24.57	0,98	1,00	483			1,64	
	32.59	0,93	0,95	482			1,48	
	41. 2	0,90	0,91	483			1,36	
	49. 5	0,85	0,87	483			1,24	
	57. 8	0,82	0,83	483			1,13	
58,8	2. 5.10	0,78	0,80	482			1,05	
58,4	Mean			482,3	480,3	86092,15	1,63	86093,78
	July 23, P. M.				**Barometer 30,3 inches.**			
58,8	2. 9.54	1,21						
	17.55	1,16	1,18	481			2,28	
	25.56	1,11	1,13	481			2,10	
	33.57	1,06	1,08	481			1,91	
	41.58	1,01	1,03	481			1,74	
	50. 0	0,97	0,99	482			1,61	
	58. 1	0,94	0,95	481			1,48	
	3. 6. 3	0,90	0,92	482			1,39	
	14. 5	0,85	0,87	482			1,24	
	22. 7	0,82	0,83	482			1,13	
59,8	30. 9	0,79	0,80	482			1,05	
59,3	Mean			481,5	479,5	86091,55	1,59	86093,14

July 24, A. M. UNST.

Clock gaining $50^s,63$. Barometer 29,9 inches.

Temp.	Time of Coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
o	h. m. s.	o	o				s.	
56,7	8. 4.15	1,22	1,19	481			2,32	
	12.16	1,17	1,14	481			2,13	
	20.17	1,12	1,10	481			1,99	
	28.18	1,08	1,05	482			1,80	
	36.20	1,03	1,00	481			1,64	
	44.21	0,98	0,96	481			1,51	
	52.22	0,94	0,92	482			1,39	
	9. 0.24	0,91	0,89	483			1,30	
	8.27	0,87	0,85	482			1,18	
	16.29	0,83	0,81	483			1,08	
58,0	24.32	0,80						
57,3	Mean			481,7	479,7	86091,70	1,63	86093,33

July 24, P. M.

Barometer, 29,82 inches.

59,7	1. 2.36	1,21	1,17	481			2,24	
	10.37	1,14	1,12	479			2,06	
	18.36	1,10	1,07	481			1,88	
	26.37	1,05	1,03	480			1,74	
	34.37	1,02	0,99	481			1,60	
	42.38	0,97	0,95	481			1,48	
	50.39	0,93	0,91	480			1,36	
	58.39	0,89	0,87	481			1,24	
	2. 6.40	0,85	0,84	481			1,16	
	14.41	0,83	0,81	481			1,08	
59,8	22.42	0,79						
59,7	Mean			480,6	478,6	86090,87	1,58	86092,45

July 25, A. M. Unst.

Clock gaining 50s,63. Barometer 29,84 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
57,00	7.41.34	1,20						
	49.35	1,14	1,17	481			2,24	
	57.36	1,10	1,12	481			2,06	
	8. 5.37	1,05	1,07	481			1,88	
	13.39	1,01	1,03	482			1,74	
	21.40	0,97	0,99	481			1,60	
	29.42	0,93	0,95	482			1,48	
	37.44	0,89	0,91	482			1,36	
	45.46	0,85	0,87	482			1,24	
	53.47	0,82	0,83	481			1,13	
58,4	9. 1.49	0,79	0,80	482			1,05	
57,7	Mean			481,5	479,5	86091,54	1,58	86093,12

July 25, P. M.

Barometer 29,72 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
58,7	2. 0.27	1,21						
	8.27	1,17	1,19	480			2,32	
	16.27	1,11	1,14	480			2,13	
	24.27	1,06	1,08	480			1,91	
	32.26	1,01	1,03	479			1,74	
	40.27	0,98	0,99	481			1,60	
	48.27	0,93	0,95	480			1,48	
	56.27	0,90	0,91	480			1,36	
	3. 4.29	0,87	0,88	482			1,27	
59,3	12.29	0,83	0,85	480			1,18	
59,0	Mean			480,2	478,2	86090,57	1,67	86092,24

July 26, A. M. UNST.

Clock gaining 50",63. Barometer 29,95 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
57,1	7.42.47	1,13	1,10	480			1,98	
	50.47	1,08	1,06	480			1,84	
	58.47	1,04	1,02	481			1,71	
	8. 6.48	1,00	0,98	481			1,57	
	14,49	0,97	0,95	481			1,48	
	22.50	0,93	0,91	480			1,36	
	30 50	0,89	0,86	481			1,21	
	38 51	0,84	0,82	481			1,10	
	46.52	0,81	0,80	481			1,05	
	54.53	0,79	0,77	481			0,97	
58,6	9. 2.54	0,75						
47,8	Mean			480,7	478,7	86090,94	1,43	86092,37

Oil was now applied to the scapement without stopping the clock.

July 27, A. M.—Unst.

Clock gaining 50^s,63. Barometer 29,95 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
56,4	7.45.32	1,14	1,11	479			2,02	
	53.31	1,09	1,06	480			1,84	
	8. 1.31	1,04	1,02	478			1,71	
	9.29	1,00	0,98	480			1,57	
	17.29	0,97	0,94	480			1,45	
	25.29	0,92	0,90	480			1,33	
	33.29	0,88	0,86	480			1,21	
	41.29	0,84	0,82	481			1,10	
	49.30	0,80	0,78	480			1,00	
	57.30	0,77	0,75	480			0,92	
57,3	9. 5.30	0,73						
56,8	Mean			479,8	477,8	86090,27	1,42	86091,69

July 27, P. M.

Barometer 30,0 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
57,2	1.29. 6	1,18	1,15	479			2,17	
	37. 5	1,13	1,10	478			1,98	
	45. 3	1,08	1,06	478			1,84	
	53. 1	1,04	1,01	480			1,68	
	2. 1. 1	0,98	0,97	481			1,54	
	9. 2	0,96	0,94	479			1,45	
	17. 1	0,92	0,90	480			1,33	
	25. 1	0,88	0,86	480			1,21	
	33. 1	0,84	0,83	480			1,13	
	41. 1	0,82	0,80	480,5			1,05	
57,2	49.01,5	0,78						
57,2	Mean			479,6	477,6	86090,08	1,54	86091,62

July 28, A. M.—UNST.

Clock gaining 50ˢ,63. Barometer 30,05 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
53,8	8. 2. 7	1,29						
	10. 7	1,13	1,21	480			2,40	
	18. 7	1,08	1,10	480			1,98	
	26. 7	1,03	1,05	480			1,80	
	34. 7	1,01	1.02	480			1,70	
	42. 8	0,96	0,98	481			1,57	
	50. 9	0,92	0,94	481			1,45	
	58. 9	0,88	0,90	480			1,33	
	9. 6.11	0,85	0,86	482			1,21	
	14.12	0,82	0,83	481			1,13	
54,8	22.14	0,78	0,80	482			1,05	
54,3	Mean			480,7	478,7	86090,95	1,56	86092,51

July 28, P. M.

Barometer 30,2 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
57.6	2.12. 1	1,27						
	19.59	1,22	1,24	478			2,52	
	27.57	1,17	1,19	478			2,32	
	35.55	1,11	1,14	478			2,13	
	43.55	1,06	1,08	480			1,91	
	51.53	1,02	1,04	478			1,77	
	3. 9.53	0,98	1,00	480			1,64	
	7.52	0,93	0,95	479			1,48	
	15.53	0,89	0,91	481			1,36	
	23.53	0,85	0,87	480			1,24	
58,5	32.53	0,82	0,83	480			1,13	
58,0	Mean			479,2	477,2	86089,82	1,75	86091,57

August 6, A. M. at PORTSOY.—1st Series.

Clock gaining 37",63 in a mean solar day. Barometer 29,95 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s,	°	°				s.	
64.8	7.38.22	1,16	1,14	488			2,13	
	46.30	1,12	1,09	489			1,95	
	54.39	1,07	1,05	488			1,80	
	8. 2.47	1,03	1,01	489			1,67	
	10.56	0,99	0,96	489			1,51	
	19. 5	0,94	0,92	489			1,39	
	27.14	0,90	0,88	489			1,27	
	35.23	0,87	0,85	490			1,18	
	43.33	0,84	0,82	489			1,10	
	51.42	0,80	0,78	489			1,00	
64,8	59.51	0,76						
64,8	Mean			488,9	486,9	86084,03	1,50	86085,53

August 6, P. M. Barometer 30,0 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
64,8	1. 0.42	1,23	1,19	486			2,32	
	8.48	1,16	1,14	486			2,13	
	16.54	1,12	1,08	487			1,91	
	25. 1	1,05	1,03	487			1,74	
	33. 8	1,02	1,00	487			1,64	
	41.15	0,98	0,95	487			1,48	
	49.22	0,93	0,91	487			1,36	
	57.29	0.89	0,87	487			1,24	
	2. 5.36	0,85	0,84	487			1,16	
	13.43	0,83	0,81	488			1,07	
65,7	21.51	0,79						
65,2	Mean			486,9	484,9	86082,58	1,61	86084,19

August 7, A. M. PORTSOY.—1st Series.

Clock gaining 37',63. Barometer 29,89 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
62,7	7.26.17	1,15						
	34.22	1,10	1,12	485			2,06	
	42.27	1,06	1,08	485			1,91	
	50.32	1,01	1,03	485			1,74	
	58.38	0,98	0,99	486			1,61	
	8. 6.44	0,94	0,96	486			1,51	
	14.49	0,89	0,91	485			1,36	
	22.55	0,85	0,87	486			1.24	
	31. 1	0,83	0,84	486			1,16	
	39. 7	0,79	0,81	486			1,08	
61,9	47.13	0,76	0,77	486			0,97	
62,3	Mean			485,6	483,6	86081,63	1,46	86083,09

August 7, P. M. Barometer 29,88 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
62,2	0.52. 9	1,19						
	1. 0.12	1,14	1,16	483			2,21	
	8.16	1,09	1,11	484			2,02	
	16.20	1,05	1,07	484			1,87	
	24.24	1,00	1,02	484			1,71	
	32.29	0,96	0,98	485			1,57	
	40.34	0,93	0,94	485			1,45	
	48.38	0,89	0,91	484			1,36	
	56.43	0,85	0,87	485			1,24	
	2. 4.47	0,82	0,83	484			1,13	
63,0	12.53	0,78	0,80	486			1,05	
62,6	Mean			484,4	482,4	86080,74	1,56	86082,30

August 8, A. M. Portsoy.—1st. Series.

Clock gaining 37",63. Barometer 30,05 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
58,6	7.39.46	1,21	1,18	482			2,28	
	47.48	1,15	1,13	483			2,10	
	55.51	1,12	1,09	483			1,95	
	8. 3.54	1,06	1,04	484			1,77	
	11.58	1,02	1,00	483			1,64	
	20. 1	0,98	0,96	484			1,51	
	28. 5	0,94	0,92	483			1,39	
	36. 8	0,90	0,88	484			1,27	
	44.12	0,86	0,84	484			1,16	
	52.16	0,83	0,81	484			1,08	
59,0	9. 0.20	0,79						
58,8	Mean			483,4	481,4	86080,00	1,61	86081,61

August 8, P. M.

Barometer 30,09 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
60,0	1. 4.28	1,16	1,13	483			2,10	
	12.31	1,11	1,08	482			1,91	
	19.33	1,06	1,04	482			1,77	
	27.35	1,02	1,00	483			1,64	
	36.38	0,9)	0,96	483			1,51	
	44.41	0,94	0,92	483			1,39	
	52.54	0,90	0,88	484			1,27	
	2. 0.48	0,86	0,84	483			1,16	
	8.51	0,83	0,81	483			1,08	
	16.54	0,79	0,77	483			0,97	
61,1	24.57	0,76						
60,5	Mean			482,9	480,9	86079,63	1,48	86081,11

Oil was applied to the scapement without stopping the clock.

August 9, A. M. PORTSOY.—1st Series.

Clock gaining 37^{s},63. Barometer 30,04 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
60,3	7.34.10	1,17						
	42. 9	1,13	1,15	479			2,17	
	50. 9	1,08	1,10	480			1,98	
	58. 9	1,04	1,06	480			1,84	
	8. 6.10	1,00	1,02	481			1,71	
	14.11	0,95	0,97	481			1,54	
	22.11	0,92	0,93	480			1,42	
	30.12	0,88	0,90	481			1,33	
	38.13	0,84	0,86	481			1,21	
	46.13	0,80	0,82	480			1,10	
60,5	54.15	0,77	0,78	482			0,99	
60,4	Mean			481,5	479,5	86078,60	1,53	86080,13

August 9. P. M. Barometer 30,04 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
60,3	0.55.12	1,21						
	1. 3.11	1,16	1,18	479			2,29	
	11. 9	1,10	1,13	477			2,09	
	19. 8	1,06	1,08	479			1,91	
	27. 8	1,01	1,03	480			1,74	
	35. 7	0,98	0,99	479			1,61	
	43. 7	0,93	0,95	480			1,48	
	51. 7	0,90	0,91	480			1,36	
	59. 7	0,86	0,88	480			1,27	
	2. 7. 7	0,82	0,84	480			1,16	
60,7	15. 7	0,79	0,80	480			1,05	
60,5	Mean			479,4	477,4	86077,03	1,60	86078,63

August 10, A. M. Portsoy.—1st. Series.

Clock gaining 37",63. Barometer 30,10 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
58,7	7.30.24	1,20	1,18	478			2,29	
	38.22	1,16	1,13	478			2,09	
	46.20	1,10	1,08	479			1,91	
	54.19	1,06	1,03	480			1,74	
	8. 2.19	1,01	0,98	479			1,57	
	10.18	0,96	0,94	479			1,45	
	18.17	0,93	0,91	480			1,36	
	26.17	0,89	0,87	479			1,24	
	34.16	0,85	0,83	479			1,13	
	42.15	0,82	0,81	480			1,08	
59,0	50.15	0,80						
58,8	Mean			479,1	477,1	86076,80	1,59	86078,39

August 10, P. M.

Barometer 30,16 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
59,8	1.26.11	1,18	1,15	477			2,17	
	34. 8	1,13	1,10	478			1,98	
	42. 6	1,08	1,06	478			1,84	
	50. 4	1,04	1,01	478			1,67	
	58. 2	0,99	0,97	478			1,54	
	2. 6. 0	0,95	0,93	478			1,42	
	13.58	0,91	0,89	478			1,30	
	22.56	0,87	0,85	480			1,18	
	30.56	0,84	0,82	478			1,10	
	38.54	0,81	0,79	478			1,03	
60,8	45.52	0,79						
60,3	Mean			478,1	476,1	86076,04	1,52	86077,56

August 11. A. M. PORTSOY.—1st Series.

Clock gaining 37ˢ,63. Barometer 30,28 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours
°	h. m. s.	°	°				s.	
56,3	7.35.17	1,20	1,17	478			2,24	
	43.15	1,14	1,12	479			2,06	
	51.14	1,10	1,07	479			1,88	
	59.13	1,04	1,02	479			1,71	
	8. 7.12	1,01	0,98	479			1,57	
	15.11	0,96	0,94	479			1,45	
	23.10	0,92	0,90	480			1,33	
	31.10	0,89	0,87	479			1,24	
	39. 9	0,85	0,83	480			1,13	
	47. 9	0,81	0,79	480			1,02	
57,0	55. 9	0,78						
56.6	Mean			479,2	477,2	86076,88	1,56	86078,44

August 11, P. M. Barometer 30,27 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours
59,5	1.38.11	1,18	1,15	478			2,17	
	46. 9	1,13	1,10	477			1,98	
	54. 6	1,08	1,06	478			1,84	
	2. 2. 4	1,04	1,02	477			1,77	
	10. 1	1,00	0,98	478			1,57	
	18.59	0,96	0,93	478			1,42	
	26.57	0,91	0,89	478			1,30	
	34.55	0,87	0,85	478			1,18	
	42.53	0,83	0,82	478			1,10	
	50.51	0,80	0,79	478			1,03	
60,5	58.49	0,78						
60.0	Mean			477,8	475.8	86075,81	1,53	86077,34

August 12, A. M. PORTSOY.—1st Series.

Clock gaining $37^s,63$ Barometer 30,26 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
58,6	7.31.30	1,16						
	39.27	1,11	1,13	477			2,09	
	47.24	1,06	1,08	477			1,91	
	55.21	1,01	1,03	477			1,74	
	8. 3.18	0,97	0,99	477			1,60	
	11.16	0,94	0,95	478			1,48	
	19.13	0,90	0,92	477			1,39	
	27.12	0,86	0,88	479			1,27	
	35. 9	0,82	0,84	477			1,16	
	43. 7	0,79	0,80	478			1,05	
	51. 5	0,76	0,77	478			0,97	
59,8	59. 2	0,73	0,74	477			0,89	
59,2	Mean			477,4	475,4	86075,51	1,41	86076,92

August 12, P. M. Barometer 30,27 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
61,0	1. 9.25	1,18						
	17.21	1,13	1,15	476			2,17	
	25.17	1,08	1,11	476			2,02	
	33.13	1,03	1,06	476			1,84	
	41.10	1,00	1,01	477			1,67	
	49. 6	0,95	0,97	476			1,54	
	57. 3	0,91	0,93	477			1,42	
	2. 5. 0	0,87	0,89	477			1,30	
	12.58	0,84	0,85	478			1,18	
	20.54	0,81	0,82	476			1,10	
61,3	28.52	0,78	0,79	478			1,02	
61,1	Mean			476,7	474,7	86074,98	1,53	86076,51

August 13, P. M. PORTSOY.—2d Series.

Clock gaining 42s,18 in a mean solar day. Barometer 30,25 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
61,5	1.10.17	1,21						
	18.13	1,16	1,18	476			2,28	
	26. 9	1,10	1,13	476			2,10	
	34. 6	1,06	1,08	477			1,91	
	42. 2	1,01	1,03	476			1,74	
	49.58	0,97	0,99	476			1,61	
	57.55	0,93	0,95	477			1,48	
	2. 5.52	0,90	0,91	477			1,35	
	13.48	0,86	0,88	476			1,27	
	21.46	0,82	0,84	478			1,16	
62,3	29.43	0,79	0,80	477			1,05	
61,9	Mean			476,6	474,6	86079,44	1,60	86081,04

August 14, A. M. Portsoy.—2d Series.

Clock gaining $42^s,18$. Barometer 30,25 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
60,1	7.30.40	1,21	1,18	476			2,28	
	38.36	1,16	1,13	476			2,09	
	46.32	1,11	1,08	476			1,91	
	54.28	1,05	1,03	477			1,74	
	8. 2.25	1,01	0,99	476			1,61	
	10.21	0,98	0,96	477			1,51	
	18.18	0,94	0,92	477			1,39	
	26.15	0,90	0,88	477			1,27	
	34.12	0,86	0,84	477			1,16	
	42. 9	0,83	0,81	478			1,08	
60,5	50. 7	0,79						
60,3	Mean			476,7	474,7	86079,51	1,60	86081,11

August 14, P. M.

Barometer 30,27 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
62,2	1.15.59	1,31	1,27	474			2,64	
	23.53	1,23	1,20	474			2,35	
	31.47	1,18	1,15	475			2,17	
	39.42	1,12	1,11	475			2,02	
	47.37	1,10	1,07	475			1,88	
	55.32	1,05	1,03	476			1,74	
	2. 3.28	1,01	0,98	475			1,57	
	11.23	0.96	0,93	476			1,42	
	19.19	0,91	0,89	475			1,30	
	27.14	0,87	0,85	477			1,19	
62,7	35.11	0,83						
62,4	Mean			475,2	473,2	86078,36	1,83	86080,19

August 15, A. M. PORTSOY.—2d Series.

Clock gaining 42^s,18. Barometer 30,25 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
59,9	7.16.40	1,29						
	24.35	1,23	1,26	475			2,60	
	32.31	1,18	1,20	476			2,36	
	40.26	1,13	1,15	475			2,17	
	48.22	1,08	1,10	476			1,98	
	56.18	1,03	1,05	476			1,81	
	8. 4.14	0,99	1,01	476			1,67	
	12.11	0,96	0,97	477			1,54	
	20. 7	0,91	0,93	476			1,42	
	28. 4	0,87	0,89	477			1,30	
60,3	36. 1	0,83	0,85	477			1,18	
60,1	Mean			476,1	474,1	86079,05	1,80	86080,85

August 15, P. M.

Barometer 30,25 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
61,4	1.11. 5	1,21						
	19. 0	1,16	1,18	475			2,28	
	26.54	1,11	1,13	474			2,09	
	34.50	1,07	1,09	476			1,95	
	42.44	1,02	1,04	474			1,78	
	50.40	0,98	1,00	476			1,64	
	58.36	0,94	0,96	476			1,51	
	2. 6.31	0,90	0,92	475			1,39	
	14.27	0,87	0,88	476			1,27	
	22.23	0,84	0,85	476			1,18	
61,9	30.19	0,79	0,81	476			1,08	
61,6	Mean			475,4	473,4	86078,51	1,62	86080,13

August 16, A. M. PORTSOY.—2d Series.

Clock gaining $42^s,18$. Barometer 30,18 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
58,0	7.26.39	1,18	1,15	476			2,16	
	34.35	1,12	1,10	476			1,98	
	42.31	1,08	1,06	477			1,84	
	50.28	1,05	1,02	476			1,70	
	58.24	1,00	0,98	478			1,57	
	8. 6.22	0,96	0,93	477			1,42	
	14.19	0,91	0,89	477			1,30	
	22.16	0,88	0,86	476			1,21	
	30.12	0,85	0,83	478			1,13	
	38.10	0,81	0,79	478			1,02	
58,8	46. 8	0,78						
58,4	Mean			476,9	474,9	86079,66	1,53	86081,19

August 16, P. M.

Barometer 30,17 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
60,5	1. 5.32	1,21	1,18	474			2,28	
	13.26	1,15	1,13	476			2,09	
	21.22	1,11	1,08	475			1,91	
	29.17	1,06	1,04	475			1,77	
	37.12	1,02	0,99	476			1,60	
	45. 8	0,97	0,94	475			1,45	
	53. 3	0,92	0,90	476			1,33	
	2. 0.59	0,89	0,87	476			1,24	
	8.55	0,85	0,83	476			1,13	
	16.51	0,82	0,80	477			1,05	
61,3	24.48	0,79						
60,9	Mean			475,6	478,6	86078,67	1,59	86080,26

August 17, A. M. PORTSOY.—2d Series.

Clock gaining 42s,18. Barometer 30,15 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
59,5	7.18.34	1,27	1,24	475			2,53	
	26.29	1,22	1,19	475			2,32	
	34.24	1,17	1,14	475			2,13	
	42.19	1,12	1,09	476			1,95	
	50.15	1,07	1,04	476			1,77	
	58.11	1,02	1,00	476			1,64	
	8. 6. 7	0,99	0,97	476			1,54	
	14. 3	0,95	0,93	476			1,42	
	21.59	0,91	0,89	476			1,30	
	29.55	0,88	0,86	477			1,21	
60,2	37.52	0,84						
59,8	Mean			475,8	473,8	86078,82	1,78	86080,60

August 17, P. M. Barometer 30,16 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
61,0	1.28.27	1,30	1,26	474			2,60	
	36.21	1,23	1,20	475			2,36	
	44.16	1,18	1,15	474			2,17	
	52.10	1,13	1,11	474			2,02	
	2. 0. 4	1,09	1,06	476			1,84	
	8. 0	1,04	1,02	475			1,71	
	15.55	1,00	0,97	476			1,54	
	23.51	0,95	0,93	475			1,42	
	31.46	0,92	0,90	476			1,33	
	39.42	0,88	0,86	476			1,21	
61,5	47.38	0,84						
61,2	Mean			475,1	473;1	86078,29	1,82	86080,11

August 18, A. M. Portsoy.—2d Series.

Clock gaining $42^s,18$ Barometer 30,14 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
58,4	7.32.46	1,20						
	40.41	1,16	1,18	475			2,28	
	48.37	1,10	1,13	476			2,09	
	56.33	1,06	1,08	476			1,91	
	8. 4.29	1,01	1,03	476			1,74	
	12.25	0,98	0,99	476			1,60	
	20.21	0,93	0,95	476			1,48	
	28.18	0,89	0,91	477			1,36	
	36.15	0,85	0,87	477			1,24	
	44.12	0,81	0,83	477			1,13	
58,5	52. 9	0,78	0,79	477			1,02	
58,4	Mean			476,3	474,3	86079,20	1,59	86080,79

August 18, P. M. Barometer 30,14 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
59,7	1. 0.54	1,21						
	8.49	1,15	1,18	475			2,28	
	16.44	1,10	1,12	475			2,06	
	24.39	1,06	1,08	475			1,92	
	32.34	1,01	1,03	475			1,74	
	40.29	0,97	0,99	475			1,60	
	48.25	0,93	0,95	476			1,48	
	56.21	0,89	0,91	476			1,36	
	2. 4.17	0,85	0,87	476			1,24	
	12.13	0,82	0,83	476			1,13	
60,7	20. 9	0,79	0,80	476			1,05	
60,2	Mean			475,5	473,5	86078,59	1,59	86080,18

August 19, A. M. PORTSOY.—2d Series.

Clock gaining $42^s,18$. Barometer 30,1 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°					
57,3	7.38.35	1,20						
	46.30	1,14	1,17	475			2,24	
	54.26	1,11	1,12	476			2,06	
	8. 2.22	1,05	1,08	476			1,92	
	10.18	1,01	1,03	476			1,74	
	18.15	0,98	0,99	477			1,60	
	26.11	0,94	0,96	476			1,51	
	34. 8	0,89	0,91	477			1,36	
	42. 5	0,85	0,87	477			1,24	
	50. 2	0,81	0,83	477			1,13	
57.5	58.59	0,78	0,79	477			1,02	
57,4	Mean			476,4	474,4	86079,27	1,58	86080,85

August 31, A. M. at LEITH FORT.—1st. Series

Clock gaining 26ˢ,85 in a mean solar day. Barometer 29,95 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations. in 24 hours.
°	h. m. s.	°	°				s.	
56,5	7.29. 9	1,10	1,08	492			1,91	
	37.21	1,06	1,04	494			1,77	
	45.35	1,02	0,99	494			1,61	
	54.49	0,97	0,95	493			1,48	
	8. 2. 2	0,93	0,90	495			1,33	
	10.17	0,88	0,86	495			1,21	
	18.32	0,85	0,83	494			1,13	
	26.46	0,82	0,80	494			1,05	
	35. 0	0,78	0,76	496			0,94	
	43.16	0,75	0,74	494			0,89	
5,67	51.30	0,73						
56,6	Mean			494,1	492,1	86077,01	1,33	86078,34

August 31, P. M. Barometer 29,85 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations. in 24 hours.
58,6	1.33.24	1,17	1,14	492			2,13	
	41.36	1,12	1,09	492			1,95	
	49.48	1,07	1,05	492			1,80	
	58. 0	1,03	1,00	493			1,64	
	2. 6.13	0,98	0,96	493			1,51	
	14.26	0,94	0,91	492			1,36	
	22.38	0,89	0,87	494			1,24	
	30.52	0,86	0,84	493			1,16	
	39. 5	0,83	0,81	493			1,08	
	47.18	0,80	0,78	493			1,00	
59,2	55.31	0,77						
58,9	Mean			492,7	490,7	86076,02	1,48	86077,50

September 1, A. M. LEITH FORT.—1st Series.

Clock gaining 26ˢ,85. Barometer 29,55 inches.

Temp.	Time of coincidence	Arc of vibration	Mean Arc.	Interval in seconds.	No of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
58,7	8. 3. 0	1,22						
	11. 9	1,17	1,19	489			2,32	
	19.18	1,12	1,14	489			2,13	
	27.28	1,07	1,09	490			1,95	
	35.39	1,03	1,05	491			1,80	
	43.49	0,98	1,00	490			1,64	
	52. 0	0,94	0,96	491			1,51	
	9. 0.12	0,90	0,92	492			1,39	
	8.22	0,87	0,88	490			1,27	
	16.34	0,83	0,85	492			1,18	
58,8	24.45	0,79	0,81	491			1,07	
58,7	Mean			490,5	488,5	86074,45	1,63	86076,08

September 1, P. M.

Barometer 29,49 inches.

Temp.	Time of coincidence	Arc of vibration	Mean Arc.	Interval in seconds.	No of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
59,7	1.50.37	1,12						
	58.46	1,07	1,09	489			1,95	
	2. 6.57	1,02	1,04	491			1,77	
	15. 7	0,98	1,00	490			1,64	
	24.16	0,93	0,95	489			1,48	
	31.27	0,89	0,91	491			1,36	
	39.37	0,85	0,87	490			1,24	
	47.48	0,82	0,83	491			1,13	
	55.59	0,78	0,80	491			1,05	
	3. 4. 9	0,76	0,77	490			1,97	
60,5	12.21	0,73	0,74	492			1,89	
60,1	Mean			490,4	488,4	86074,37	1,35	86075,72

September 2, A. M. Leith Fort.—1st Series.

Clock gaining 26s,85. Barometer 29,58 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
58,0	8.19.41	1,12	1,09	489			1,95	
	27.50	1,07	1,04	489			1,77	
	35.59	1,02	0,99	489			1,61	
	44. 8	0,97	0,95	490			1,48	
	52.18	0,93	0,90	490			1,33	
	9. 0.28	0,88	0,86	489			1,21	
	8.37	0,85	0,83	490			1,13	
	16.47	0,82	0,80	490			1,05	
	24.57	0,78	0,76	490			0,94	
	33. 7	0,75	0,74	490			0,89	
58,7	41.17	0,73						
58,4	Mean			489,6	487,6	86073,80	1,34	86075,14

September 2, P. M. Barometer 29,68 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
59,8	1.15.32	1,08	1,05	488			1,80	
	23.40	1,03	1,00	488			1,64	
	31.48	0,98	0,96	489			1,51	
	39.57	0,94	0,92	488			1,39	
	48. 5	0,91	0,89	490			1,30	
	56.15	0,87	0,85	489			1,18	
	2. 4.24	0,83	0,81	489			1,08	
	12.33	0,80	0,78	489			1,00	
	20.42	0,76	0,74	489			0,90	
	28.51	0,73	0,71	490			0,82	
60,0	37. 1	0,70						
59,9	Mean			488,9	486,9	86073,29	1,26	86074,55

September 3, A. M. LEITH FORT.—1st Series.

Clock gaining 26ˢ,85. Barometer 29,95 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
56,9	7.49.55	1,07	1,05	489			1,80	
	58. 4	1,03	1,00	489			1,64	
	8. 6.13	0,98	0,96	489			1,51	
	14.22	0,94	0,92	490			1,39	
	22.32	0,91	0,89	490			1,30	
	30.42	0,87	0,85	490			1,18	
	38.52	0,83	0,81	490			1,08	
	47. 2	0,79	0,77	491			0,97	
	55.13	0,76	0,74	489			0,90	
	9. 3.22	0,73	0,71	490			0,82	
57,9	11.32	0,70						
57,4	Mean			489,7	487,7	86073,87	1,26	86075,13

September 3. P. M. Barometer 29,97 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
59,5	1. 6. 6	1,18	1,15	486			2,17	
	14.12	1,13	1,09	487			1,95	
	22.19	1,06	1,04	489			1,77	
	30.28	1,03	1,00	487			1,64	
	38.35	0,98	0,96	488			1,51	
	46.43	0,94	0,92	489			1,39	
	54.52	0,90	0,88	488			1,27	
	2. 3. 0	0,86	0,84	488			1,15	
	11. 8	0,83	0,81	489			1,08	
	19.17	0,79	0,77	489			0,97	
59,9	27.26	0,76						
59,7	Mean			488	486	86072,64	1,49	86074,13

September 4, A. M. Leith Fort.—1st. Series.

Clock gaining 26^s,85. Barometer 29,78 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
59,3	7.55.48	1,18						
	8. 3.54	1,13	1,15	486			2,17	
	12. 2	1,08	1,10	488			1,98	
	20.10	1,02	1,05	488			1,80	
	28.18	0,98	1,00	488			1,64	
	36.26	0,93	0,95	488			1,48	
	44.34	0,90	0,91	488			1,36	
	52.42	0,87	0,88	488			1,27	
	9. 0.51	0,83	0,85	489			1,18	
	8.59	0,79	0,81	488			1,08	
59,8	17. 8	0,76	0,77	489			0,97	
59,5	Mean			488	486	86072,64	1,49	86074,13

September 4, P. M. Barometer 29,76 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
61,6	1.21.40	1,17						
	29.46	1,12	1,14	486			2,13	
	37.52	1,06	1,09	486			1,95	
	45.58	1,02	1,04	486			1,77	
	54. 5	0,98	1,00	487			1,64	
	2. 2.12	0,93	0,95	487			1,48	
	10.18	0,90	0,91	486			1,36	
	18.26	0,87	0,88	488			1,27	
	26.33	0,83	0,85	487			1,18	
	34.40	0,79	0,81	487			1,08	
62,2	42.47	0,76	0,77	487			0,97	
61,9	Mean			486,7	484,7	86071,68	1,48	86073,16

September 5, A. M. LEITH FORT.—1st Series.

Clock gaining 26^s,85. Barometer 29,85 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations. in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
60,0	7.44. 8	1,19	1,16	484			2,21	
	52.12	1,14	1,11	486			2,02	
	8. 0.18	1,09	1,06	485			1,84	
	8.23	1,04	1,02	485			1,71	
	16.28	1,00	0,98	486			1,57	
	24.34	0,96	0,94	486			1,45	
	32.40	0,93	0,91	486			1,36	
	40.46	0,89	0,86	486			1,21	
	48.52	0,84	0,82	486			1,10	
	56.58	0,81	0,80	486			1,05	
60,6	9. 5. 4	0,79						
60,3	Mean			485,6	483,6	86070,88	1,55	86072,43

September 5, P. M. Barometer 29,83 inches.

62,0	0.58.30	1,14	1,11	485			2,02	
	1. 6.35	1,09	1,07	483			1,88	
	14.38	1,05	1,02	485			1,71	
	22.43	0,99	0,97	484			1,54	
	30.47	0,95	0,93	485			1,42	
	38.52	0,92	0,90	484			1,32	
	46.56	0,88	0,87	485			1,24	
	55. 1	0,86	0,83	485			1,13	
	2. 3. 6	0,81	0,79	484			1,02	
	11.10	0,78	0,76	486			0,94	
62,3	19.16	0,75						
62,1	Mean			484,6	482,6	86070,15	1,42	86071,57

September 6, A. M. Leith Fort.—1st Series.

Clock gaining 26ˢ,85. Barometer 29,6 inches.

Tem	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
59,7	7.49.27	1,13	1,10	483			1,98	
	57.30	1,08	1,05	483			1,80	
	8. 5.33	1,03	1,00	483			1,64	
	13.36	0,98	0,96	484			1,51	
	21.40	0,94	0,92	483			1,38	
	29.43	0,90	0,88	483			1,27	
	37.46	0,86	0,84	484			1,15	
	45.50	0,83	0,81	484			1,07	
	53.54	0,79	0,77	485			0,97	
	9. 1.59	0,75	0,73	485			0,87	
60,2	10. 4	0,72						
59,9	Mean			483,7	481,7	86069,49	1,36	86070,85

September 6, P. M.

Barometer 29,62 inches.

Tem	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
61,4	1.11.44	1,18	1,15	481			2,17	
	19.45	1,13	1,10	482			1,98	
	27.47	1,08	1,05	483			1,80	
	35.50	1,03	1,00	482			1,64	
	43.52	0,98	0,96	484			1,51	
	51.56	0,95	0,93	483			1,42	
	59.59	0,91	0,89	483			1,30	
	2. 8. 2	0,87	0,85	483			1,18	
	16. 5	0,83	0,81	484			1,07	
	24. 9	0,81	0,78	483			1,00	
61,3	32.12	0,78						
61,4	Mean			482,8	480,8	86068,82	1,51	86070,33

September 9, A. M. LEITH FORT.—2d Series.

Clock gaining 34ˢ,1 in a mean solar day. Bar. 29,9 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
54,2	7.55.58	1,16						
	8. 3.59	1,12	1,14	481			2,13	
	12. 1	1,08	1,10	482			1,98	
	20. 3	1,04	1,06	482			1,84	
	28. 5	1,01	1,02	482			1,70	
	36. 7	0,97	0,99	482			1,60	
	44.10	0,93	0,95	483			1,48	
	52.12	0,90	0,91	482			1,36	
	9. 0.15	0,88	0,89	483			1,30	
	8.17	0,84	0,86	482			1,21	
54,3	16.19	0,81	0,82	482			1,10	
54,2	Mean			482,1	480,1	86075,53	1,57	86077,10

September 9, P. M. Barometer 29,95 inches.

55,5	1.13.37	1,19						
	21.38	1,14	1,16	481			2,21	
	29.38	1,10	1,12	480			2,06	
	37.40	1,03	1,06	482			1,84	
	45.41	1,00	1,01	481			1,67	
	53.42	0,96	0,98	481			1,57	
	2. 1.44	0,92	0,94	482			1,45	
	9.45	0,88	0,90	481			1,33	
	17.47	0,85	0,86	482			1,21	
	25.49	0,82	0,83	482			1,13	
55,7	33.52	0,79	0,81	483			1,08	
55,6	Mean			481,5	479,5	86075,07	1,56	86076,63

September 10, A. M. Leith Fort.—2d Series.

Clock gaining, 34s,10. Barometer 29,94 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°	°			s.	
52,1	7.59.12	1,15	1,12	482			2,06	
	8. 7.14	1,10	1,08	482			1,91	
	15.16	1,06	1,04	483			1,78	
	23.19	1,02	1,00	482			1,64	
	31.21	0,98	0,96	483			1,51	
	39.24	0,94	0,92	483			1,39	
	47.27	0,90	0,88	483			1,27	
	55.30	0,87	0,85	483			1,18	
	9. 3.33	0,84	0,82	483			1,11	
	11.36	0,80	0,77	483			0,97	
52,8	19.39	0,77						
52,4	Mean			482,7	480,7	86075,97	1,48	86077,45

September 10, P. M. Barometer 29,91 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
54,2	1. 8.54	1,14	1,12	482			2,06	
	16.56	1,10	1,07	481			1,88	
	24.57	1,04	1,02	482			1,71	
	32.59	1,00	0,98	482			1,57	
	41. 1	0,96	0,94	482			1,45	
	49. 3	0,93	0,91	481			1,36	
	57. 4	0,89	0,86	482			1,21	
	2. 5. 6	0,84	0,82	483			1,10	
	13. 9	0,81	0,79	483			1,02	
	21.12	0,78	0,76	482			0,94	
54,3	29.14	0,74						
4,2	Mean			482	480	86075,45	1,53	86076,98

September 11, A. M. Leith Fort.—2d Series.

Clock gaining 34ˢ,10. Barometer 29,92 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
51,3	7.58.14	1,17						
	8. 6.15	1,13	1,15	481			2,16	
	14.17	1,08	1,10	482			1,98	
	22.19	1,05	1,06	482			1,84	
	30.21	1,01	1,03	482			1,74	
	38.24	0,98	0,99	483			1,60	
	46.26	0,94	0,96	482			1,51	
	54.28	0,89	0,91	482			1,36	
	9. 2.31	0,86	0,87	483			1,24	
	10 33	0,82	0,84	482			1,16	
51,8	18.36	0,79	0,80	483			1,05	
51,5	Mean			482,2	480,2	86075,60	1,56	86077,16

September 11, P. M. Barometer 29,95 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
53,2	1.12. 9	1,14						
	20.10	1,09	1,11	481			2,02	
	28.11	1,04	1,06	481			1,84	
	36.13	0,99	1,01	482			1,67	
	44.14	0,95	0,97	481			1,54	
	52.16	0,91	0,93	482			1,42	
	2. 0.18	0,88	0,89	482			1,30	
	8.21	0,84	0,86	483			1,21	
	16.23	0,81	0,82	482			1,10	
	24.25	0,78	0,79	482			1,02	
53,5	32.27	0,74	0,76	482			0,94	
53,3	Mean			481,8	479,8	86075,30	1,41	86076,71

September 12, A. M. LEITH FORT.—2d. Series.

Clock gaining 34^s,10. Barometer 30,14 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
52,8	8.16.19	1,17	1,14	481			2,13	
	24.20	1,12	1,09	481			1,95	
	32.21	1,07	1,04	480			1,77	
	40.21	1,02	1,00	483			1,64	
	48.23	0,98	0,96	481			1,51	
	56.24	0,94	0,92	482			1,38	
	9. 4.26	0,91	0,89	482			1,30	
	12.28	0,87	0,85	482			1,18	
	20.30	0,83	0,81	483			1,08	
	28.33	0,80	0,78	481			1,00	
53,4	36.34	0,77						
53,1	Mean			481,6	479,6	86075,15	1,49	86076,64

September 12, P. M. Barometer 30,14 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
53,9	0. 8.28	1,16	1,13	480			2,09	
	16.28	1,11	1,08	481			1,92	
	24.29	1,06	1,03	480			1,74	
	32.29	1,01	0,99	481			1,60	
	40.30	0,97	0,95	481			1,48	
	48.31	0,93	0,90	482			1,33	
	56.33	0,88	0,86	481			1,21	
	1. 4.34	0,85	0,83	481			1,13	
	12.35	0,82	0,80	482			1,05	
	20.37	0,79	0,77	482			0,97	
54,5	28.39	0,76						
54,2	Mean			481,1	479,1	86074,77	1,45	86076,22

September 13, A. M. LEITH FORT.—2d. Series.

Clock gaining 34ˢ,10. Barometer 30,28 inches.

Temp.	Time of coin-cidence.	Arc of vibra-tion.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correc-tion for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
53,6	8.37.37	1,14	1,11	479			2,02	
	45.36	1,09	1,06	480			1,84	
	53.36	1,04	1,02	481			1,71	
	9. 1.37	1,00	0,98	481			1,57	
	9.38	0,96	0,94	481			1,45	
	17.39	0,92	0,90	481			1,33	
	25.40	0,88	0,86	481			1,21	
	33.41	0,84	0,82	481			1,10	
	41.42	0,81	0,79	481			1,02	
	49.42	0,78	0,76	483			0,94	
54,4	57.45	0,75						
54,0	Mean			480,9	478,9	86074,63	1,42	86076,05

September 13, P. M. Barometer 30,24 inches.

Temp.	Time of coin-cidence.	Arc of vibra-tion.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correc-tion for Arc.	Vibrations in 24 hours.
°								
55,6	1. 7.18	1,12	1,09	479			1,95	
	15.17	1,07	1,04	479			1,77	
	23.16	1,02	1,00	480			1,64	
	31,16	0,98	0,96	480			1,51	
	39,16	0,94	0,92	481			1,39	
	47,17	0,91	0,89	480			1,30	
	55.17	0,87	0,85	480			1,18	
	2. 3.17	0,83	0,81	481			1,08	
	11.18	0,80	0,78	480			1,00	
	19.18	0,77	0,75	481			0,92	
56,3	27.19	0,74						
55,9	Mean			480,1	478,1	86074,03	1,37	86075,40

September 14, A. M. Leith Fort.—2nd Series.

Clock gaining 34^s,10. Barometer 29,89 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
56,2	8.16.19	1,09						
	24.19	1,04	1,06	480			2,13	
	32.18	1,00	1,02	479			1,95	
	40.18	0,97	0,98	480			1,80	
	48.18	0,93	0,95	480			1,64	
	56.18	0,89	0,91	480			1,51	
	9. 4.18	0,85	0,87	480			1,38	
	12.18	0,82	0,83	480			1,27	
	20.19	0,78	0,80	481			1,18	
	28.19	0,76	0,77	480			1,10	
56,6	36.20	0,73	0,74	481			0,99	
56,4	Mean			480,1	478,1	86074,03	1,32	86075,35

September 14, P. M. Barometer 29,85 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
57,1	1.21.53	1,16						
	29.51	1,12	1,14	478			2,13	
	37.50	1,07	1,09	479			1,95	
	45.48	1,03	1,05	478			1,80	
	53.48	0,98	1,00	480			1,64	
	2. 1.47	0,94	0,96	479			1,51	
	9.46	0,90	0,92	479			1,38	
	17.45	0,87	0,88	479			1,27	
	25.45	0,84	0,85	480			1,18	
	33.45	0,80	0,82	480			1,10	
57,2	41.45	0,77	0,78	480			0,99	
57,1	Mean			479,2	477,2	86073,36	1,50	86074,86

October 3, A. M. at CLIFTON.

Clock losing 10^s,60 in a mean solar day. Barometer 29,22 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
57,2	7.32.46	1,23	1,20	528			2,36	
	41.34	1,17	1,14	529			2,13	
	50.23	1,12	1,09	527			1,95	
	59.10	1,07	1,04	529			1,77	
	8. 7.59	1,02	1,00	529			1,64	
	16.48	0,98	0,95	530			1,48	
	25.38	0,93	0,90	529			1,33	
	34.27	0,88	0,86	530			1,21	
	43.17	0,84	0,83	530			1,13	
	52. 7	0,82	0,80	531			1,05	
57,7	9. 0.58	0,78						
57,4	Mean			529,2	527,2	86062,91	1,61	86064,52

October 3, P. M. Barometer, 29,20 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
58,2	1.56.23	1,28	1,25	526			2,57	
	2. 5. 9	1,23	1,20	528			2,36	
	13.57	1,17	1,14	527			2,13	
	22.44	1,12	1,09	527			1,95	
	31.31	1,07	1,04	528			1,77	
	40.19	1,02	0,99	528			1,61	
	49. 7	0,97	0,95	529			1,48	
	57.56	0,93	0,91	529			1,36	
	3. 6.45	0,89	0,86	529			1,21	
	15.34	0,84	0,82	529			1,10	
58,3	24.23	0,81						
58,2	Mean			528	526	86062,17	1,75	86063,92

October 4, A. M. Clifton.

Clock losing 10s,60. Barometer 29,18 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
57,1	9.44. 8	1,23						
	52.57	1,17	1,20	529			2,36	
	10. 1.45	1,12	1,15	528			2,17	
	10.33	1,06	1,09	528			1,95	
	19.22	1,02	1,04	529			1,77	
	28.11	0,97	0,99	529			1,61	
	37. 1	0,92	0,94	530			1,45	
	45.49	0,88	0,90	528			1,33	
	54.38	0,83	0,85	529			1,18	
	11. 3.29	0,79	0,81	531			1,08	
57,3	12.19	0,76	0,77	530			0,97	
57,2	Mean			529,1	527,1	86062,85	1,59	86064,44

October 4, P. M.

Barometer 29,13 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
57,2	1. 6.12	1,24						
	15. 0	1,20	1,22	528			2,43	
	24.47	1,13	1,16	527			2,20	
	32.35	1,08	1,10	528			1,98	
	41.24	1,04	1,06	529			1,84	
	50.12	0,99	1,01	528			1,67	
	58.59	0,94	0,96	527			1,51	
	2. 7.48	0,89	0,91	529			1,36	
	16.37	0,85	0,87	529			1,24	
	25.27	0,82	0,83	530			1,13	
57,3	34.18	0,78	0,80	531			1,05	
57,2	Mean			528,6	526,6	86062,54	1,64	86064,18

October 5, A. M. CLIFTON.

Clock losing 10^s,60. Barometer 29,10 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
54,8	7.57. 6	1,23						
	8. 6.55	1,18	1,21	529			2,40	
	14.45	1,12	1,15	530			2,17	
	23.35	1,07	1,09	530			1,95	
	32.24	1,02	1,04	529			1,77	
	41.15	0,97	0,99	531			1,61	
	50. 6	0,93	0,95	531			1,48	
	58.56	0,89	0,91	530			1,36	
	9. 7.47	0,84	0,86	531			1,21	
	16.38	0,81	0,82	531			1,10	
55,4	25.30	0,78	0,79	532			1,02	
55,1	Mean			530,4	528,4	86063,65	1,61	86065,26

October 5, P. M.

Barometer 29,08 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
55,6	1.52.53	1,27						
	2. 1.41	1,22	1,24	528			2,52	
	10.30	1,18	1,20	529			2,36	
	19.19	1,13	1,15	529			2,17	
	28. 8	1,07	1,10	529			1,98	
	36.57	1,02	1,04	529			1,77	
	45.47	0,98	1,00	530			1,64	
	54.38	0.93	0,95	531			1,48	
	3. 3.28	0,89	0,91	530			1,36	
	12.17	0,86	0,87	529			1,24	
55,9	21. 9	0,82	0,84	532			1,15	
55,7	Mean			529,6	527,6	86063,16	1.77	86064,93

October 6, A. M. Clifton.

Clock losing 10s,60 Barometer 29,01 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
	h. m. s,	°	°				s.	
53°,2	7.52.54	1,31						
	8. 1.43	1,25	1,28	529			2,68	
	10.33	1,19	1,22	530			2,44	
	19.24	1,13	1,16	531			2,20	
	28.14	1,08	1,10	530			1,98	
	37. 5	1,03	1,05	531			1,80	
	45.56	0,98	1,00	531			1,64	
	54.47	0,93	0,95	531			1,48	
	9. 3.38	0,88	0,90	531			1,33	
	12.30	0,85	0,86	532			1,21	
53,6	21.23	0,82	0,83	533			1,13	
53,4	Mean			530,9	528,9	86063,96	1,79	86065,75

October 6, P. M. Barometer 29,10 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
53,9	1.55. 5	1,22						
	2. 3.54	1,16	1,19	529			2,32	
	12.45	1,11	1,13	531			2,09	
	21.34	1,06	1,08	529			1,91	
	30.24	1,01	1,03	530			1,74	
	39.14	0,97	0,99	530			1,60	
	48. 5	0,92	0,94	531			1,45	
	56.56	0,87	0,89	531			1,30	
	3. 5.46	0,83	0,85	530			1,18	
	14.36	0,79	0,81	530			1,08	
55,1	23.27	0,76	0,77	531			0,97	
54,5	Mean			530,2	528,2	86063,52	1,56	86065,08

October 7, A. M. CLIFTON.

Clock losing 10^{s},60. Barometer 29,30 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
52,5	9.34.54	1,28	1,25	529			2,57	
	43.43	1,23	1,20	530			2,36	
	52.33	1,18	1,15	529			2,17	
	10. 1.22	1,13	1,10	530			1,98	
	10.12	1,07	1,04	531			1,77	
	19. 3	1,02	0,99	531			1,61	
	27.54	0,97	0,94	531			1,45	
	36.45	0,92	0,90	531			1,33	
	45.36	0,88	0,86	531			1,21	
	54.27	0,84	0,82	532			1,10	
53,3	11. 3.19	0,81						
52,9	Mean			530,5	528,5	86063,71	1,76	86065,47

October 7, P. M. Barometer 29,33 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
53,4	1.53.19	1,23	1,20	530			2,36	
	2. 2. 9	1,17	1,14	529			2,13	
	10.58	1,12	1,09	530			1,95	
	19.48	1,07	1,04	530			1,77	
	28.38	1,02	0,99	531			1,60	
	37.29	0,97	0,95	530			1,48	
	46.19	0,93	0,91	531			1,36	
	55.10	0,89	0,86	531			1,21	
	3. 4. 1	0,84	0,83	530			1,13	
	12.51	0,82	0,80	532			1,05	
54,1	21.43	0,78						
53,7	Mean			530,4	528,4	86063,65	1,60	86065,25

October 8, A. M. Clifton.

Clock losing 10',60. Barometer 29,52 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
51,9	7.54.51	1,24	1,21	529			2,40	
	8. 3.40	1,19	1,16	530			2,20	
	12.30	1,13	1,10	529			1,98	
	21.19	1,08	1,05	529			1,81	
	30. 8	1,03	1,01	532			1,67	
	39. 0	0,99	0,96	531			1,51	
	47.51	0,93	0,91	531			1,36	
	56.42	0,90	0,88	531			1,27	
	9. 5.53	0,87	0,85	531			1,18	
	14.24	0,83	0,81	532			1,07	
52,5	23.16	0,79						
52,2	Mean			530,5	528,5	86063,71	1,65	86065,36

October 8. P. M.

Barometer 29,57 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
52,7	2.24. 0	1,23	1,20	529			2,36	
	42.49	1,18	1,15	529			2,17	
	51.38	1,13	1,10	529			1,98	
	3. 0.27	1,07	1,04	530			1,77	
	9.17	1,02	1,00	530			1,64	
	18. 7	0,98	0,95	531			1,48	
	26.58	0,93	0,91	530			1,36	
	35.48	0,89	0,87	531			1,24	
	44.39	0,85	0,83	531			1,13	
	53.30	0,81	0,79	531			1,02	
53,2	4. 2.21	0,78						
52,9	Mean			530,1	528,1	86063,46	1,62	86065,08

October 21, P. M.—at ARBURY HILL.

Clock losing $6^s,2$ in a mean solar day. Barometer 29,65 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
56,7	1.33.46	1,19						
	42,18	1,13	1,16	512			2,20	
	50,52	1,09	1,11	514			2,02	
	59.26	1,05	1,07	514			1,88	
	2. 8. 0	1,00	1,02	514			1,70	
	16.34	0,96	0,98	514			1,57	
	25. 8	0,92	0,94	514			1,45	
	33.43	0,88	0,90	515			1,33	
	42.17	0,84	0,86	514			1,21	
	50.52	0,81	0,82	515			1,10	
56,7	59.27	0,78	0,79	515			1,02	
56,7	Mean			514,1	512,1	86057,70	1,55	86059,25

October 22, A. M. Arbury Hill.

Clock losing 6s,2. Barometer 29 52 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours
°	h. m. s.	°	°				s.	
54,1	9.10.38	1,13	1,12	515			2,06	
	19.13	1,10	1,08	516			1,91	
	27.49	1,06	1,04	516			1,77	
	36,25	1,02	0,99	516			1,61	
	45. 1	0,97	0,95	516			1,48	
	53.37	0,93	0,91	516			1,36	
	10. 2.13	0,89	0,87	517			1,24	
	10.50	0,85	0,83	517			1,13	
	19.27	0,82	0,80	517			1,05	
	28. 4	0,78	0,76	518			0,94	
54,4	36.42	0,74						
54.2	Mean			516,4	514,4	86059,20	1,46	86060,66

October 22, P. M. Barometer 29,50 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours
54,4	1.52.46	1,14	1,12	516			2,06	
	2. 1.22	1,10	1,08	515			1,91	
	9.57	1,06	1,04	516			1,77	
	18.33	1,02	0,99	517			1,61	
	27.10	0,97	0,94	515			1,45	
	35.45	0,92	0,90	517			1,33	
	44.22	0,88	0,87	516			1,24	
	52.58	0,86	0,84	517			1,15	
	3. 1 35	0,82	0,80	517			1,05	
	10.12	0,78	0,76	516			1,94	
54,4	18.48	0,75						
54,4	Mean			516,2	514,2	86059,07	1,45	86060,52

October 23. ARBURY HILL.

Clock losing 6ˢ,20. Barometer 29,50 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
52,6	9. 8.44	1,21						
	17.20	1,17	1,19	516			2,32	
	25.56	1,12	1,14	516			2,13	
	34.32	1,06	1,09	516			1,95	
	43. 8	1,01	1,04	516			1,77	
	51.45	0,97	0,99	517			1,61	
	10. 0.22	0,93	0,95	517			1,48	
	9. 0	0,89	0,91	518			1,36	
	17.38	0,86	0,87	518			1,24	
	26.14	0,82	0,84	516			1,16	
53,1	34.52	0,80	0,81	518			1,08	
52,8	Mean			516,8	514,8	86059,46	1,61	86061,07

October 23, P. M. Barometer 29,52 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
53,2	1.43.21	1,14						
	51.57	1,11	1,12	516			2,06	
	2. 0.33	1,05	1,08	516			1,91	
	9. 9	1,02	1,03	516			1,74	
	17.45	0,98	1,00	516			1,64	
	26.21	0,94	0,96	516			1,51	
	34.58	0,91	0,92	517			1,39	
	43.35	0,87	0,89	517			1,30	
	52.12	0,83	0,85	517			1,18	
	3. 0.50	0,80	0,81	518			1,07	
53,2	9.28	0,77	0,78	518			1,00	
53,2	Mean			516,7	514,7	86059,40	1,48	86060,88

October 24, A. M. Arbury Hill.

Clock losing 6^{s},20. Barometer 29,57 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
50,7	9. 9.14	1,17	1,14	517			2,13	
	17.51	1,12	1,09	517			1,95	
	26.28	1,07	1,05	517			1,80	
	35. 5	1,03	1,00	517			1,64	
	43.42	0,98	0,96	517			1,51	
	52.19	0,94	0,92	518			1,39	
	10. 0.57	0,90	0,88	518			1,27	
	9.35	0,86	0,84	517			1,16	
	18.12	0,82	0,80	519			1,05	
	27.51	0,78	0,76	518			0,94	
51,0	35.29	0,75						
50,8	Mean			517,5	515,5	86059,92	1,48	86061,40

October 24, P. M. Barometer 29,55 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
50,5	1.35. 5	1,22	1,19	516			2,32	
	43.41	1,17	1,14	516			2,13	
	52.17	1,12	1,10	517			1,98	
	2. 0.54	1,08	1,05	516			1,80	
	9.30	1,03	1,00	517			1,64	
	18. 7	0,98	0,96	517			1,51	
	26.44	0,94	0,92	518			1,39	
	35.22	0,90	0,88	518			1,27	
	44. 0	0,87	0,85	518			1,18	
	52.38	0,83	0,81	518			1,07	
50,8	3. 1. 16	0,79						
50,6	Mean			517,1	515,1	86059,65	1,63	86061,28

October 25, A. M. ARBURY HILL.

Clock losing 6',20. Barometer 29,56 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
50,7	9.19.37	1,18						
	28.13	1,12	1,15	516			2,17	
	36.50	1,08	1,10	517			1,98	
	45.26	1,03	1,05	516			1,81	
	54. 3	0,98	1,00	517			1,64	
	10. 2.42	0,93	1,95	519			1,48	
	11.19	0,89	0,91	517			1,36	
	19.56	0,84	0,86	517			1,21	
	28.34	0,82	0,83	518			1,13	
	37.14	0,79	0,80	520			1,05	
51,2	45.52	0,76	0,77	518			0,97	
50,9	Mean			517,5	515,5	86059,92	1,48	86061,40

October 25, P. M. Barometer 29,54 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
52,0	1.45.36	1,14						
	54.12	1,09	1,11	516			2,02	
	2. 2.49	1,03	1,06	517			1,84	
	11.25	1,00	1,01	516			1,67	
	20. 2	0,96	0,98	517			1,57	
	28.39	0,92	0,94	517			1,45	
	37.16	0,88	0,90	517			1,33	
	45.53	0,83	0,85	517			1,18	
	54.31	0,80	0,81	518			1,07	
	3. 3. 8	0,77	0,78	517			1,00	
52,6	11.46	0,73	0,75	518			0,92	
52,3	Mean			517	515	86059,59	1,41	86061,00

October 26, A. M. ARBURY HILL.

Clock losing 6^s,20. Barometer 29,55 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
51,9	9. 7.12	1,16	1,13	516			2,10	
	15.48	1,11	1,08	516			1,91	
	24.24	1,06	1,03	516			1,74	
	33. 0	1,01	0,98	516			1,57	
	41.36	0,96	0,94	516			1,45	
	50.12	0,92	0,90	517			1,33	
	58.49	0,88	0,85	517			1,18	
	10. 7.26	0,83	0,82	516			1,10	
	16. 2	0,81	0,79	518			1,02	
	24.40	0,78	0,75	516			0,92	
52,5	33.16	0,73						
52,2	Mean			516,4	514,4	86059,20	1,43	86060,63

October 26, P. M.

Barometer 29,55 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
53,5	2. 8.18	1,15	1,13	515			2,10	
	16.53	1,11	1,08	515			1,91	
	25.28	1,06	1,03	515			1,74	
	34. 3	1,01	0,98	515			1,57	
	42.38	0,96	0,94	516			1,45	
	51.14	0,92	0,90	516			1,33	
	59.50	0,88	0,86	516			1,21	
	3. 8.26	0,85	0,83	516			1,13	
	17. 2	0,81	0,79	516			1,02	
	25.38	0,77	0,75	516			0,92	
53,9	34.14	0,73						
53,7	Mean			515,6	513,6	86058,68	1,44	86060,12

1819, March 8, A. M. *at Mr. Browne's house*, LONDON.

Clock gaining $1^s,75$ in a mean solar day. Barometer 30,10 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
49,8	10.40. 1	1,18	1,15	502			2,16	
	48.23	1,12	1,10	503			1,99	
	56.46	1,08	1,05	503			1,81	
	11. 5. 9	1,03	1,00	503			1,64	
	13.32	0,98	0,96	504			1,51	
	21.56	0,94	0,92	504			1,39	
	30.20	0,91	0,89	504			1,30	
	38.44	0,87	0,85	504			1,19	
	47. 8	0,83	0,81	504			1,07	
	55.32	0,80	0,78	505			1,00	
50,3	0. 3.57	0,77						
50,0	Mean			503,6	501,6	86058,61	1,51	86060,12

March 9, A. M. LONDON.

Clock gaining $1^s,85$. Barometer 30,10 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
49,8	10.35.36	1,14	1,11	503			2,02	
	43.59	1,09	1,07	503			1,88	
	52.22	1,05	1,03	503			1,74	
	11. 0.45	1,01	0,98	504			1,57	
	9. 9	0,96	0,94	505			1,45	
	17.34	0,92	0,90	503			1,33	
	25.57	0,88	0,86	504			1,21	
	34.21	0,84	0,82	504			1,11	
	42.45	0,81	0,79	504			1,02	
	51. 9	0,78	0,76	504			0,95	
50,5	59.33	0,74						
50,1	Mean			503,7	501,7	86058,78	1,43	86060,21

March 15, A. M. London.

Clock gaining 2^s,24. Barometer 30,14 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
o	h. m. s.	o	o				s.	
51,5	10.24.21	1,14						
	32.42	1,08	1,11	501			2,02	
	41.3	1,04	1,06	501			1,84	
	49.24	0,99	1,01	501			1,67	
	57.47	0,94	0,96	503			1,51	
	11. 6.9	0,91	0,92	502			1,38	
	14.31	0,88	0,89	502			1,30	
	22.53	0,84	0,86	502			1,21	
	31.16	0,81	0,82	503			1,10	
	39.38	0,78	0,79	502			1,02	
52,2	48.1	0,74	0,76	503			0,94	
51,8	Mean			502	500	86058,01	1,40	86059,41

March 16, A. M. London.

Clock gaining 2^s,24. Barometer 30,0 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
52,2	10.20.42	1,18						
	29. 2	1,12	1,15	500			2,17	
	37.23	1,07	1,09	501			1,95	
	45.44	1,03	1,05	501			1,80	
	54. 5	0,98	1,00	501			1,64	
	11. 2.26	0,95	0,96	501			1,51	
	10.48	0,92	0,93	502			1,42	
	19. 9	0,88	0,90	501			1,33	
	27.30	0,84	0,86	501			1,21	
	35.52	0,81	0,82	502			1,10	
53,1	44.14	0,78	0,79	502			1,02	
52,7	Mean			501,2	499,2	86057,46	1,52	86058,98

March 17, A. M. LONDON.

Clock gaining $2^s,24$. Barometer 30,10 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
53,2	10.24.19	1,17	1,15	500			2,17	
	32.39	1,13	1,10	501			1,98	
	41. 0	1,08	1,06	500			1,84	
	49.20	1,04	1,02	501			1,71	
	57.41	1,00	0,97	501			1,54	
	11. 6. 2	0,95	0,93	502			1,42	
	14.24	0,92	0,90	502			1,33	
	22.46	0,88	0,86	500			1,21	
	31. 6	0,84	0,82	502			1,10	
	39.28	0,81	0,79	502			1,02	
53,7	47.50	0,78						
53,5	Mean			501,1	499,1	86057,39	1,53	86058,92

March 18, A. M. LONDON.

Clock gaining $2^s,24$. Barometer 30,21 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
52,5	10.39.58	1,16	1,13	501			2,09	
	48.19	1,11	1,08	500			1,91	
	56.39	1,06	1,04	501			1,77	
	11. 5. 0	1,02	0,99	501			1,60	
	13.21	0,97	0,95	501			1,48	
	21.42	0,93	0,91	501			1,36	
	30. 3	0,90	0,88	501			1,27	
	38.24	0,86	0,84	502			1,15	
	46.46	0,82	0,80	502			1,05	
	55. 8	0,78	0,77	502			0,97	
53,2	0. 3.30	0,76						
52,8	Mean			501,2	499,2	86057,46	1,47	86058,93

May 11, A. M. at Shanklin Farm.

Clock losing $9^s,4$ in a mean solar day. Barometer 30,17 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
60,5	9.27. 9	1,22						
	35.35	1,14	1,18	506			2,28	
	44. 3	1,09	1,11	508			2,02	
	52.31	1,04	1,06	508			1,84	
	10. 0.59	0,99	1,01	508			1,68	
	9.27	0,95	0,97	508			1,54	
	17.56	0,92	0,93	509			1,42	
	26.25	0,88	0,90	509			1,33	
	34.53	0,83	0,85	508			1,18	
	43.22	0,79	0,81	509			1,07	
61,3	51.51	0,76	0,77	509			0,97	
60,9	Mean			508,2	506,2	86050,61	1,53	86052,14

May 11, P. M. Barometer 30,16 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
61,6	0.22.53	1,20						
	31.19	1,14	1,17	506			2,24	
	39.46	1,08	1,11	507			2,02	
	48.14	1,04	1,06	508			1,84	
	56.41	0,99	1,01	507			1,68	
	1. 5. 8	0,94	0,96	507			1,51	
	13.36	0,91	0,92	508			1,38	
	22. 3	0,87	0,89	507			1,30	
	30.31	0,83	0,85	508			1,18	
	38.59	0,80	0,81	508			1,07	
62,1	47.28	0,76	0,78	509			1,00	
61,8	Mean			507,5	505,5	86050,21	1,52	86051,73

May 12, A. M. SHANKLIN FARM.

Clock losing 9s,4. Barometer 30,10 inches.

Temp.	Time of coincidence.	Arc of vibrations.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
	h. m. s.	o	o				s.	
60,6	9.17.32	1,18	1,15	507			2,17	
	25.59	1,13	1,10	508			1,98	
	34.27	1,08	1,05	507			1,81	
	42.54	1,03	1,00	507			1,64	
	51.21	0,98	0,96	508			1,51	
	59.49	0,94	0,92	508			1,39	
	10. 8.17	0,90	0,88	509			1,27	
	16.46	0,86	0,84	509			1,16	
	25.15	0,83	0,81	508			1,08	
	33.43	0,79	0,77	508			0,97	
61,4	42.11	0,76						
61,0	Mean			507,9	505,9	86050,46	1,50	86051,96

May 12, P. M.

Barometer 30,09 inches.

Temp.	Time of coincidence.	Arc of vibrations.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
61,2	0.16.43	1,21	1,18	507			2,28	
	25.10	1,16	1,13	507			2,09	
	33.37	1,11	1,08	507			1,91	
	42. 4	1,05	1,02	507			1,71	
	50.31	1,00	0,98	508			1,57	
	58.59	0,96	0,94	508			1,45	
	1. 7.27	0,93	0,90	508			1,32	
	15.55	0,88	0,86	508			1,21	
	24.23	0,84	0,82	508			1,10	
	32.51	0,81	0,79	508			1,02	
61,4	41.19	0,77						
61,3	Mean			507,6	505,6	86050,28	1,57	86051,85

May 13, A. M. SHANKLIN FARM.

Clock losing $9^s,4$. Barometer 30,08 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
6,08	9.12.17	1,16	1,14	506			2,13	
	20.43	1,12	1,09	507			1,95	
	29.10	1,06	1,04	507			1,77	
	37.37	1,02	0,99	508			1,60	
	46. 5	0,97	0,95	507			1,48	
	54.32	0,93	0,90	508			1,32	
	10. 3. 0	0,88	0,86	508			1,21	
	11.28	0,84	0,83	508			1,13	
	19.56	0,82	0,79	508			1,02	
	28.24	0,77	0,75	509			0,92	
60,9	36.53	0,73						
60,8	Mean			507,6	505,6	86050,28	1,45	86051,73

May 13, P. M. Barometer 30,08 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
60,9	0.20.36	1,18	1,15	506			2,17	
	29. 2	1,13	1,10	507			1,99	
	37.29	1,08	1,05	507			1,81	
	45.56	1,03	1,00	507			1,64	
	54.23	0,98	0,96	507			1,51	
	1. 2.50	0,94	0,92	508			1,39	
	11.18	0,91	0,88	508			1,27	
	19.46	0,86	0,84	508			1,16	
	28.14	0,82	0,80	508			1,05	
	36.42	0,79	0,77	508			0,97	
61,1	45.10	0,76						
61,0	Mean			507,4	505,4	86050,14	1,50	86051,64

May 14, A. M. SHANKLIN FARM.

Clock losing 9^s,4. Barometer 30,14 inches.

Temp	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
60,4	9.35.41	1,19						
	44. 8	1,14	1,16	507			2,20	
	52.35	1,08	1,11	507			2,01	
	10. 1. 3	1,03	1,05	508			1,81	
	9.31	0,99	1,01	508			1,67	
	17.59	0,95	0,97	508			1,54	
	26.28	0,92	0,93	509			1,42	
	34.56	0,88	0,90	508			1,33	
	43.25	0,84	0,86	509			1,21	
	51.54	0,80	0,82	509			1,10	
60,7	11. 0.23	0,76	0,78	509			1,00	
60,5	Mean			508,2	506,2	86050,61	1,53	86052,14

May 14, P. M. Barometer 30,10 inches.

Temp	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
60,7	0.16.14	1,18						
	24.41	1,13	1,15	507			2,17	
	33. 8	1,08	1,10	507			1,99	
	41.36	1,03	1,05	508			1,81	
	50. 4	0,98	1,00	508			1,64	
	58.32	0,94	0,96	508			1,51	
	1. 7. 0	0,90	0,92	508			1,39	
	15.28	0,86	0,88	508			1,27	
	23.56	0,82	0,84	508			1,16	
	32.25	0,78	0,80	509			1,05	
60,9	40.54	0,75	0,76	509			0,95	
60,8	Mean			508	506	86050,48	1,49	86051,97

May 15, A. M. Shanklin Farm.

Clock losing $9^s,4$. Barometer 30,05 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
60,5	9.18.29	1,18	1,15	506			2,17	
	26.55	1,12	1,09	507			1,95	
	35.22	1,07	1,04	507			1,77	
	43.49	1,02	0,99	507			1,60	
	52.16	0,97	0,95	506			1,48	
	10. 0.42	0,93	0,91	507			1,36	
	9. 9	0,90	0,88	508			1,27	
	17.37	0,87	0,85	508			1,29	
	26. 5	0,83	0,81	508			1,18	
	34.33	0,79	0,77	508			0,97	
61,4	43. 1	0,76						
60,9	Mean			507,2	505,2	86049,94	1,50	86051,44
	May 15, P. M.				**Barometer 30,05 inches.**			
61,3	0.31.38	1,17	1,14	506			2,13	
	40. 4	1,12	1,09	507			1,95	
	48.31	1,07	1,04	507			1,78	
	56.58	1,02	1,00	506			1,64	
	1. 5.24	0,98	0,95	507			1,48	
	13.51	0,93	0,91	507			1,36	
	22.18	0,89	0,87	508			1,24	
	31.46	0,85	0,83	507			1,13	
	39.13	0,82	0,80	507			1,05	
	47.40	0,78	0,76	508			0,95	
61,4	56. 8	0,75						
61,3	Mean			507	505	86049,81	1,47	86051,28

May 16, A. M. SHANKLIN FARM.

Clock losing $9^s,4$. Barometer 30,03 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
°	h. m. s.	°	°				s.	
59,8	9.29.58	1,20						
	38.25	1,14	1,17	507			2,24	
	46.51	1,09	1,11	506			2,02	
	55.18	1,04	1,06	507			1,84	
	10. 3.45	1,00	1,02	507			1,71	
	12.13	0,96	0,98	508			1,57	
	20.40	0,92	0,94	507			1,45	
	29. 8	0,87	0,89	508			1,30	
	37.36	0,83	0,85	508			1,29	
	46. 5	0,80	0,81	509			1,18	
60,4	54.32	0,76	0,78	507			1,00	
60,1	Mean			507,4	505,4	86050,14	1,56	86051,70

May 16, P. M.

Barometer 30,03 inches.

Temp.	Time of coincidence.	Arc of vibration.	Mean Arc.	Interval in seconds.	No. of vibrations.	Observed vibrations in 24 hours.	Correction for Arc.	Vibrations in 24 hours.
60,6	0.24.40	1,19						
	33. 6	1,13	1,16	506			2,20	
	41.32	1,08	1,10	506			1,99	
	49.59	1,03	1,05	507			1,81	
	58.26	0,98	1,00	507			1,64	
	1. 6.53	0,94	0,96	507			1,51	
	15.20	0,91	0,92	507			1,39	
	23.47	0,87	0,89	507			1,30	
	32.14	0,83	0,85	507			1,29	
	40.42	0,79	0,81	508			1,18	
60,8	49.10	0,76	0,77	508			0,97	
60,7	Mean			507	505	86049,81	1,53	86051,34

Observations for connecting the Stations of the Trigonometrical Survey with those of the Pendulum.

Clifton.

Oct. 9th 1818. The angles of the following triangles were observed, in order to obtain the distance from Clifton Beacon to the Pendulum.

Clifton Beacon from Laughton Spire, 25409 feet.

Clifton Beacon,	83° 22′ 23″	to Station A	934 feet.
Laughton Spire	(2. 6. 0)		
Station A, -	94.31.37		

Clifton Beacon from Station A, 934 feet.

Clifton Beacon,	85° 48′ 29″	to Pendulum Stat.	1380 feet.
Station A, -	58.48.41		
Pendulum Station,	(35.22.50)		

The angle between Laughton Spire and the Pendulum Station is, - -	169° 10′ 52″
Laughton Spire is south west of the Meridian of Clifton Beacon, - -	1.56.12
Hence, the bearing of the Pendulum Station from Clifton Beacon to the N.E. is	12.45.20

Arbury Hill.

On the 26th of October, a base of 906 feet was measured in the meadows at the foot of Arbury Hill, for the purpose of finding the distance from Arbury Hill to the Pendulum

Station. As the house could not be seen, I chose a station (B) near it, which by measurement was 206 feet to the north of the clock. The following triangles were then observed.

From the North end of the Base to the South end, 906 feet.

		° ′ ″		
North end,	-	97.37. 5	to Arbury Hill	——
South end,	-	54.30.21		1921 feet.
Arbury Hill,	-	(27.52.34)		

From the South end of the Base to Arbury Hill, 1921 feet.

		° ′ ″		
South end,	-	104.24.17	to Station B.	——
Arbury Hill,		(34.42. 4)		2842 feet.
Station B,	-	40.53.39		

Adding 206 feet to 2842, we obtain 3048 feet, for the distance from the Pendulum to Arbury Hill, which was so nearly in the direction of the meridian as to require no correction.

Dunnose.

9th May, 1819, measured a Base of 1140 feet on Shanklin Down, and observed the following readings on the azimuth circle.

At the North end of the Base.		
Objects.	Readings of the Verniers.	Mean.
	° ′ ″	° ′ ″
Summer house chimney, - -	0.42.15 42.50 42.50	0.42.38
South end of base, - - - -	106.11.20 11. 5 11. 5	106.11.10
Top of the Signal Post, - -	210.15.40 16.20 15.35	210.15.52
Dunnose Station, - - - -	235.50.10 51. 0 50.30	235.50.33
At the South end of the Base.		
Sir Richard Worsleys's Obelisk,	0.25.40 25.35 25.35	0.25.37
Dunnose Station, - - -	57.19.55 19.50 19.45	57.19.50
Top of the Signal Post, - -	57.56.20 56. 5 56. 0	57.56. 8
North end of base, - - -	65.41. 0 40.40 40.35	65.40.45
Summer House chimney, - -	125. 3.25 3.25 3.25	125. 3.25

At Dunnose Station.		
Objects.	Readings of the Verniers.	Mean.
	° ′ ″	° ′ ″
North end of Base, - -	0.17. 0 16.40 16.50	0.16.50
Top of the Signal Post, - -	36.26.20 26.20 26.15	36.26.18
Sir RICHARD WORSLEY's Obelisk,	159.26.20 26.30 26. 0	159.26.17

No. 1. *From the North to South end of Base,* 1140 *feet.*

		° ′ ″		
North end Base,	-	105.28.32	to Summer house chimney,	3755
South end Base,	-	59.22.40		4205
Summer house,	-	(15. 8.48)		

No. 2. *From the North to South end of Base,* 1140 *feet.*

		° ′ ″		
North end Base,		104. 4.42	to Signal Post	165
South end Base,		7.44.37		1191
Signal Post,	-	(68.10.41)		

No. 3. In the following triangle, we have given the two sides from the south end of the Base to the Summer house, and from the south end of the Base to the Signal Post and the included angle, to find the remaining angles and the distance from the Signal Post to the Summer house.

		° ′ ″		
South end Base,		67. 7.17	to Signal Post	1191
Summer house,		16.20.38		3900
Signal Post,	-	96.32. 5		

The distance from the Signal Post to the gun marking Dunnose station, was found by measurement to be 120 feet, the gun being to the northward, and nearly in a right line with the south end of the base and the Signal Post. This being added to 1191 feet, the distance of the Signal Post from the south end of the Base, we have 1311 feet, for the distance of the gun from the south end of the Base. In the following triangle therefore, two sides, and the included angle, are given to find the remaining angles and the third side.

No. 4. *From the South end of Base to Dunnose Station* 1311 *feet.*

	° ′ ″		
South end Base,	67.43.35	to Summer house	——
Dunnose Station,	(94. 9.24)		3901
Summer house,	(18. 7. 1)		

The following angles are for the purpose of determining the angle at Dunnose station, between the north and south ends of the base.

	° ′ ″
North end Base, - - -	129.39.23
South end Base, - -	8.20.55
Dunnose Station, - -	(41.59.42)

In the triangle No. 4, if from 94°.9′.24″ we subtract 41°.59′.42″ the remainder 52°.9′.42″ will be the angle at Dunnose Station, between the Summer house and the north end of the Base; to which the observed angle between the north end of the Base and Sir Richard Worsley's Obelisk 159°.9′.27″ being added, we obtain 211°.19′.9″, or 148°.40′.51″ for the

angle at Dunnose Station between the Obelisk and the Summer house.

The bearing of Sir RICHARD WORSLEY's Obelisk, according to the Trigonometrical Survey, is 87°.42'.40 north-west from the meridian of Dunnose; therefore the bearing of the Summer house appears to be 60°.58'.11" north-east, and the resulting distance on the meridian 1893 feet.

May 12th, the following observations were made with the Repeating Circle, for obtaining the Zenith distance of the top of the Signal Post.

Level.		Readings, &c.			
					° ′ ″
+ 21	− 5	1st Vernier	-		292.54. 5
+ 16	− 12	Second	-	-	0
+ 6	− 22	Third	-	-	5
+ 7	− 20	Fourth	-	-	0
+ 11	− 17				
+ 10	− 19	Mean	-	-	292.54. 2,5
+ 18	− 10	Index	-	+	13,0
+ 14	− 18	Level	-	−	24,0
+103	−123			+	360. 0. 0
					8) 652.53.51,5
		Zen. Dist.	-		81.36.43,9

$\frac{(+103-123)}{2} \times 2{,}4'' = -24{,}0''$

From the above Zenith distance, and the distance of the Signal Post from the Summer house, we obtain 576 feet, for the elevation of the top of the Signal Post above the Summer house.

The Signal Post was carefully estimated to be 30 feet high, and Dunnose Station is about 7 feet below the base of the Signal Post. Deducting therefore 37 feet, we have 539 feet, for the elevation of Dunnose Station above the Pendulum.

By the Trigonometrical Survey, Dunnose appears to be 792 feet above the level of the sea; the height therefore of the Pendulum above the sea was 253 feet.

Observations with a Barometer of Sir H. ENGLEFIELD'S *construction at the Isle of Wight.*

Date.	Thermometer.	Stations.	Barometer. inches.	Calculated height, and correction	Feet above high water mark.
May 12	62°	Summer house, - -	30,078		
	61	High water mark, -	30,314	217,2	
	63	Summer house, - -	30,092	+7,0	
					224,2
15	62	Summer house, - -	30,036	209,8	
	61	High water mark, -	30,260	+6,7	
					216,5
16	61	Summer house, - -	30,015		
	56	Beach (2 ft. above h. water,)	30,227	212,8	
	61	Summer house, - -	30,008	+7,0	
				+2,0	
					221,8
				Mean	220,8
15	60	Dunnose, - -	29,499	707,7	
	61	High water mark, -	30,260	+22,8	
					730,5
	60	Dunnose, - -	29,499	497,4	
	62	Summer house, - -	30,036	+16,1	
					513,4

The correction applied, is $\frac{1}{30}$ of the calculated height on account of the rise of the mercury in the cistern of the barometer.

From the preceding table we have

	Feet.
Dunnose above the Summer house by Trigonometrical measurement, - - - -	539,0
By the Barometer, - - -	513.4
Difference, -	25,6

Summer house above high water mark by the barometer, - - - -	220,8
Add for the fall of the tide, - - -	10,0
Summer house above low water, - - -	230,8
Above low water by the Survey and Trigonometrical observation, - - -	253,0
Difference -	22,2