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CONTENTS.

OBSERVATIONS OF THE COMET OF 1807.

BY NATHANIEL BOWDITCH, A. M. & A. A. S.

THE first time I observed this comet was on the twenty fifth day of September 1807, at seven o'clock in the evening, near the foot of the constellation *Virgo*. I did not make any accurate estimate of its place before the eighth of October, when I commenced a series of observations, by measuring its distance from several of the fixed stars, by a circular instrument of reflection of Borda's construction, and, to diminish the unavoidable errors of the observations, I generally measured ten or twelve distances from each star. This method was made use of until the seventeenth day of December, when the comet ceased to be visible to the naked eye. Not having any instrument proper to continue the observations, or even to keep sight of the comet for a much longer time, I applied to the Reverend Doctor Prince, who was so obliging as to fix several cross wires, at equal distances from each other, in the diaphragm of an excellent night-glass, having a vertical and horizontal motion in a stand; and by placing the wires nearly perpendicular to the horizon, we were enabled to estimate the difference of altitude and azimuth between the comet and any fixed star, near which it passed, more accurately than we otherwise could have done, though not with that degree of accuracy we could have wished. However, the observations, imperfect as they were, answered the valuable purpose of proving, that the elements of the orbit, calculated from the observations made with the circular instrument of reflection, gave the place of the comet at the period of its disappearance within the limits of the errors of the observations ; as will be perceived by the last observation of this kind, that we made, which will be given at the end of this memoir.

The apparent motion of the comet was nearly in a great circle at the average rate of about a degree per day. It passed in succession through the constellations *Mons Mænalus*, *Serpens*, *Hercules*, *Lyra*, *Cygnus*, and *Lacerta*, and on the thirtieth day of January 1808 was near the extremity of the right hand of *Andromeda*. It had then the appearance of a *Nebula*, and was so faint, as to be hardly visible with the assistance of the night-glass. After this time I was prevented by indisposition from seeking for it.

In reducing the observations, made with the circular instrument, allowance was made for the variations of the distances during the time elapsed between observing the different stars, so as to make the distances correspond to the same moment of time. This correction being small was calculated with sufficient accuracy by taking a proportional part of the observed daily increase or decrease of distance. Allowance was made for refraction by adding to the observed distances a small correction, calculated by Shepherd's "*Tables* "*for correcting the apparent distance of the Moon and Stars, etc.*" by taking twenty times the correction in the column "*Var*," corresponding to the observed distances and altitudes ;* this being the value for the mean temperature and density of the air. The Parallax was so small, that it was neglected. The Aberration, which sometimes exceeded a minute, was found and applied to the calculated longitudes and latitudes made use of in the last process for finding the elements of the orbit. The longitudes were always counted

* This tabular correction is equal to the variation of the apparent distance of any two heavenly bodies corresponding to a change of 20 degrees of Fahrenheit's thermometer, and is nearly one twentieth part of the correction arising from the whole refraction at the mean temperature, as may be easily proved by Dr. Bradley's rule for calculating the variation.

from the mean equinox. The right ascensions and declinations of the stars, made use of in reducing the observations, were taken from Zach's catalogue, published in Vince's Astronomy, and from Maskelyne's, published in his "Requisite Tables."

Early in November I began to calculate the elements of the orbit by the method given by La Place, in vol. i. book ii. § 37 of the "Mecanique Celeste." For this purpose I made use of all the observations from the first appearance of the comet to the sixth of November, as they are given in the table at the end of this article. To render this part of the calculation more simple, and to avoid divisions by fractions of a day, I reduced all the observations to seven o'clock in the evening, by applying to the observed places the corrections for the motion of the comet between the time of observation and seven o'clock. This correction was found sufficiently near for this purpose, by taking a proportional part of the daily variation of the comet in longitude and latitude. The observations having been thus prepared, I combined them together in ten different examples, each one containing five observations. By the mean of these calculations I found, for a first approximation, that the time of passing the perihelion was September 20, 1807, and the perihelion distance 0·65636, the mean distance of the sun from the earth being estimated as unity.

These elements I afterward corrected by the method explained by La Place in the same section of his work. For this purpose I made choice of the observations of October 8, October 23, and November 6. From these I found, for a second approximation, that the corrected time of passing the perihelion was September 19d. 7h. mean time at Salem, and the perihelion distance 0·6645. These elements, with the longitude of the node, the longitude of the perihelion, and the inclination of the orbit to the ecliptic corresponding, were published in the Salem Gazette of the tenth of November 1807; in which it was mentioned, that these elements were very different from those of any of the known comets, published by De La Lande in his astronomy.

For a third approximation I combined the observations of October and November in ten examples similar to the last, and thus procured twenty equations like those given by La Place in vol. i. pag. 229, "Mecanique Celeste." From the mean of these the corrected elements were found as follow.

Perihelion distance	D=0·6485.
Time of passing the perihelion . .	T=Sep. 18d. 12h.
Place of the perihelion counted on the orbit of the comet . . .	P=9s. 0° 53′ 15″
Longitude of the ascending node .	N=8 26 36 29
Inclination of the orbit to the ecliptic .	I=63 13 31.

The geocentric longitudes and latitudes calculated by these elements were found in general not to differ more than five minutes from the observations in September, October, and November. To obtain a greater degree of accuracy I made use of the following method.

I supposed the corrections to be applied to the preceding elements to be represented by $0{,}002.d$, $0{,}2.t$, $10'.p$, $-10'.n$, $-10'.i$, which would make the corrected elements respectively as follow.

$$D + 0{,}002 \cdot d$$
$$T + 0{,}2 \cdot t$$
$$P + 10' \cdot p$$
$$N - 10' \cdot n$$
$$I - 10' \cdot i$$

and then calculated the values of d, t, p, n, and i, in the following manner.

First supposition. Making use of the elements D, T, P, N, and I, I calculated to seconds by Taylor's logarithms, the geocentric longitude and latitude of the comet for each of the observations contained in the following table from October 8 to December 17. Denoting any one of these longitudes or latitudes by L' and the corresponding observed longitude or latitude by L, I put $L—L'=l$.

Second Supposition. Making use of all the preceding elements excepting D, and increasing that by the quantity 0·002, I recalculated the same geocentric longitude or latitude and denoted it by L'', and put $L'—L''=l'$.

Third Supposition. Making use of all the elements of the first supposition excepting T and increasing that by two tenths of a day, I recalculated the same geocentric longitude or latitude and denoted it by L''', and put $L'—L'''=l''$.

Fourth Supposition. Making use of all the elements of the first supposition excepting P and increasing that by ten minutes, I recalculated the same geocentric longitude or latitude and denoted it by L^{iv} and then put $L'—L^{iv}=l'''$.

Fifth Supposition. Making use of all the elements of the first supposition excepting N and decreasing that by ten minutes, I recalculated the same geocentric longitude or latitude and denoted it by L^{v} and then put $L'—L^{v}=l^{iv}$.

Sixth Supposition. Making use of all the elements of the first supposition excepting I and decreasing that by ten minutes, I recalculated the same geocentric longitude or latitude and denoted it by L^{vi} and then put $L'—L^{vi}=l^{v}$.

Each of the observed longitudes and latitudes by this means furnished an equation of the following form between the sought quantities d, t, p, n, i, upon the supposition, that the small variations of the calculated longitudes and latitudes are exactly proportional to the corresponding variations of the elements of the orbit.

$$o=l'\cdot d+l''\cdot t+l'''\cdot p+l^{iv}\cdot n+l^{v}\, i+l.$$

So that by three observations of the comet we should procure six equations, which is one more than is necessary for finding the values of d, t, p, n, i, and determining the elements of the orbit.

Now it is evident that if the comet moved exactly in a parabola, and the observations were perfectly correct, all these equations would concur in giving nearly* the same values of d, t, p, n, and i, but as errors arising from those sources are unavoidable, the substitution of the correct values of d, t, p, n, and i, in the equations will not generally make the second members equal to o; but will render them equal to the combined effect of the errors of the observations and of the parabolic hypothesis, and if we denote these errors by $x^{(1)}$, $x^{(2)}$, $x^{(3)}$, etc.† the equations will become of this form.‡

$$x^{(r)} = l' \cdot d + l'' \cdot t + l''' \cdot p + l^{iv} \cdot n + l^{v} \cdot i + l.$$

* The variations of the calculated latitudes and longitudes are not *accurately* proportional to the corresponding variations of the elements of the orbit, therefore the equations will not give *exactly* the same values of d, t, p, n, and i.

† It may be necessary to observe, that the figures annexed to x do not signify exponents of the powers of x, as the quantities $x^{(1)}$, $x^{(2)}$, etc. are wholly independent of each other.

‡ If the comet, during its appearance, had described so great an arch of its orbit, as to render it sensibly different from a parabola, we might calculate the elliptical elements by introducing another term into the above equation. For if D be the perihelion distance of the comet, U its angular distance from the perihelion, calculated for the time of any of the observations by the parabolic hypothesis, U$+x$ the same angular distance calculated in the elliptical hypothesis, supposing the perihelion distance of the comet, divided by its mean distance from the sun, to be E, we should have by the rules, given by La Place in the abovementioned work,

$$\text{Sine } x = \tfrac{1}{10}\,\mathrm{E} \cdot \text{tang.}\,\tfrac{1}{2}\,\mathrm{U} \cdot \left\{ 4 - 3 \cdot \overline{\cos.\,\tfrac{1}{2}\,\mathrm{U}}|^2 - 6 \cdot \overline{\cos.\,\tfrac{1}{2}\,\mathrm{U}}|^4 \right\}$$

and the radius vector in the elliptical hypothesis would be

$$\frac{\mathrm{D}}{\overline{\cos.\,\tfrac{1}{2}\,(\mathrm{U}+x)}|^2} \cdot \left\{ 1 - \frac{\mathrm{E}}{2} \cdot \left(\text{tang.}\,\frac{\mathrm{U}+x}{2} \right)^2 \right\}$$

By

In this manner I calculated the equations, resulting from the twenty eight observations, made from October 8 to December 17, and obtained the following system of equations A, of which the first twenty eight were deduced from the observed longitudes and the rest from the observed latitudes, the equations being arranged according to the times of observation, and the errors in the observed longitudes counted in the same order, being denoted by $x^{(1)}, x^{(2)} \ldots x^{(28)}$, and the errors in the observed latitudes by $x^{(29)}, x^{(30)} \ldots x^{(56)}$.

$$x^{(1)} = -315 \cdot d + 2 \cdot t + 129 \cdot p + 239 \cdot n - 234 \cdot i + 38$$
$$x^{(2)} = -317 \cdot d - 1 \cdot t + 138 \cdot p + 242 \; n - 248 \cdot i - 88$$
$$x^{(3)} = -319 \cdot d - 4 \cdot t + 145 \cdot p + 244 \; n - 262 \cdot i - 98$$
$$x^{(4)} = -323 \cdot d - 8 \cdot t + 151 \cdot p + 246 \; n - 279 \cdot i - 84$$
$$x^{(5)} = -330 \cdot d + 2 \cdot t + 198 \cdot p + 249 \; n - 412 \cdot i + 21$$
$$x^{(6)} = -329 \cdot d + 14 \cdot t + 207 \cdot p + 246 \; n - 448 \cdot i - 76$$
$$x^{(7)} = -327 \cdot d + 17 \cdot t + 208 \cdot p + 242 \; n - 467 \cdot i + 16$$
$$x^{(8)} = -324 \cdot d + 26 \cdot t + 212 \cdot p + 240 \; n - 485 \cdot i - 164$$
$$x^{(9)} = -321 \cdot d + 31 \cdot t + 213 \cdot p + 235 \; n - 505 \cdot i - 116$$

....

By these rules we might calculate the true anomaly and distance of the comet from the sun, and thence deduce the geocentric longitude and latitude for each of the observations, supposing the elements D, T, P, N, I, to be the same, as in the first supposition, and E to be a very small quantity, as for example $\frac{1}{100}$. Then, denoting any one of these longitudes or latitudes by L^{vii}, and putting $L' - L^{vii} = l^{vi}$ and $E = \frac{e}{100}$, we must add to the above value of $x^{(r)}$ the term $l^{vi} e$. By this means the system of equations A, B, C, etc. would contain terms depending on e, and it would be necessary to make another assumption similar to the four first, made use of in the above calculations, which would furnish another equation, by means of which e might be exterminated, and the equation reduced to the same form as the system F, from which the value of p might be found as above. The observations of this comet accorded so well with a parabolic hypothesis, that the differences between the calculated and true places were within the limits of the errors of the observations ; therefore I did not attempt to calculate the elliptical orbit.

$$
\begin{array}{lrrrrrr}
 & {}'' & {}'' & {}'' & {}'' & {}'' & {}'' \\
x(^{10})= & -318\cdot d & +40\cdot t & +215\cdot p & +231\, n & -526\cdot i & -71 \\
x(^{11})= & -314\cdot d & +48\cdot t & +215\cdot p & +225\, n & -547\cdot i & +86 \\
x(^{12})= & -308\cdot d & +57\cdot t & +214\cdot p & +218\, n & -567\cdot i & -278 \\
x(^{13})= & -304\cdot d & +67\cdot t & +213\cdot p & +211\, n & -589\cdot i & -158 \\
x(^{14})= & -199\cdot d & +202\cdot t & +157\cdot p & +108\cdot n & -789\cdot i & -413 \\
x(^{15})= & -140\cdot d & +262\cdot t & +119\cdot p & +59\cdot n & -851\cdot i & +385 \\
x(^{16})= & -122\cdot d & +280\cdot t & +99\cdot p & +37\cdot n & -876\cdot i & +120 \\
x(^{17})= & -95\cdot d & +305\cdot t & +81\cdot p & +16\cdot n & -895\cdot i & -304 \\
x(^{18})= & -14\cdot d & +378\cdot t & +12\cdot p & -55\cdot n & -955\cdot i & +1081 \\
x(^{19})= & 47\cdot d & +429\cdot t & -40\cdot p & -105\cdot n & -987\cdot i & +775 \\
x(^{20})= & 187\cdot d & +533\cdot t & -165\cdot p & -217\cdot n & -1033\cdot i & +263 \\
x(^{21})= & 267\cdot d & +588\cdot t & -240\cdot p & -280\cdot n & -1045\cdot i & +164 \\
x(^{22})= & 306\cdot d & +613\cdot t & -282\cdot p & -314\cdot n & -1048\cdot i & +757 \\
x(^{23})= & 509\cdot d & +726\cdot t & -483\cdot p & -464\cdot n & -1020\cdot i & +204 \\
x(^{24})= & 542\cdot d & +742\cdot t & -520\cdot p & -489\cdot n & -1007\cdot i & +238 \\
x(^{25})= & 582\cdot d & +761\cdot t & -562\cdot p & -517\cdot n & -992\cdot i & +614 \\
x(^{26})= & 690\cdot d & +804\cdot t & -676\cdot p & -587\cdot n & -929\cdot i & +47 \\
x(^{27})= & 724\cdot d & +813\cdot t & -713\cdot p & -609\cdot n & -905\cdot i & +1628 \\
x(^{28})= & 944\cdot d & +789\, t & -1006\cdot p & -716\cdot n & -496\cdot i & +69 \\
x(^{29})= & 226\cdot d & +957\cdot t & -336\cdot p & -214\cdot n & +43\cdot i & -180 \\
x(^{30})= & 237\cdot d & +950\cdot t & -337\cdot p & -212\cdot n & +41\cdot i & -235 \\
x(^{31})= & 247\cdot d & +945\cdot t & -339\cdot p & -211\cdot n & +39\cdot i & -301 \\
x(^{32})= & 258\cdot d & +933\cdot t & -341\cdot p & -209\cdot n & +38\cdot i & -143 \\
x(^{33})= & 333\cdot d & +865\cdot t & -361\cdot p & -208\cdot n & +28\cdot i & -262 \\
x(^{34})= & 349\cdot d & +849\cdot t & -367\cdot p & -210\cdot n & +27\cdot i & -197 \\
x(^{35})= & 359\cdot d & +839\cdot t & -372\cdot p & -211\cdot n & +27\cdot i & -386 \\
x(^{36})= & 366\cdot d & +831\cdot t & -374\cdot p & -212\, n & +27\cdot i & -180 \\
x(^{37})= & 375\cdot d & +824\cdot t & -378\cdot p & -213\cdot n & +28\cdot i & -98 \\
x(^{38})= & 383\cdot d & +814\cdot t & -382\cdot p & -215\cdot n & +29\cdot i & -127 \\
x(^{39})= & 390\cdot d & +804\cdot t & -386\, p & -217\cdot n & +28\cdot i & -92 \\
x(^{40})= & 397\cdot d & +794\cdot t & -391\cdot p & -220\cdot n & +31\cdot i & +74
\end{array}
\tag{A}
$$

$$\begin{array}{l}
\qquad\qquad\quad{}'' \qquad\quad {}'' \qquad\quad {}'' \qquad\quad {}'' \qquad\quad {}'' \qquad\quad {}'' \\
x(^{41})=403\cdot d+784\cdot t-395\cdot p-223\cdot n+\ 32\cdot i-108 \\
x(^{42})=463\cdot d+702\cdot t-435\cdot p-241\cdot n+\ 74\cdot i+244 \\
x(^{43})=476\cdot d+671\cdot t-447\cdot p-245\cdot n+\ 97\cdot i-294 \\
x(^{44})=478\cdot d+659\cdot t-451\cdot p-246\cdot n+106\cdot i-197 \\
x(^{45})=483\cdot d+651\cdot t-454\cdot p-246\cdot n+115\cdot i+413 \\
x(^{46})=491\cdot d+617\cdot t-464\cdot p-246\cdot n+146\cdot i-803 \\
x(^{47})=493\cdot d+593\cdot t-468\cdot p-242\cdot n+170\cdot i-200 \\
x(^{48})=488\cdot d+541\cdot t-468\cdot p-229\cdot n+223\cdot i-177 \\
x(^{49})=484\cdot d+516\cdot t-466\cdot p-220\cdot n+252\cdot i+287 \\
x(^{50})=477\cdot d+500\cdot t-464\cdot p-215\cdot n+267\cdot i+424 \\
x(^{51})=447\cdot d+428\cdot t-440\cdot p-176\cdot n+342\cdot i+565 \\
x(^{52})=436\cdot d+412\cdot t-434\cdot p-167\cdot n+355\cdot i+101 \\
x(^{53})=427\cdot d+397\cdot t-426\cdot p-157\cdot n+370\cdot i-143 \\
x(^{54})=395\cdot d+351\cdot t-398\cdot p-123\cdot n+412\cdot i-589 \\
x(^{55})=384\cdot d+338\cdot t-387\cdot p-111\cdot n+425\cdot i-1082 \\
x(^{56})=206\cdot d+167\cdot t-219\cdot p+\ 56\cdot n+539\cdot i-229
\end{array}$$

Having obtained these equations it remained to deduce from them the values of the unknown quantities d, t, p, n, and i. The method, I thought most advisable to pursue for this purpose, is founded on the following assumed principles.

1. That the sum of all the positive errors in the calculated longitudes should be equal to the sum of the negative ones. That is in symbols

$$x(^1)+x(^2)+x(^3)\ldots+x(^{28})=0.$$

2. That the sum of all the positive errors in the calculated latitudes should be equal to the sum of the negative ones. That is,

$$x(^{29})+x(^{30})+x(^{31})\ldots+x(^{56})=0.$$

3. That the sum of all the positive errors in the observed longitudes in the observations made in October should be equal to the sum of the negative ones. That is,

$$x(^1)+x(^2)+x(^3)\ldots x(^{13})=0.$$

4. That the sum of the positive errors in the observed latitudes in the observations made in October should be equal to the sum of the negative ones. That is,

$$x^{(29)}+x^{(30}+x^{(31)}\ldots x^{(41)}=0.$$

5. The four preceding conditions having been fulfilled, the fifth is that the sum of all the errors in the longitudes and latitudes taken positively should be a *minimum*.

In applying the four first of these conditions to the system of equations A, they furnished four equations between d, t, p, n, i, by means of which I exterminated d, t, n, i from the equations A. Thus the equations $x^{(1)}+x^{(2)}+x^{(3)}\ldots+x^{(56)}=0$, found by adding together the equations $x^{(1)}+x^{(2)}\ldots+x^{(28}=0$ and $x^{(28)}+x^{(29)}\ldots+x^{(56)}=0$,* gives for the sum of all the equations A,

$0=11030\cdot d+27248\cdot t-12941\cdot p-6648\cdot n-15086\cdot i+742$, which by dividing by -27248,

$$0=-0{\cdot}40480\cdot d-t+0{\cdot}47493\cdot p+0{\cdot}24398\cdot n+0{\cdot}55366\cdot i-0{\cdot}02723. \quad (1)$$

By multiplying this equation successively by the coefficients of t in the equations A, I obtained a system of equations B, in which the coefficients of t were equal and of a contrary sign to those of the system A, and by adding together the corresponding equations of the systems A and B, I obtained the equations C independent of t, of this form:

$$\left.\begin{array}{l} x^{(1)}=-316\cdot d+130\cdot p+239\cdot n-233\cdot i+38 \\ x^{(2)}=-317\cdot d+138\cdot p+242\cdot n-249\cdot i-88 \\ \text{\&c. \&c.} \end{array}\right\} \quad (C)$$

The sum of the first twenty eight of these equations gives, in putting $x^{(1)}+x^{(2)}\ldots+x^{(28)}=0$,

* I took the sum of the two equations instead of the second of them from the circumstance of having previously calculated the sum of all the equations A.

$$0=-3368\cdot d+2284\cdot p+1011\cdot n-14683\cdot i+4424,$$

and by dividing by 14683

$$0=-0{\cdot}22944\cdot d+0{\cdot}15555\cdot p+0{\cdot}06885\cdot n-i+0{\cdot}30130 \quad (2).$$

By multiplying this equation successively by the coefficients of i in the equations C, and adding these new equations to the corresponding ones of the system C, I obtained the system of equations D independent of t and i of this form:

$$\left.\begin{array}{l} x(^1)=-263\cdot d+94\cdot p+223\cdot n-32 \\ x(^2)=-260\cdot a+99\cdot p+225\cdot n-163 \\ \&c.\ \&c. \end{array}\right\} \quad (D)$$

The sum of the first thirteen of these equations gives in putting $x(^1)+x(^2)\ldots+x(^{13})=0$,

$$0=-3027\cdot d+1757\cdot p+2766\cdot n-2609,$$

and by dividing by 3027

$$0=-d+0{\cdot}58044\cdot p+0{\cdot}91378\cdot n-0{\cdot}86191. \quad (3)$$

By multiplying this equation successively by the coefficients of d in the equations D, and adding these new equations to the corresponding ones of the system D, I obtained the equations E, independent of d, t, and i.

$$\left.\begin{array}{l} x(^1)=-59\cdot p-17\cdot n+195 \\ x(^2)=-52\cdot p-13\cdot n+61 \\ \&c.\ \&c. \end{array}\right\} \quad (E)$$

By adding these equations from the 29th to the 41st, and putting $x(^{29})+x(^{30})\ldots+x(^{41})=0$, I obtained this equation

$$0=580\cdot p-1164\cdot n+941,$$

and by dividing by 1164

$$0=0{\cdot}49828\cdot p-n+0{\cdot}80842. \quad (4)$$

This equation being multiplied successively by the coefficients of n in the equations E, and added to the corresponding ones of that system, produced the equations F.

$$
\left.\begin{aligned}
x(^{1}) &= -67\cdot p+181 \\
x(^{2}) &= -58\cdot p+\ \ 50 \\
x(^{3}) &= -51\cdot p+\ \ 36 \\
x(^{4}) &= -49\cdot p+\ \ 45 \\
&\text{\&c. \&c.}
\end{aligned}\right\} \qquad (F)
$$

These equations are of the same form as those given by La Place in vol. ii, pag. 135 of his "Mecanique Celeste," and the value of p, which will render the sum of the errors taken positively a *minimum*, may be found by the method explained in that part of his work. In the first place the coefficients of the term p must be rendered positive by changing the signs of all the terms of the equation when necessary. Then the equations must be arranged according to the magnitudes of the quotients found by dividing the constant term of each equation by the coefficient of p, due regard being had to the signs: That is, the equations must be arranged according to the magnitude of the terms $\frac{181}{-67}$, $\frac{50}{-58}$, $\frac{36}{-51}$, etc. In this manner I procured the system of equations G.

$-x(^{5}) = 1\cdot p-104$	$x(^{16}) = 75\cdot p-52$
$x(^{46}) = 8\cdot p-738$	$x(^{6}) = 12\cdot p-2$
$-x(^{49}) = 8\cdot p-370$	$-x(^{30}) = 56\cdot p+8$
$-x(^{51}) = 17\cdot p-683$	$-x(^{53}) = 19\cdot p+7$
$-x(^{50}) = 15\cdot p-510$	$x(^{41}) = 28\cdot p+14$
$x(^{47}) = 4\cdot p-134$	$x(^{38}) = 30\cdot p+17$
$x(^{35}) = 18\cdot p-227$	$x(^{39}) = 30\cdot p+44$
$-x(^{52}) = 21\cdot p-228$	$-x(^{31}) = 48\cdot p+78$
$x(^{43}) = 21\cdot p-223$	$x(^{37}) = 26\cdot p+51$
$-x(^{27}) = 101\cdot p-1050$	$-x(^{28}) = 241\cdot p+475$
$x(^{33}) = 10\cdot p-86$	$x(^{15}) = 83\cdot p+235$
$x(^{44}) = 15\cdot p-129$	$x(^{11}) = 35\cdot p+116$
$x(^{14}) = 73\cdot p-518$	$x(^{56}) = 21\cdot p+70$

$$
\begin{array}{ll}
x^{(31)} = 35 \cdot p - 244 & x^{(7)} = 14 \cdot p + 79 \\
x^{(12)} = 39 \cdot p - 258 & -x^{(26)} = 88 \cdot p + 522 \\
x^{(17)} = 80 \cdot p - 493 & -x^{(24)} = 42 \cdot p + 291 \\
x^{(8)} = 22 \cdot p - 105 & x^{(40)} = 29 \cdot p + 203 \\
x^{(13)} = 42 \cdot p - 148 & x^{(19)} = 68 \cdot p + 489 \\
-x^{(1)} = 67 \cdot p - 181 & -x^{(23)} = 29 \cdot p + 313 \\
x^{(9)} = 26 \cdot p - 68 & x^{(18)} = 73 \cdot p + 835 \\
x^{(20)} = 49 \cdot p - 103 & x^{(42)} = 26 \cdot p + 325 \\
x^{(34)} = 16 \cdot p - 32 & -x^{(48)} = 7 \cdot p + 102 \\
-x^{(32)} = 39 \cdot p - 75 & x^{(22)} = 22 \cdot p + 327 \\
-x^{(25)} = 55 \cdot p - 72 & -x^{(54)} = 17 \cdot p + 426 \\
x^{(36)} = 24 \cdot p - 25 & x^{(45)} = 16 \cdot p + 481 \\
x^{(10)} = 32\, p - 30 & -x^{(55)} = 14 \cdot p + 909 \\
-x^{(4)} = 49 \cdot p - 45 & \\
-x^{(2)} = 58 \cdot p - 50 & \\
-x^{(29)} = 66 \cdot p - 51 & \\
-x^{(3)} = 51 \cdot p - 36 &
\end{array}
\qquad (G)
$$

The sum of all the coefficients of p in these equations is 2211, which put $=$ F. The sum of the first thirty of the coefficients is 1062, which is less than $\frac{1}{2}$ F, and by adding the next coefficient the sum becomes 1137, which is greater than $\frac{1}{2}$ F, hence by the rule given by La Place the value of p, which will render the sum of the errors $x^{(1)}$, $x^{(2)}$, &c. taken positively a *minimum* will be found by putting the second member of the thirty first of the equations (G) equal to 0; that is, $75 \cdot p - 52 = 0$, which gives $p = 0{\cdot}693$. By substituting this value in the equations marked (4), (3), (2), (1), we successively obtain

$$n = 0{\cdot}49828 \cdot p + 0{\cdot}80842 = 1{\cdot}154.$$

$$d = 0{\cdot}58044 \cdot p + 0{\cdot}91378 \cdot n - 0{\cdot}86191 = 0{\cdot}595.$$

$$i = -0{\cdot}22944 \cdot d + 0{\cdot}15555 \cdot p + 0{\cdot}06885 \cdot n + 0{\cdot}30130 = 0{\cdot}352.$$

$$t = -0{\cdot}40480 \cdot d + 0{\cdot}47493 \cdot p + 0{\cdot}24398 \cdot n + 0{\cdot}55366 \cdot i - 0{\cdot}02703 = 0{\cdot}537.$$

These values being substituted in the preceding expressions of the elements of the orbit, they become

$D+0{\cdot}002 \cdot d = 0{\cdot}64969$
$T+0{\cdot}2 \cdot t =$ Sep. 18d. 6074
$P+10' \cdot p = 9s\ 1^\circ\ 0'\ 11''$
$N-10' \cdot n = 8\ 26\ 24\ 57$
$I-10' \cdot i = 63\ \ 9\ 42$

These would be the true elements depending on the principles laid down if the variations of the calculated geocentric longitudes and latitudes were strictly proportional to the variations of the elements $0{\cdot}002{\cdot}d$, $0{\cdot}2{\cdot}t$, &c. but as this is not the case, it was necessary to repeat in part the operation to make the calculations agree exactly with those principles. For this purpose I made use of the approximate values of the elements last found, instead of D, T, P, N, and I, and recalculated the values of l as in the first supposition, and thus obtained new values of the constant terms of the equations A, instead of +38, —88, etc. These new terms arranged in the order of the equations are 126, 0, —10, 1, 93, —12, 76, —108, —66, —28, 122, —248, —137, —490, 261, —25, —466, 860, 507, —102, —251, 316, —356, —346, 14, —607, 960, —643, 4, —48, —112, 46, —77, —20, —212, —11, 68, 35, 62, 224, 37, 346, —206, —114, 495, —727, —127, —101, 369, 510, 683, 224, —9, —426, —907, —115, and by substituting them in the equations A, and making the corresponding alterations in the constant terms of the equations B, C, D, etc. a new system of equations G was obtained, and by operating on them in the same manner as before I found that the value of p, which would render the sum of the errors $x^{(1)}$, $x^{(2)}$, &c. a minimum, would be had by putting $75{\cdot}p+2=0$, whence $p=-0{\cdot}027$, which, substituted in the equations (4), (3), (2), (1), deduced from these last calculations, will give $n=-0{\cdot}011$, $d=-0{\cdot}036$, $i=-0{\cdot}025$, $t=0{\cdot}0013$. Consequently the corrections of the last found elements are $0{\cdot}002{\cdot}d=-0{\cdot}00007$, $0{,}2{\cdot}t=$

0·00026, $10'\cdot p = -16''$, $-10'\cdot n = 6''$, $-10'\cdot i = 15''$. These corrections being applied to those elements produce the following

Correct elements of the orbit of the comet.

Perihelion distance 0·64962. The mean distance of the earth from the sun being denoted by unity.

Time of passing the perihelion September 18,60766, or Sep. 18d. 14h. 35′ 2″ mean time at Salem, corresponding to Sep. 18d. 19h. 18′ 34″ mean time at Greenwich.

Longitude of the Ascending Node	8s 26° 25′ 3″
Place of the Perihelion counted on the orbit of the comet	9 0 59 55
Inclination of the orbit to the ecliptic	63 9 57

Motion direct.

By these elements I calculated the geocentric longitudes and latitudes contained in the following Table.

Mean time of observation at Salem.	Observed longitude.	Calculated longitude.	Difference.		Observed latitude.	Calculated lat.	Difference.	
1807 d h ′ ″	s ° ′ ″	s ° ″	′ ″	′ ″	North.	North.	′ ″	′ ″
Sep. 26·6·32·33	7· 6· 8· 4	7· 6· 8· 3		—0· 1	12·22·13	12·23·27	+1·14	
Oct. 5·8·12·34	7·13·40·36	7·13·40·32		—0· 4	23·44·21	23·41·38		—2·43
8 6·59·22	7·16· 6·58	7·16· 4·41		—2·17	27· 6·45	27· 6·38		— 0· 7
9·6·47·11	7·16·53·36	7·16·53·25		—0·11	28·12·54	28·13·39	+0·45	
10·6·41·21	7.17·42·37	7·17·42·36		—0· 1	29·18·11	29·20 0	+1·49	
11·6·49·54	7·18·32·49	7·18·32·36		—0·13	30·26·52	30·26· 3		—0·49
19·7·25·16	7·25·33· 4	7·25·31·17		—1·47	38·35·58	38·37·15	+1·17	
21·7·15·40	7·27·23·24	7·27·23·21		—0· 3	40·29·18	40·29·38	+0·20	
22·6·54·40	7·28·21·45	7·28·20·14		—1·31	41·20·15	41·23·47	+3·32	
23 6·27·56	7·29·16·29	7·29 18· 2	+1·33		42·16·38	42·16·49	+0·11	
24·6·25·12	8· 0·17· 9	8· 0·17·59	+0·50		43·10·55	43· 9·47		—1· 8
25·7·14·15	8· 1·21·17	8· 1·21·29	+0·12		44· 4·15	44· 3·41		—0·34
26·6·36·35	8· 2·24·51	8· 2·22·32		—2·19	44·54·34	44·53·33		—1· 1
27·6·24· 5	8· 3 22·12	8· 3·26· 3	+3·51		45·47· 2	45·43·19		—3·43
28·6·36·22	8· 4·30·12	8· 4·32· 1	+1·59		46·33·36	46·33· 0		—0·36
		Sums.	+8·25	—8·22		Sums.	+7·54	—7·58
Nov. 6·8·11·31	8 15·36·15	8·15·44· 3	+7·48		53·19·52	53·14· 9		— 5·43
9·6·20·28	8·19·59·16	8·19·54·32		—4·44	55· 1·14	55· 4·44	+3·30	
10·6·27·37	8·21·24·46	8·21·24·47	+0· 1		55·38·29	55·40·27	+1·58	
11·6·21·16	8·22·49· 0	8·22·56·22	+7·22		56·22·46	56·14·36		— 8·10
14·6·28· 2	8·28· 0·23	8 27·45·38		—14·45	57·37·53	57·50· 5	+12·12	

16·6·11·11	9· 1·16·32	9· 1· 7·39	—8·53	58·44·29	58·46·42	+ 2·13
20 6·31· 2	9· 8·18·16	9· 8·19·31	+1·15	60·22·12	60·24· 0	+ 1·48
22·6·59·41	9·12· 4· 0	9·12· 7 44	+3·44	61·10· 0	61· 3·59	— 6· 1
23·8· 6· 5	9·14·14· 6	9·14· 8·23	—5·43	61·30·33	61·22·11	— 8·22
28·8·27·30	9·23·57 23	9·24· 2·53	+5·30	62·37·20	62·26· 7	—11·13
29·6·52·48	9·25·50 10	9·25·55·30	+5·20	62·37·18	62·33·45	— 3·33
30.7·24·27	9·27·59·27	9·27·58·47	—0·40	62·40·10	62·40·30	+ 0·20
Dec. 3·7·27· 0	10· 3·53·49	10· 4· 3·32	+ 9·43	62·45· 2	62·52·20	+ 7·18
4·7·13·45	10· 6·18·16	10· 6· 1·53	—16·23	62·37·41	62·53· 0	+15·19
17·6·26·30	10·29·31 47	10·29·42·16	+10·29	61·12·32	61·11· 4	— 1·28
		Sums.	59·37—59·30			52·32—52·28

The first observation in this table was made at Nantucket by Mr. W. Folger jun. the second at Cambridge by Professor Farrar and Mr. I. Nichols, the rest are those I made at Salem by a circle of reflection. The observed and calculated places of the comet in September and October agree in general as well as was to be expected. The disagreement in some of the observations in November and December arose in great measure from the difficulty of observing with a circle, when the comet was very faint, the moon near the full or the weather very damp.

The last time I saw the comet was on the 30th of January, 1808, at 8h. 49′ 10″ mean time at Salem. I estimated roughly its longitude to be about 0s. 15° 12′ and its latitude 47° 22′ N. The longitude calculated by the above elements was 0s. 15° 22′ and the latitude 47° 3′ N. The differences are within the limits of the errors of this ooservation.

I did not attempt to investigate the elliptical orbit of the comet; for I found that if its mean distance from the sun was sixty times as great as that of the earth, and the other elements the same as in the parabolic orbit, the differences between the heliocentric places, calculated in the elliptical and in the parabolic orbit, from September to the middle of November, rarely exceeded four minutes; so that it would have been in vain to have attempted to calculate the elliptical motion without observations made to a much greater degree of precision. It is possible that on this account the preceding elements may require some small corrections.

None of the elements of the orbits of the known comets, inserted by De La Lande and Vince in their systems of Astronomy, agree with the orbit of this comet. That seen in the year 1748 agrees more nearly than any one of them ; but there is so great a difference in the longitude of the node and in the inclination of the orbit, that there is not any probability of its being the same comet. We may therefore safely conclude that the comet, whose elements we have here calculated, is one, which was before unknown to Astronomers.

OBSERVATIONS

ON THE

TOTAL ECLIPSE OF THE SUN JUNE 16, 1806, MADE AT SALEM,

BY NATHANIEL BOWDITCH, A. M. et A. A. S.

THE chronometer made use of in observing this eclipse had been kept going for that purpose nearly seven months, during which time it moved with great regularity, losing about $1\frac{3}{4}$ second per day. Great pains were taken to regulate it on the day of the eclipse by corresponding altitudes of the sun observed in the morning and evening. These altitudes were taken by an excellent theodolite made by Jones, furnished with spirit levels to adjust it parallel to the horizon, and a quadrant of altitude graduated to minutes, to which was attached a telescope with cross wires, having a magnifying power of about twenty times. Five sets of altitudes of the sun were observed in the morning from 6h. 41m. 21s. to 7h. 23m. 38s. each set contained six observations of the lower, and six of the upper, limb. In the afternoon from 4h. 36m. 27s. to 5h. 20m. 47s. seven similar sets were observed. Before and after each set the index error of the quadrant was found by observing several times the difference between zero on the limb and on the nonius, when the spirit level attached to the telescope was horizontal, and taking the mean of the observations. By the mean of all these observations the time of apparent noon by the chronometer was found to be 12h. 2m. 10s.8, and as the mean time of apparent noon on that day was 12h. 0m. 6s.8, the chronometer was 2m. 4s. too fast for mean time at noon. The eclipse happened so near to noon, that it was thought unnecessary to apply a correction for the daily retardation of $1\frac{3}{4}$ seconds, as that correction did not exceed a sixth of a second.

On the day of the eclipse the weather was remarkably fine, scarcely a cloud being visible in any part of the heavens. I made preparations for the observation in the garden adjoining the house, in which I reside, near the northern part of Summer street, Salem. Having been disappointed in procuring a telescope of a large magnifying power, I was obliged to make use of that attached to my theodolite, which gave very distinct vision, though its magnifying power was small. An assistant was seated near me, who counted the seconds from the chronometer, and thus enabled me to mark down with a pencil the time when the first impression was made on the sun's limb, without taking my eye from the telescope till four or five seconds had elapsed, and the eclipse had sensibly increased ; after which I examined the second and minute hands of the chronometer and took every precaution to prevent mistakes. Four or five minutes before the commencement of the eclipse I began to observe that part of the sun's limb, where the first contact was expected to take place, and at 10h. 8′ 28″ by the chronometer I observed the first impression on the limb. In two seconds the indentation of the limb was quite perceptible. As the eclipse advanced there did not appear to be so great a diminution of the light as was generally expected, and it was not till the sun was nearly covered that the darkness was very sensible. A few minutes before this time I recommenced my observations with the telescope, and at 11h. 37′ 30″ by the chronometer the sun's surface was wholly covered. The last ray of light from the sun's limb disappeared so instantaneously, that it seemed as if there could not have been a mistake of a second in this phase. The whole of the moon was then seen surrounded by a luminous appearance of considerable extent, such as has generally been taken notice of in total eclipses of the sun. This light with a crepuscular brightness round the horizon prevented the darkness from being great during the time that the sun's surface was wholly covered. The degree of light can be estimated by the number of stars visible to the naked eye. Those I took notice of were *Capella*, *Aldebaran*, *Sirius*, *Procyon*, the three bright stars in the belt of Orion, and the star α in its shoulder. *Venus* and *Mars* were also visible. A candle had been provided to assist in reading off the seconds from the chronometer, but it was not found necessary in the garden, though it would have been in the house adjoining. As the time drew near for observing the end of the total darkness, I took notice that there was a visible increase of light in the atmosphere for about two seconds before any part of the sun's limb was visible in the telescope, but at 11h. 32m. 18s. by the chronometer the light burst forth with great splendor. This I noted as the time of the end of the total darkness. After this the light appeared to increase much faster than it had decreased, and in a short time it was as light as in a common cloudy day. The end of the eclipse, observed with the same precaution as the other phases, was found to be at 12h. 52m. 46s. by the chronometer.

If the times shown by the chronometer be corrected for its error —2′ 4″, we shall have the mean times of the observations as follow.

	Mean time.		
	h	*m*	*s*
Beginning of the eclipse	10	6	24
Beginning of total darkness	11	25	26
End of total darkness	11	30	14
End of the eclipse	12	50	42
Duration of the eclipse	2	44	18
Duration of total darkness		4	48

The latitude of the place of observation* was found to be 42° 33′ 30″ by the mean of three hundred and twenty altitudes of the sun, observed when within a few minutes of the meridian by a circle of reflection, on the 7th, 8th, 9th, 12th, 14th, 15th, and 17th of October 1805. This latitude, reduced on account of the spheroidical figure of the earth, supposing the difference between the equatorial and polar diameters to be $\frac{1}{310}$ part of the diameters† becomes 42° 22′ 4″ N. The longitude of the place of observation is about 59″ in time east from Cambridge University, according to an estimate founded on my trigonometrical observations from Salem to Boston Light-House; and on the observations of Hollond from that Light-House to Cambridge, as they are published in his chart of Boston and its vicinity. Hence, if we estimate the longitude of Cambridge to be 4h. 44m. 31s. west from Greenwich, agreeably to the calculations of the late President Willard in vol. i, of the Memoirs of the American Academy of Arts and Sciences, the longitude of the place of observation will be 4h. 43m. 32s. west from Greenwich, or 4h. 52m. 51s. west from Paris. This time being added to the times of observation at Salem gave the corresponding times at Paris, with which I calculated the following elements by the tables in the third edition of La Lande's astronomy, decreasing the moon's horizontal parallax four seconds to make it conform to the new tables of Burg.

* The place where this latitude was observed was in the garden adjoining Essex Bank in Market-street, Salem, about an eighth of a mile to the eastward of the place where the chronometer was regulated and the eclipse observed.

† This is conformable to La Lande's tables. La Place, in his "Mecanique Celeste," vol. ii, p. 150, calculated, from the observed lengths of pendulums in different latitudes, that the ellipticity was $\frac{1}{336}$; but in this calculation a small mistake was made in the coefficient of y, in the tenth of his equations A″, which ought to have been ·60340, instead of ·57624. This error being corrected the result is $\frac{1}{313}$, which does not differ much from $\frac{1}{303}$, calculated from two of the lunar equations, in volume iii, pages 282 and 285 of the same work. This last estimate agrees nearly with that made use of in the above calculations.

	Beginning of eclipse.	Beginning of total darkness.	End of total darkness.	End of the eclipse.
	s ° ′ ″	s ° ′ ″	s ° ′ ″	s ° ′ ″
☉'s long. from the apparent equinox	2·24·41· 2· 3	2·24·44·11· 0	2·24·44·22· 4	2·24·47·34· 6
☉'s horizontal parallax . .	8· 5	8· 5	8· 5	8· 5
☉'s semidiameter—Irradiation 3″,5	15·42· 5	15·42· 5	15·42· 5	15·42· 5
☉'s horary motion . .	2·23·15	2.23·15	2·23·15	2·23·15
Apparent obliquity of the ecliptic	23·27·50	23·27·50	23·27·50	23·27·50
☽'s long. from the apparent equinox	2·23·49·28· 8	2·24·37·47· 7	2·24·40·43· 8	2·25·29·58· 3
☽'s latitude north decreasing	24·34· 4	20· 6· 5	19·50· 3	15·17. 3
☽'s horizontal parallax for Salem	60· 9· 0	60·10· 4	60·10· 5	60·12· 0
☽'s semidiameter—Inflexion 2″	16·39· 7	16·41· 4	16·41· 4	16·41· 7
☽'s horary motion in longitude	36·39·92	36·41·77	36·41·89	36·43·72
☽'s horary motion in lat. southerly	3·23·21	3·23·62	3·23·62	3·23·95
☽'s horary motion from the ☉ in long.	34·16·77	34·18·62	34·18·74	34·20·57
☽'s parallax—☉'s parallax .	60· 0· 5	60· 1· 9	60· 2· 0	60· 3· 5
Parallax in longitude (☽—☉)	+19·44· 2	+ 5·53· 1	+ 5· 0· 0	— 9·57· 9
Parrallax in latitude (☽—☉)	—22·27· 9	—20· 0· 2	—19·55· 1	—19·39· 5

Now if the latitude of the moon by the tables be supposed to be correct, the mean time of the ecliptic conjunction at Salem will be 11h. 37′ 20″·3 by the mean of all the observations. This will be increased only 0″·4, by decreasing the latitude 6″·9, which appears to be necessary from the observations at Rutland, Pawlet, &c. as given by Doctor Williams and others.

I shall continue this subject in another memoir.

ADDITION

TO THE

MEMOIR ON THE SOLAR ECLIPSE OF JUNE 16, 1806,

By NATHANIEL BOWDITCH, A.M. et A.A.S.

SINCE the communication of my observations of the solar eclipse of June 16, 1806, I have endeavored to procure the observations made in New-England on the northern and southern limits of the total darkness in order to deduce from them the true latitude of the moon at the time of the ecliptic conjunction of the Sun and Moon. The only observations I have yet been able to obtain are those made at Pawlet in Vermont, on the northern limit of the shadow, and at Tarpaulin-Cove, Nashewena, Martha's Vineyard, and Falmouth on the southern limit.

The observations at Pawlet were made by Captain Potter and published a few days after by Doctor Williams. At the time of the greatest obscuration Captain Potter observed "that the light of the Sun "instantly ceased for a moment or second of time, and as instantane-"ously appeared." The place where this observation was made is about 40 rods south of the northern boundary of Pawlet, in the latitude of about 43° 24′ N, (or 43° 12′ 33″ reduced to the centre) and in the longitude of from 50″ to 66″ in time west of the place in Rutland, where Doctor Williams observed the eclipse; this place by his observations is in the longitude of 4h. 51′ 53″ W from Greenwich, as will be shown in the course of this memoir, therefore Pawlet is nearly in the longitude of 4h. 52′ 51″ W from Greenwich. With this latitude and longitude and making use of the elements in the former part of this memoir as found in the tables of the third edition of La Lande's

Astronomy, supposing the error of the lunar tables to be in longitude —25″·5, and in latitude —6″·8,* I found the *mean* time of the least apparent distance of the centres of the sun and moon at Pawlet was at 11h. 14′ 4″ The ☽'s parallax —☉'s parallax, in longitude was then +7′ 53″·86, in latitude —21′ 4″·72; the moon's apparent semidiameter 16′ 41″·18; the sun's semidiameter 15′ 42″·5, being the same during the whole of the eclipse. In estimating the semidiameters I supposed the irradiation to decrease the sun's semidiameter 3½″, and the inflexion to decrease the moon's semidiameter 2″; these being the numbers made use of by La Lande in his Tables. The error that might arise in calculating the moon's latitude at the ecliptic conjunction, from an error in the estimated values of the semidiameters of the sun and moon, will in general be obviated by taking the mean of an equal number of observations on the northern and southern limits of the total darkness; and the error that might arise in the calculated time of the ecliptic conjunction will be nearly obviated, by taking the mean of the times deduced from the beginning and end of the eclipse, or from the beginning and end of the total darkness. From the preceding data I found that the least distance of the centres of the sun and moon according to the tables thus corrected was 58″·28, and the difference of their semidiameters 58″·68. The difference of these numbers 0″·4, is nearly the additional correction to be applied to the latitude, making the whole correction —7″·2. This is the only northern observation I could procure.

In a communication made to me by Mr. D. Leslie of New-Bedford, he remarks that the Eclipse was observed to be total at Tarpaulin-Cove, "the duration being at least one minute," and at the north-

* These numbers were obtained by a first approximation, and they will be found to agree nearly with the true values given in this memoir.

east part of the Island of Nashewena five miles W S W from Tarpaulin-Cove, "the Eclipse was not total but the lucid part was very "small and of a circular form and appeared very much agitated; "suddenly changing its place round the south limb of the moon." By comparing the latitudes and longitudes of these places as given by Mr. Leslie with those marked on two well executed and apparently accurate charts of the Elizabeth Islands &c. surveyed by Hollond, it appears that the latitude of Tarpaulin-Cove is 41° 28′ 25″ N, which, reduced to the centre, is 41° 17′ 2″, and the longitude 4h. 42′ 59″ W from Greenwich; and that the NE part of Nashewena is in the latitude of 41° 26′ 43″ N (reduced 41° 15′ 20″), and the longitude 4h. 43′ 22″ W from Greenwich. Hence I found by a calculation similar to that made with the Pawlet observation, that the *mean* time of the least apparent distance of the centres of the sun and moon at Tarpaulin-Cove was 11h. 28′ 32″. The ☽'s parallax—☉'s parallax, in longitude +5′ 26″·93, in latitude—18′ 51″. 75, and the moon's apparent semidiameter 16′ 41″·52. The apparent motion of the moon from the sun in half a minute of time 11″·58. The apparent difference of the semidiameters of the sun and moon 59″·02. Hence, if the duration of the total darkness at Tarpaulin-Cove be supposed exactly one minute, the least distance of the centres resulting would be $\overline{\overline{59\cdot02}|^2-\overline{11\cdot58}|^2}|^{\frac{1}{2}}=57''\cdot87$. The distance at that time by the tables corrected as before (in the longitude of the moon —25″·5 and in the latitude —6″·8) was 59″·58. The difference between this and 57″·87 is 1″·7, which is nearly the additional correction to be applied to the latitude of the moon; making the whole correction —8″·5. This result would be but little affected by a few seconds error in the duration of total darkness. For if we suppose the eclipse to have been just total, the least distance, instead of being 57″·87, would be 59″·02, and the correction of the latitude would be varied by the difference of the two numbers ; that is, by 1″·15. So that this error of 60″ in the duration would only cause an error of 1″·15 in the latitude. By a similar calculation the *mean* time of the least apparent distance of the centres of the sun and moon at Nashewena was 11h. 27′ 57. The ☽'s parallax—☉'s parallax, in longitude +5′ 34″·01, in latitude—18′ 50″·68, the moon's apparent semidiameter 16′ 41″·51. Hence the least apparent distance of the centres of the sun and moon by the tables corrected as above was 61″·34, the apparent difference of the semidiameters was 59″·01 ; the difference, 2″·3, being added to 6″·8, gives nearly the limit of the correction of latitude —9″·1. That is, the correction to be subtracted from the latitude given by the tables must be less than 9″·1, because the eclipse did not appear to be total. This observation confirms in a degree the result obtained from the observation at Tarpaulin-Cove; namely,—8″·5.

Mr. Leslie also informed me that the eclipse was observed at Martha's Vineyard by several persons on the point called West-Chop, about half a mile from the extremity of the point, at which place the total darkness continued about a minute; and at the distance of a mile and a quarter south of this place the eclipse was not total. By the above charts the latitude of the former point is 41° 28′ 10″ N (reduced 41° 16′ 47″); the latter 41° 26′ 55″ N (reduced 41° 15′ 32″); and the longitude 4h. 42m. 16s. W from Greenwich. From these data I found, by calculations similar to the foregoing, that the mean time of the least apparent distance of the sun and moon was at 11h. 29m. 37s; and at the first place the ☽'s parallax—☉'s parallax in longitude was +5′ 14″·32, in latitude —18′ 50″.31; the moon's apparent semidiameter 16′ 41″·54, the apparent motion of the moon from the sun in half a minute of time 11″·58, and the apparent difference of the semidiameters of the sun and moon 59″·04. Hence, if the duration of total darkness was one minute, the least distance of the centres of the sun and moon would be $\sqrt{\overline{59{\cdot}04}|^2 - \overline{11{\cdot}58}|^2} = 57''{\cdot}89$. The distance at that time by the tables, corrected in longitude and latitude as in the above calculations, was 59″·79. The difference between this and 57″·89 is 1″·9, which is nearly the additional correction to be applied to the latitude of the moon, making the whole correction —8″·7. At the southern place of observation the ☽'s parallax—☉'s parallax in longitude was +5′ 14″·49, in latitude —18′ 49″·10, and the moon's apparent semidiameter 16′ 41″·54. Hence the least apparent distance of the centres of the sun and moon, by the tables, corrected as above, was 61″·0. The apparent difference of their semidiameters was 59″·04. The difference of these numbers, 1″·96, being added to 6″·8 gives nearly the limit of the error of the tabular latitude —8″·76 ; that is, the correction to be subtracted from the latitude given by the tables must be less than 8″·76, because the eclipse was not total. This agrees with the northern observation just calculated, which made the correction —8″·7. This quantity will be taken for the tabular correction deduced from the observations at the Vineyard.

From the observations made at Falmouth and communicated to President Webber by Mr. Elisha Clap, it appears that the south limit of the shadow at Wood's Hole was at the sea shore in the latitude of 41° 33′, or 41° 33′ 30″. By comparing the situation of this place on Mr. Clap's chart with the abovementioned charts of the Elizabeth Islands, I am induced to believe that the latitude of this point is 41° 33′ N (reduced 41° 21′ 37″), and the longitude 4h. 42′ 20″ W from Greenwich. Hence I find that the *mean* time of the least apparent distance of the sun and moon was 11h. 29′ 32″. The ☽'s parallax—☉'s parallax, in longitude +5′ 14″·80, in latitude —18′ 55″·30, and the moon's apparent semidiameter 16′ 41″·52. From which it follows that the correction of the moon's latitude is by this observation —2″·7. The mean of this and of the results obtained from the observations at Tarpaulin-Cove and Martha's Vineyard is —6″·6, which may be assumed as the error in latitude deduced from the observations at the southern limit of the shadow.

The eclipse was not total at Nantucket in the latitude of 41° 15′ 32″ N and in the longitude of 4h. 40′ 0″ W from Greenwich, as was observed by Mr. Walter Folger jun. The only deduction I have made from this observation is, that the error in the tabular latitude was less than 20″.

By taking the mean of the error in latitude determined at the northern limit, namely —7″·2, and that at the southern limit —6″·6, we have the error of the tables in latitude as determined by the mean of all the observations —6″·9. The quantity thus determined is (as was before observed) independent of any error in the estimated values of the semidiameters of the sun and moon. Now in the former part of this memoir it was shown that at 11h. 30′ 14″ mean time at Salem, the moon's latitude by the tables was 19′ 50″·3 N, and the horary decrease of latitude corresponding to the middle time between 11h. 30′ 14″ and the conjunction, 11h. 37′ 20″·7, was 3′ 23″·63. Hence at the time of the conjunction the latitude by the tables was 19′ 26″·2, and as the correction obtained above was —6″·9, the true latitude at the time of the ecliptic conjunction was by these observations 19′ 19″·3. This latitude will be made use of in the rest of this memoir, in calculating several observations made in this country.

OBSERVATIONS AT SALEM.

FROM the calculations before made on the observations at Salem

	Mean time.
we may easily deduce from the observed beginning and end of the eclipse, that the ecliptic conjunction was at - - - - - - -	11h. 37′ 19″·2
And by the beginning and end of total darkness	11 37 22·1
The mean time of the four observations gives the ecliptic conjunction at Salem - -	11 37 20·7

In making the preceding calculations it was supposed that Salem was in the longitude of 4h. 43′ 32″ W from Greenwich. Hence it would follow that the ecliptic conjunction at Greenwich was at 4h. 20′ 52″.7 mean time, or 4h. 20″ 45″·9 apparent time; and as Paris is 9′ 18″·8 east of Greenwich, the ecliptic conjunction at Paris would be at 4h. 30′ 11″·5 mean time, or 4h. 30′ 4″·7 apparent time. These times may be liable to an error of 4″ or 5″ from the uncertainty in the longitude of Cambridge, from which that of Salem is deduced.

It was found in the former part of these calculations that at 11h. 30′ 14″ *mean* time at Salem, the longitude of the sun, as given by the tables in the third edition of La Lande's astronomy, was 2s. 24° 44′ 22″·4, the longitude of the moon 2s. 24° 40′ 43″·8,* the sun's horary motion 2′ 23″·15, the moon's horary motion in longitude, corresponding to the middle time between 11h. 30′ 14″ and the ecliptic conjunction, 36′ 41″·97. Hence at the conjunction the tabular longitude of the sun was 2s. 24° 44′ 39″·4, and that of the moon 2s. 24° 45′ 4″·8; so that, if the solar tables were correct, the moon's tabular longitude was too great by 25″·4. If we suppose an error of l seconds of time in the longitude of Salem, making the true longitude equal to 4h. 52′ 51″$+l$ west from Paris, the error of the moon's longitude will be —25″·4—0″·57·l.

OBSERVATIONS AT RUTLAND.

THE observations at Rutland were made by Dr. Samuel Williams, who observed the beginning of the eclipse at 9h. 55′ 12″ apparent time, and the end at 12h. 37′ 51″† apparent time. The eclipse was not total,

* In calculating this longitude allowance was made for the error 0″·7, mentioned in the first page of the explanation of those tables.

† In some of the public papers this was printed by mistake 12h. 32′ 51″. I wrote to Doctor Williams on this subject, and he informed me that in the Rutland Gazette of June 21, 1806, where he published the observations, the time was very distinctly printed 12h. 37′ 51″.

" but at 11h. 11′ 47″ apparent time the sun's limb appeared to be re-
" duced to a small circular thread, or rather like a very fine horn, the
" upper end of which broke into a drop and instantly disappeared.
" The lucid part of the sun evidently decreased till 11h. 16′ 52″. The
" position of the lucid part at that time seemed to change suddenly to
" the east, and in a few minutes appeared on that part of the sun, where
" the eclipse began, and the light instantly increased before there was
" any appearance to the eye of an increase of the lucid part." The latitude of the place of observation was 43° 36′ N (reduced 43° 24′ 32″ N). The longitude made use of in calculating the parallaxes was 4h. 52′ 32″ W from Greenwich. The moon's parallax *minus* the sun's parallax at the beginning of the eclipse was, in longitude +21′ 10″·2, in latitude —23′ 57″·2 ; and at the end of the eclipse was in longitude —7′ 27″·2, and in latitude —20′ 36″·4. The moon's semidiameter at the beginning was 16′ 39″·3, at the end 16′ 41″·7. Hence the mean time of the ecliptic conjunction at Rutland was 11h. 28′ 59″·7. This, subtracted from the mean time of the conjunction at Salem, 11h. 37′ 20″·7, leaves the longitude of Rutland 8′ 21″ W from Salem, or 4h. 51′ 53″ W from Greenwich.

It appears by calculation that the least apparent distance of the centres of the sun and moon at Rutland was at 11h. 15′ 36″ mean time, and that the eclipse would have been total if the error of the tables of the moon's latitude at the time of the conjunction had been +4″·5, instead —6″·9, found by the other observations.

The observations made at Albany, Kinderhook, Philadelphia, Lancaster, and Natches, were communicated by Mr. Ferrer to President Webber, who politely furnished me with a copy, from which I have deduced the longitudes of those places, as in the following calculations.

OBSERVATIONS AT ALBANY BY MR. S. DE WITT.

LATITUDE of place 42° 38′ 39″ N, reduced 42° 27′ 13″ N. Longitude made use of in calculating the parallaxes 4h. 55′ 4″·7 W from Greenwich.

	Mean time.	☽'s semidia.	☽'s par.—☉'s par. in long.	in lat.
	h ′ ″	′ ″	′ ″	′ ″
Beginning of total darkness	11· 8·12·6	16·41·2	+9· 7.3	—20·28·1
End of total darkness	11·13· 3·6	16·41·2	+8·14·5	—20·21·3

Hence the mean time of the ecliptic conjunction was	11h.	25′	51″·	1
This, subtracted from the time of the conjunction at Salem,	11	37	20	7
Leaves the longitude of Albany W from Salem		11	29	6
. . . . or W from Greenwich	4	55	1	6

OBSERVATIONS AT KINDERHOOK, NEW YORK.

LATITUDE of Kinderhook 42° 23′ 3″ N, reduced 42° 11′ 37″ N. Longitude made use of in calculating the parallaxes 4h. 55′ 13″ W from Greenwich.

	Mean time.	☽'s S. D.	☽'s par.—☉'s par. in long.	in lat.
	h. ′ ″	′ ″	′ ″	′ ″
Beginning of the eclipse	9·49·37	16·39·2	+22·34·9	—23· 4·6
Beginning of total darkness	11· 8· 2	16·41·2	+ 9·12·5	—20·12·9
End of total darkness	11·12·39	16·41·2	+ 8·22·0	—20· 6·4
End of the eclipse	0·33·45	16·41·8	— 6·44·6	—19·22·1

	Mean time.			
Hence the ecliptic conjunction by the external contacts was at	11h.	25′	42″·	0
. . . . internal contacts	11	25	42	3
The mean of all four observations gives the eclipt. conj. at	11	25	42	1
This, subtracted from the time of the conjunction at Salem,	11	37	20	7
Leaves the longitude of Kinderhook W from Salem		11	38	6
. . . . or W from Greenwich	4	55	10	6

OBSERVATIONS AT PHILADELPHIA, BY MR. PATTERSON.

LATITUDE of Philadelphia 39° 57′ 2″ N, reduced 39° 45′ 44″ N. Longitude made use of in calculating the parallaxes 5h. 0′ 37″ W from Greenwich.

	Mean time.	☽'s S. D.	☽'s par.—☉'s par. in long.	in lat.
	h. ′ ″	′ ″	′ ″	′ ″
Beginning of the eclipse	9·40· 5	16·39·1	+25· 9·6	—21·15·2
End of the eclipse	0·26·14	16·42·1	— 5·22·7	—16·52·8

	Mean time.
Hence the ecliptic conjunction was at . . .	11h. 20′ 17″.0
This, subtracted from the time of the conj. at Salem,	11 37 20 7
Leaves the longitude of Philadelphia W from Salem .	17 3 7
. . . . or W from Greenwich	5 0 35 7

OBSERVATIONS AT LANCASTER, PENNSYLVANIA, BY MR. A. ELLICOTT.

LATITUDE of Lancaster 40° 2′ 36″ N, reduced 39° 51′ 18″ N. Longitude made use of in calculating the parallaxes 5h. 5′ 23″ W from Greenwich.

	Mean time.	☽'s S.D.	☽'s par.—☉'s par. in long.	in lat.
	h ′ ″	′ ″	′ ″	′ ″
Beginning of the Eclipse.	9·53·14	16·38·9	+26·13·7	—21·42·6
End of the Eclipse.	0·19· 2	16·42·1	— 3·55·8	—16·58·4

	Mean time.
Hence the ecliptic conjunction was at	11h. 15′ 29″ 2
This subtracted from the time of the conjunction at Salem	11 37 20 7
Gives the longitude of Lancaster W from Salem	21 51 5
. . . . or W from Greenwich	5 5 23 5

OBSERVATIONS AT NATCHES, BY MR. W. DUNBAR.

LATITUDE of Natches 31° 27′ 48″ N, reduced 31° 17′ 36″ N. Longitude made use of in calculating the parallaxes 6h. 5′ 31″ W from Greenwich.

	Mean time.	☽'s S. D.	☽'s par.—☉'s par. in long.	in lat.
	h ′ ″	′ ″	′ ″	′ ″
Beginning of the Eclipse	8· 5·24	16·35·1	+42·43·4	—19·44·0
End of the Eclipse	10·38·55	16·41·6	+17·56·5	—10. 7·7

	Mean time.
Hence the ecliptic conjunction was at	10h. 15′ 20″·4
This subtracted from the time of conjunction at Salem	11 37 20 7
Gives the longitude of Natches W from Salem	1 22 0 3
. . . . or W from Greenwich	6 5 32 3

The observatory of Mr. Dunbar is 9″ east from the Castle of Natches. Hence the longitude of that Castle is 6 5 41 3

I have not yet been able to obtain any European observations of the Eclipse, to compare with those made in this country.

APPLICATION

OF NAPIER'S RULES FOR SOLVING THE CASES OF RIGHT-ANGLED SPHERIC TRIGONOMETRY TO SEVERAL CASES OF OBLIQUE-ANGLED SPHERIC TRIGONOMETRY.

BY NATHANIEL BOWDITCH, A. M. et A. A. S.

BY the celebrated rules of Lord Napier the whole of Right-Angled Spheric Trigonometry is reduced to two simple analogies or equations, which, being very easy to be remembered, are much made use of by mathematicians. The object of the present memoir is to point out a small alteration in the expression of those rules, so that they may include the solutions of most of the cases of Oblique-Angled Spheric Trigonometry in a more simple manner than in their original form.

In every Right-Angled Spheric Triangle there are five circular parts ; namely, the two legs, the complement of the hypotenuse, and the complements of the two oblique angles, which are named *adjacent* or *opposite*, according to their positions with respect to each other. The right angle is not included as one of the circular parts, neither is it supposed to separate the legs. In all cases of Right-Angled Spheric Trigonometry two of these parts are given to find a third. *If the three parts join, that, which is in the middle, is called the middle part : if they do not join, two of them must, and the other part, which is separate, is called the middle part, and the other two, opposite parts, as in Fig.* 1, 2. Then, putting the radius equal to unity, the equations given by Napier will become

Sine of middle part = Rectangle of the tangents of the adjacent parts.
= Rectangle of the cosines of the opposite parts.

The method of applying these solutions to the various cases of Right-Angled Spheric Trigonometry is very simple, and is explained in several treatises of Trigonometry.

To apply this method to Oblique-Angled Spheric Trigonometry it is necessary to divide the triangle into two right-angled spheric triangles by means of a perpendicular AP (Fig. 3) let fall from the point A upon the opposite side BC : *the perpendicular being so chosen as to make two of the given things fall in one of the right-angled triangles.** Each triangle thus formed contains, as above, five circular parts, the perpendicular being counted and bearing the same name in each of them: consequently the parts of each triangle similarly situated with respect to the perpendicular must have the same name. In every case of Oblique-Angled Spheric Trigonometry there are three parts given to find a fourth, and in most of the cases there are two of these parts in each of the triangles ACP, ABP, similarly situated with respect to each other. To each of these must be joined the perpendicular AP, and there will be three parts in each triangle, which are to be named *middle*, *adjacent*, or *opposite*, according to the above directions. Then the equations for solving all the cases of Right-Angled, and most of the cases of Oblique-Angled Spheric Trigonometry† are

$$\text{Sine middle part} \begin{cases} = \\ \propto \end{cases} \begin{cases} \text{Tangents of the adjacent parts.} \\ \text{Cosines of the opposite parts.} \end{cases}$$

These equations, when applied to Right-Angled Spheric Triangles,

* Or in other words the perpendicular ought to be let fall from the end of a given side and opposite to a given angle. When this can be done in two different ways, that one is to be rejected, which makes the perpendicular a middle part. Thus in Example 3 the perpendicular ought not to be let fall from the point B.

† The cases excepted are where three sides or three angles are given ; or where the question relates to two angles and their opposite sides. It may be proper to observe, that it will be of considerable assistance in remembering the above rules to take notice of the circumstance, that the second letters of the words *tangent* and *cosine* are the same as the first letters of *adjacent* and *opposite*.

signify, as before, that the sine of the middle part is equal to the rectangle of the tangents of the adjacent parts, or to the rectangle of the cosines of the opposite parts ; but when applied to an Oblique-Angled Triangle, they signify, that the sines of the middle parts are respectively proportional to the tangents of the adjacent parts, or to the cosines of the opposite parts of the same triangle ; observing, that the perpendicular being common to both triangles APB, APC, and having the same name in each of them cannot be made use of in the analogies, and must not therefore be counted as a middle part. This circumstance can produce no embarrassment, because all the cases in Oblique Spheric Trigonometry may be solved without calculating the length of the perpendicular.

These rules for solving the cases of Oblique Spheric Trigonometry are easily deduced from those given by Lord Napier. For if we put M for the middle part, A for the adjacent part, and B for the opposite part of the triangle APC (Fig. 3, 4, or 5), m, a, b, for the corresponding parts of the triangle APB, and P for the perpendicular AP. Then, if P is an adjacent part, we shall have by Napier's rules, tang. P$=\frac{\text{sine M}}{\text{tang. A}}$, and tang. P$=\frac{\text{Sine } m}{\text{tang. } a}$, hence $\frac{\text{Sine M}}{\text{tang. A}}=\frac{\text{Sine } m}{\text{tang. } a}$, consequently Sine M : tang. A :: sine m : tang. a ; and if P is an opposite part, we shall have, cos. P$=\frac{\text{Sine M}}{\text{Cos. B}}$, and cos. P$=\frac{\text{sine } m}{\text{cos. } b}$. Hence $\frac{\text{sine M}}{\text{cos. B}}=\frac{\text{sine } m}{\text{cos. } b}$, consequently sine M : cos. B :: sine m : cos. b. Which are the two propositions to be demonstrated.

To illustrate these rules the following examples are given.

EXAMPLE 1.

Given AB, AC, and the angle C, to find BC, Fig. 3.

In the right-angled triangle ACP we have AC and C ; whence we may find PC by the rule, sine of middle part = tangents adjacent parts, which gives (as in Fig. 2) sine (co. C) = tang. PC × tang. (co. AC), whence tang. PC = cos. C × tang. AC. Then in the triangles ABP, APC, we have AB, AC and PC to find BP, and if to these we join the perpendicular AP, we shall find, in the triangle APC, that the complement of AC is the middle part and PC an opposite part. The triangle ABP is to be marked in a similar manner. Then the rule, Sine middle part ∝ cosines of the opposite parts, gives Sine (co. AC) : cos. PC : : sine (co. AB) : cos. BP. Having found BP we have BC = BP $\underset{s}{+}$ PC.

EXAMPLE 2.

Given BC, AC, and the angle C, to find AB. Fig. 3.

As in the last example we find PC, thence BP = BC $\underset{s}{+}$ PC. Then in the triangles APC, ABP we have AC, PC and PB to find AB, which requires that the triangles should be marked as in the last example, and the rule

Sine middle part ∝ cosines of opposite parts, gives sine (co. AC) : cos. PC : : sine (co. AB) : cos. BP, whence we obtain cos. PC : cos. AC : : cos. BP : cos. AB.

EXAMPLE. 3.

Given AC, BC and the angle C to find the angle B. Fig. 4.

Find PC, PB, as in the preceding example, then the rule, sine middle part ∝ tangents of adjacent parts gives sine PC : tang. (co. C) : : sine BP : tang. (co. B).

EXAMPLE 4.

Given the angles A and C and the side AC to find AB. Fig. 5.

In the right angled triangle ACP we have AC and the angle C, whence we may find the angle PAC by the rule, Sine middle part = tangents adjacent parts, which gives, (as in fig. 1.) Sine (co. AC)

= tang. (co. C) $\times$ tang. (co. PAC), or cotang. PAC = cos. AC $\times$ tang. C, whence we have BAP = BAC $\pm$ PAC. Then in the triangles ABP, APC we have the angles PAC, BAP, and the side AC, to find AB; and if to these we join the perpendicular AP we shall find, in the triangle APC, that the complement of the angle PAC is the middle part and the complement of AC is an adjacent part; and the triangle APB is to be marked in a similar manner. Whence the rule, Sine middle part $\propto$ tangents adjacent parts, gives sine (co. PAC) : tang. (co. AC) : : sine (co. PAB) : tang. (co. AB).

In the same manner we may proceed with any other examples; taking care always to exclude the perpendicular from the analogies.

This method embraces all the cases of Spheric Trigonometry excepting two; namely, where the question is between two sides and the opposite angles of an oblique angled triangle, or where three sides are given to find an angle. The first of these may be solved by the noted rule, that the sine of a side is proportional to the sine of its opposite angle. Thus if AB, AC, and B were given to find C, we should have sine AC : sine B :: sine AB : sine C. The case where three sides are given includes that where three angles are given, by taking the supplementary triangle. The usual rule for finding one of the angles as B, when the three sides AB, AC, BC are given, is by putting $s = \frac{1}{2}$ (AB + AC + BC) then

$$\text{Log. cos.} \tfrac{1}{2} B = \tfrac{1}{2} \times \left\{ \text{log. sine } s + \text{log. sine } \overline{s - AC} + \text{log. cosec. AB} + \text{log. cosec. BC} \right\}$$

Both these excepted cases occur so frequently in practice that it becomes quite easy to remember the rules for solving them, and if to these we join the rules of Napier, altered in the manner we have here suggested, it will be very easy to remember all the rules necessary for solving the various cases of right-angled and oblique-angled Spheric Trigonometry.

TWO TABLES

OF THE VARIETIES IN THE FIRST AND SECOND CASES OF OBLIQUE SPHERICS.

By WILLIAM CROSWELL, A. M.

Inclosed with a letter to the Honorable John Davis, Esq.

I. A TABLE

Of the varieties in the first case of oblique spherics, in which are given two sides, and an angle opposite to one of those sides.

N	Given∠	Giv.sid.	Side adjacent to given angle	∠op.adj.s	Perpr. falls
1	acute	acute	equal to opposite side	acute	within
2	acute	acute	less than opposite side	acute	within
3	acute	acute	greater than opposite side	uncertain	uncertain
4	acute	obtuse	greater than opposite side	obtues	without
5	acute	mixed	acute less than supplement opp. side	acute	within
6	acute	mixed	obtuse equal to supp. opposite side	obtuse	without
7	acute	mixed	obtuse less than supp. opp. side	uncertain	uncertain
8	acute	mixed	obtuse greater than supp. opp. side	obtuse	without
9	obtuse	acute	less than opposite side	acute	without
10	obtuse	obtuse	less than opposite side	uncertain	uncertain
11	obtuse	obtuse	equal to opposite side	obtuse	within
12	obtuse	obtuse	greater than opposite side	obtuse	within
13	obtuse	mixed	obtuse greater than supp. opp. side	obtuse	within
14	obtuse	mixed	acute equal to supp. opposite side	acute	without
15	obtuse	mixed	acute less than supp. opposite side	acute	without
16	obtuse	mixed	acute greater than supp. opp. side	uncertain	uncertain

It appears above that only four varieties in this case are ambiguous.

Let the sides be 114° 30′ and 56° 40′, and let the angle opposite to 114° 30′ be 125° 20′. The angle opposite to 56° 40′ is found by calculation to be 48° 31′, or 131° 29′.

Robertson, from whom this example is taken, observes, that the affection must be determined by construction.

This example belongs to the 15th variety in the Table, whence the angle concerned is found to be acute ; and the affections of the other required parts are determined.

In constructing the ambiguous varieties, two triangles are produced, equally agreeing with the example ; and the uncertainty continues.

II. A TABLE

OF THE VARIETIES IN THE SECOND CASE OF OBLIQUE SPHERICS, IN WHICH ARE GIVEN TWO ANGLES, AND A SIDE OPPOSITE TO ONE OF THOSE ANGLES.

N	Given sid.	Given ∠	Angle adjacent to given side	sid.op. adj. ∠	Perpr. falls	Angle m	Arc M	Angle n	Arc N
1	acute	acute	equal to opposite angle	acute	within	acute	acute	acute	acute
2	acute	acute	less than opposite angle	acute	within	acute	acute	acute	acute
3	acute	acute	greater than opposite angle	uncer.	within	acute	acute	uncer.	uncer.
4	acute	obtuse	greater than opposite angle	obtuse	within	obtuse	obtuse	acute	acute
5	acute	mixed	acute less than supp. opp. ∠	acute	without	acute	acute	acute	acute
6	acute	mixed	obtuse equal to supp. opp. ∠	obtuse	without	obtuse	obtuse	acute	acute
7	acute	mixed	obtuse less than supp. opp. ∠	uncer.	without	obtuse	obtuse	uncer.	uncer.
8	acute	mixed	obtuse greater than supp. opp. ∠	obtuse	without	obtuse	obtuse	acute	acute
9	obtuse	acute	less than opposite angle	acute	within	obtuse	obtuse	acute	acute
10	obtuse	obtuse	equal to opposite angle	obtuse	within	acute	acute	acute	acute
11	obtuse	obtuse	less than opposite angle	uncer.	within	acute	acute	uncer.	uncer.
12	obtuse	obtuse	greater than opposite angle	obtuse	within	acute	acute	acute	acute
13	obtuse	mixed	acute equal to supp. opp. ∠	acute	without	obtuse	obtuse	acute	acute
14	obtuse	mixed	acute less than supp. opp. ∠	acute	without	obtuse	obtuse	acute	acute
15	obtuse	mixed	acute greater than supp. opp. ∠	uncer.	without	obtuse	obtuse	uncer.	uncer.
16	obtuse	mixed	obtuse greater than supp. opp. ∠	obtuse	without	acute	acute	acute	acute

Let the angles be 48° 31′ and 125° 20′, and the side opposite to 125° 20′ be 114° 30′. The side opposite to 48° 31′ is found by calculation to be 56° 41′ or 123° 19′.

This example belongs to the 14th variety in this Table, whence the side concerned is acute; the angle *n* and arc N are also acute, and thus the true values of the other required parts are found.

These Tables supersede projection. They might be contracted, or reduced to one; but without advantage. They are probably correct, as every variety was determined (if memory fails not) by six constructions.

REMARKS

ON THE CONSTRUCTION OF THE COMMON SCALE-BEAM, WITH A DESCRIPTION OF THE NEW GOLD STANDARD BEAM, INVENTED BY THE AUTHOR,

Mr. BENJAMIN DEARBORN.

THE common Scale-Beam has a *fixed* centre of gravity at some distance below the centre of motion ; by this construction the beam is drawn to a level or horizontal position ; the power, by which it is thus influenced, is invariable, and is proportioned to the weight of the beam and the distance of the two centres abovementioned.

DEMONSTRATION.

Fig. 1 represents the central part of a scale-beam, constructed as usual, with the centre of motion at *a*, and the centre of gravity at or near *b*, considerably below *a*. If the two arms of the beam be equal in weight, the power of gravity will draw the centre *b*, directly under the centre *a*, in the line *c d*. To turn the beam *out* of a level position, a power must be applied superior to that, which draws it *into* a level position. If the beam weigh *three* pounds, with two thirds of its weight below the centre of motion, it will require three times the quantity to turn it into any given angle with the horizon, which would be necessary, if it weighed but *one* pound, with two thirds of its weight below the centre of motion, as in the other. If the centre of gravity were raised nearer to the centre of motion, the beam would turn with less difficulty : if both centres were in one point, the beam would stand in any position, and turn with the utmost ease, but would not vibrate. If the centre of gravity were above the centre of motion, one end or the other of the beam would preponderate, as chance or accident might direct. The preceding remarks principally concern the *light* beam; I shall next speak of the *loaded* beam.

The strength of a beam must be proportioned to the quantity it is designed to draw; and if strong it must be heavy, and if heavy it must turn with difficulty, on the construction above described, if no measure be adopted as a corrective; and the only corrective I have known applied, is a much *greater* evil to correct the *smaller;* this I shall endeavor to explain. Some workmen, finding the difficulty attending the turning of a beam was nearly in proportion to the weight of the beam, have raised the points of suspension considerably above the centre of motion, whereby the beam is made to turn with ease when loaded with a *certain weight*, but loaded beyond this quantity it becomes what is vulgarly termed a *dead beam;* that is, one scale or the other will preponderate and remain down; while the same beam, if lightly loaded, will turn with difficulty. In either of which extremes accuracy is not to be expected, the beam being fit for weighing *only* that intermediate quantity, with which it will vibrate when equally balanced, and will turn with ease.

Demonstration of the cause, which produces the effect above mentioned.

IN the line *a b c* Fig. 7, let the point *b* be the centre of motion; *d* and *e* are the points of suspension, (which are here raised to an extreme, to make the explanation more intelligible.) It is evident that the points of suspension vibrate in arcs of the circle *a d g e c*, of which *b* is the centre; that while the beam is level, the points *d* and *e* are at equal horizontal distances from the centre, and that those distances are equal to the co-sine of the angle *e b c* or the line *b f;* depress the point *e* to *c*, and the point *d* is raised to *g;* the horizontal distance of the former being increased to the radius, and that of the latter reduced to the co-sine of the angle *g b a;* hence the falling arm of the beam obtains the power of a longer lever, while the power of that, which rises, is at the same moment reduced in a greater proportion. As this inequality of power increases by multiplying the weights in the scales, it follows that the beam operates very differently when lightly or heavily loaded, and that it can be correct *only* when the scales are loaded with that precise quantity, which shall give a power to the longer lever but just inferior to the power of gravity, which draws the beam to a level. It is further evident by Fig. 8, that if the points of suspension were placed below the centre of motion, the evil would be still greater, as the rising arm would increase in power, while the other would be losing; in this state a beam turns with the greatest difficulty; it therefore follows that the points of suspension should be placed on a line with the centre of motion, or not so far out of that line as that the beam will operate differently with different weights. Yet even in this construction a *natural evil* arises, which cooperates with the first of the before mentioned *artificial* evils to obstruct the easy motion of a beam; this I shall next attempt to describe.

The *natural evil,* above alluded to, is the flexion or bending of the beam when considerably loaded, whereby the points of suspension are drawn downward below the centre of motion; this operates powerfully against the turning of the beam, and unites its effect with the fixed centre of gravity, to prevent an easy motion; hence arises the principal cause of the difficulty, with which a beam turns when heavily loaded; not from the friction of the parts alone, as is commonly, though erroneously, supposed.

Demonstration of the above position.

IN the line *m n o,* Fig. 8, *n* is the centre of motion, *p* and *q* are the points of suspension, depressed below the horizontal line. As the points vibrate in the arcs *r s* and *t u*, the rising arm becomes the increasing lever, while it moves from *q* to *o*, and the falling arm in the same period, passing from *p* to *r*, is in more rapid progression losing its power. Fig. 8, which is the reverse of Fig. 7, demonstrates, that reversing the cause reverses the effect, as the falling arm is gaining power in the first instance, and the rising arm in this; yet in both, the increase of power is proportioned to the increase of weight, therefore the more a beam is loaded, the greater is *this* obstacle to its turning, and with the greater force *it is drawn to a level by its own flexion.*

As no inflexible or nonelastic substances exist, the maker of scale beams must ever have to encounter the inconveniences, arising from the flexion of the bar, which I have termed a natural evil, as it cannot be avoided. It may be *successfully* counteracted in the construction of a beam; but not by the method usually adopted, which is to make the beam so strong as to be scarcely susceptible of flexion, with any weight it is designed to draw: it is consequently heavy, as before remarked, with a heavy centre of gravity drawing it to a level; of course the power, necessary for turning it to any given angle with the horizon, must bear a proportion to the quantity of matter in the beam.

The justice of the above remark is particularly exemplified in the beam, which has lately been imported from London for the use of the Union Bank in Boston. The beam alone weighs nearly thirty pounds avoirdupoise, and appears sufficiently strong for bearing, without injury, at least ten times the quantity, for which it was ordered; the centre of gravity is placed as usual; and although it turns as easy as a beam of that size and construction can, yet five penny weights being placed on one of the hooks, designed for the scales to hang upon, gave the index less motion, (notwithstanding the beam was not loaded) than five *grains* at the same time gave to the index of my beam, while each of the scales was loaded with six thousand pennyweights. This experiment was witnessed by the cashier and some other gentlemen. One other inconvenience attending the common scale beam arises from the lateral vibrations, to which it is subjected, by being suspended from above, as all swinging motions tend to interrupt the regular oscillations of the beam upon its centre; but this I do not consider as an object of magnitude; yet it is of sufficient importance to be avoided, when it may, especially where minute accuracy is required, as in sealing weights, &c.*

I shall now attempt an explanation of the means, devised in the construction of my Gold Standard Balance, for correcting or avoiding the evils beforementioned. See Fig. 9.

The largest size, required in Banks, is calculated for sustaining a weight in each scale, equal to a quantity of gold amounting to five thousand dollars, or between nineteen and twenty pounds avoirdupoise. The beam for this purpose is twenty five inches long, and weighs about three pounds; the base, which supports it, is a mahogany box or board, ten inches wide and fourteen long, with a screw in each corner for adjusting it in a level position. Four columns rise sufficiently high from the base for giving convenient length to the chains or cords of the scales; two of these stand contiguous, near

* It is probable that from the *want* of this minute accuracy, arises that inequality of Standard Weights, which will discover itself to any one, who shall take the trouble to make a comparative experiment. From the instances, in which I have compared, a doubt has arisen in my mind, whether there are two sets of weights on the continent, exactly agreeing with each other, and in which the component parts correspond with the whole.

each side, leaving in the centre a space of six inches for the motion of the index, which extends downward from the beam. In this space a lever is fixed for raising the beam with the scales and their load. One end of this lever is raised, and supported when up, by a bended lever and friction-wheel, the weight of the beam &c. pressing on the centre of the first mentioned lever. The pedestals and capitals of the columns are conformable to the Tuscan order of architecture, and on the top of each pair is a brass plate screwed down by rods, passing through the columns to the lower surface of the base. From one of these plates to the other two semicircular brass arches extend across, with a proper distance between them for the beam. On the internal surface of each of these arches a perpendicular dove-tail groove is made, to guide the top of the parallel, by which the beam is supported. This parallel consists of two similar parts, each of which is formed by two rods of iron, united at top and bottom, opening in the centre, and extending from the arches nearly to the base. A piece of steel is welded on the upper extremity, which is hollowed into an arch of a large circle, well tempered and polished; the lower end of each part is riveted into an iron plate, at a distance apart equal to the distance of the brass arches above; in the centre of this plate a pin is screwed, extending downward to the lever, on which it rests; a guide, through which this pin passes, and the grooves above regulate the perpendicular movement of the parallel, and prevent any lateral motion. The axis of the beam rests in the hollow at the top of the parallel, and its sharp edge is the only part, which comes in contact with other parts, when the beam is in use. This is effected by perpendicular and inclined planes in each keystone of the brass arches, whereby the axis of the beam is so governed, that it can rise only in its assigned position, preserving the central situation of the beam between the sides of the parallel, and preventing it from touching either.

The principal peculiarity of the beam, consists in the manner of forming and finishing the ends for suspending the scales. It resembles the common swan-neck beam reversed; the extremities, which are of steel, are wrought to a sharp edge, turning upward, exactly on a line with the edge of the axis or centre of motion, and equidistant from it. To obtain exact equality in the distances the ends, after being tempered, are made sharp by rubbing with an oil-stone, whereby the length of either arm can be increased or diminished in the smallest quantity required. For attaching scales to the beam, two implements, termed pendants, are suspended on these sharp edges; they are thus formed. Between two parallel brass plates, about three inches long, are inserted, at the upper end a steel cap, well tempered and polished, and at the lower end, an iron plate, with a hole in the centre. Through this hole an eye-bolt is passed upward, and a double nut is screwed on above the plate. By this construction the suspension of the scales is so adjusted, that when let down, both will rest on the table at the same instant, if the beam be level. The pendants thus constructed, produce the least possible friction, as thieir sides can touch the beam in no part, except a single point at each extremity of the sharp edges, which are much longer than the thickness of the beam. Over the centre of the beam a small weight, in the form of an antique vase, turns on an axis toward the right or left, and is adjusted by two screws; this is termed an Equipoise, its design being to level the beam, when either end may have obtained a preponderance from unequal wearing of the scales, magnetic attraction* or other causes, some of which may

* Having noticed beams, which in time had lost their original equilibrium, the circumstance led to an inquiry into the causes of such variation, and suspecting that one of them might be found in magnetic attraction, I sought conviction in experiment. Upon approaching the north point of a magnetic needle with one

be inexplicable, as experience demonstrates that a beam, turning very easily, and accurately adjusted, will in time lose its balance. The index, which is an iron rod about eighteen inches long, and made truly cylindrical, is screwed into the lower edge of the beam, and well braced. Just below the extremity or point of the index, a pallet moves upon an axis, in such a manner, that when one end is pressed down, the other rises against the end of the index, and stops its vibrations. On this pallet a centre-line is marked, for determining the exact level of the beam; and when the parts are thus far completed, the centre of gravity must be considerably above the centre of motion. An instrument, termed a Motor*, is made to slide on the index, having a spring to keep it at any point assigned; the form of the motor may be such as the fancy suggests, but its weight must be just sufficient to depress the centre of gravity a little below the centre of motion, when placed near the lower end of the index. Its proper place may be known by first raising it so high that the beam will not vibrate, then move it lower by degrees, until the beam vibrates with a slow motion. In this state a single grain will turn the beam, if lightly loaded. When a large weight is to be ascertained, and extreme precision is required, the motor should be raised, until the beam will just vibrate with the scales charged. Whether the beam be light or loaded, it will become dead, if the motor be too high; that is to say, one arm or the other will prepon-

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end of a scale-beam, which had been some years in use, the attraction was powerful; on turning the other end of the beam, the needle was repelled with equal force. This power has probably great influence over the iron weights, which are used in large scales.

* The term Motor signifies "a mover," and is here adopted because the implement, to which it is applied, moves the centre of gravity, and thereby gives to the beam its state of great sensibility or promptness to motion.

derate, and remain down. When the motor is too low, the oscillations of the beam are quickened, and it does not turn with the ease, of which it is susceptible. The beneficial effects of the motor arise from this cause. While the centre of gravity is below the centre of motion, it tends to draw the beam to a level position. The flexion of the beam, by the power of the weights, has the same tendency, as exemplified in Fig. 3. Hence *two* obstacles are to be surmounted, whenever a beam is charged with weights sufficient to spring it downward. If the motor be raised, it raises the centre of gravity *above* the centre of motion, and one of those two obstacles is not only removed thereby, but is brought into a position to counteract the other obstacle. A standard is fixed under each arm of the beam to support it when at rest, and it should be let down upon those supports, whenever the place of the motor is to be changed, or the scales to be loaded or discharged. A balance of this construction turns with the ease, necessary for weighing the smallest pieces of coin singly, and is almost equally susceptible when charged with six thousand pennyweights in each scale.

A Gold Standard Balance of the foregoing description is distinguished as the *higher style.* The same principles have been applied in the construction of another of equal size and accuracy, but less expensive; this is denominated the *lower style,* as it is inferior in elegance and convenience. Another of the higher style has been made upon a reduced scale for weighing gold, not exceeding the amount of one thousand dollars at a draft.

A Silver Standard Balance has also been made, for ascertaining the exact number of dollars in any parcel, from five to one thousand. This, if deserving the notice of the Academy, may form the subject of a future communication.

Since writing the preceding remarks, an argument in favor of the common swan-neck beam has induced me to add some observations on that instrument. A hook, suspended on the internal edge of a circle, must touch one point only at the bottom of the circle, or must touch more. If it touch but one point, it has not sufficient bearing for retaining the sharp edge of the circle and the roundness of the hook, suspended on it. If it touch more points than one, its bearing must be distributed on the bottom of the circle and on parts, which are higher than the bottom. In this case the sharp edge of the circle scrapes the sides or the bottom of the hook, to the exact extent of the angle, made by either end of the beam in its oscillations; and no piece of mechanism admits of being *scraped* into easy motion. The consequence, which results, will be readily seen, on examining beams of this construction, after being long in use; either the sharp edge of the circle is worn down, or a notch is cut in the hook, embracing the edge of the circle, and preventing the freedom of oscillation. It is therefore not uncommon to find beams in daily use, which require one hundred times the weight to turn them, that would be sufficient for a beam, properly constructed and kept in order.

If a description of an improved Hydrostatic Balance of simple construction, for gold and silver coins, would be acceptable to the Academy of Arts and Sciences, it shall be presented in a future communication.*

* The original communication, dated Boston, August 10, 1801, has been revised by the Author, and his late improvements in the Gold Standard Balance are described in the explanation, and represented in the plate.

REFERENCES.

a a, Fig. 9. The beam, raised to its position for use.

b b The base.

c c c Three of the four adjusting screws in the base.

d d d d The four supporting columns.

e The first lever, supporting on its centre the parallel *h h h h*.

f The second or bended lever, forked, and holding a friction-wheel to raise and support the first.

g g The two semicircular brass arches, between which the beam vibrates.

h h h h The parallel.

i i The pendants.

k The equipoise, regulated by the screws *l m*.

n n The index.

o o The brace of the index.

p The pallet.

q The motor.

r s Two supports for the beam, on which it rests, when not in use.

VII. A PROPOSAL

FOR ADJUSTING A NEW SCALE TO THE MERCURIAL THERMOMETER;

Inclosed in a letter, addressed to the late Rev. President Willard, dated August, 1789.

BY EDWARD A. HOLYOKE, M. D. A. A. S.

IT is matter of much regret, that an instrument so useful, so subservient to the purposes of philosophy, medicine, economy, and the arts, and which is so frequently employed, as the Thermometer, should not hitherto have been furnished with a more natural, useful, and commodious Scale; as there is not any one in common use, that has fallen under my observation, that is not liable to great objections, or which has been formed upon such natural and philosophical principles, as might be wished, or as indeed might have been expected, considering the many able hands it continually passes through. These considerations led me to the following reflections, and must apologize for their communication.

Fluids are the most convenient substances for forming Thermometers; all solids being found very inconvenient and unmanageable for common use. Now all fluids, fit for the purpose of a Thermometer, are liable, by great degrees of cold, to be congealed, and so converted into solids; and can never therefore be a proper measure of any degree of cold greater, than what will just reduce them to a solid state. On the other hand, all such fluids are liable, by a certain degree of heat, to be made to boil; after or beyond which point they dilate in an irregular and desultory manner, and cannot by any increase of heat be made to expand much farther; but, instead of expanding, are converted into vapour; and if the vessel or tube, in which they are contained, be small and closed, as for thermometers they must be, they are subject to be burst; or, if left open, the fluid by evaporation is dissipated and lost. So that beyond this boiling point no fluid can be a measure of heat. Hence nature seems to have limited, in the most rigorous manner, the degrees of heat, which each individual fluid is capable of measuring, when formed into a thermometer.

These being undoubted facts, it follows, that the most natural point, at which to fix the zero, is precisely that, at which the fluid employed just begins to lose its fluidity, and to put on the form of a solid. And the most natural point, at which to terminate the scale, is that, at which it just begins to boil, or at which it ceases to be a measure.

This appears so obvious at first glance, that we may naturally suppose it would occur to every one engaged in constructing a new scale. But unhappily the fact, that mercury, the fluid best adapted to thermometrical purposes, was capable of congelation, was unknown at the time, that Messrs. Fahrenheit and Reaumur adjusted their scales to the thermometer; otherwise it is probable they would have proceeded upon a very different plan. These two scales have been for some time and still are the most approved and employed in Europe; the former in England and the more northern parts, and the latter in France and perhaps the more southern. These are therefore, I suppose, as little liable to objections, as any. But they both fall much short of that perfection, which it were to be wished so useful an instrument were possessed of; or as the present improved state of philosophy and philosophical instruments seems to demand.

Fahrenheit begins his scale in the most arbitrary manner, and unluckily has pitched upon a point by much too high; so that whenever the cold is so great as to reduce the mercury below 0 on his scale, which happens every winter with us in North America, there is a necessity of prefixing the negative sign in our meteorological observations; of which there would not be the least occasion, if the scale were properly adjusted.

Reaumur has placed the zero of his scale at the point, at which water just begins to freeze; which is equal to 32° of Fahrenheit's scale. This appears more natural and philosophical indeed than Fahrenheit's; because the point, at which water freezes, is a fixed point, and easily and certainly determinable; but is at the same time much more inconvenient than his, as it is necessary to affix the sign + or — to every degree noted down; which is not only troublesome in itself, but is a constant source of error. For if the sign happen to be omitted, when the degree to be noted is within a few, either above or below zero, the notation is quite uncertain, and the error *may* be great. But if the wrong sign be prefixed, it *must* be great. Nor is this all; the degrees on Reaumur's scale, which are each equal to $2\frac{1}{4}$ of Fahrenheit's, are by much too large. Too large even for the common routine of meteorological observations, which are far from requiring the greatest degree of accuracy. It would certainly be thought too vague an expression to say, e. gr. + 15, or —16°, when the mercury stands by the scale in the interval between those two degrees. And if the expression were conveyed in fractions (which is still increasing the trouble), the parts of a degree must be estimated by the eye, which seems too inaccurate a mode of determining; especially when more precision may be obtained by an easier one.

Of these two thermometers then, there cannot be any hesitation, with us at least in this country, which to prefer; Reaumur's being so very incommodious for the reasons just mentioned. But Fahrenheit's, though more convenient, is certainly imperfect and needs alteration.

I am fully sensible of the great inconvenience there is in introducing a new standard. So many observations have been made on the old thermometers, and published to the world, not only by individuals, but by all the literary societies in Europe ; and the mind of the public is so inured to the scales hitherto in use, that it may perhaps be impossible that an alteration should ever obtain, and come into general use. But as far as the considerations of greater ease and convenience, more precision, and a diminution of the sources of error, will justify an alteration ; so far we have reason for making the proposal. The following is suggested for the consideration of the learned, as a remedy for the above mentioned defects.

Let a thermometrical tube of a sufficient length, whose bore is perfectly true and equable throughout, be properly filled with quicksilver and hermetically sealed. Let this thermometer be placed, in extremely cold weather, in a frigorific mixture, so as to congeal the fluid ; and let the point, at which the quicksilver just begins to freeze, be carefully marked upon the glass tube with a diamond. Let this be the beginning of the scale, and let 0 be marked upon it accordingly. (See fig. 10.) Then let the thermometer be removed into fair water, and let the point, to which the mercury rises in the tube, when the water just begins to freeze, be marked upon the tube. Now as the points, at which the mercury rises in these two cases respectively, are certainly and invariably determinable, and the distance between the freezing point of mercury and the freezing point of water, seems to be a natural and convenient measure, by which to adjust all the other divisions of the scale ; I would propose, that the freezing point of water be marked on the scale 100, and the space between 0 and 100 be divided into so many equal parts or degrees. Or if it be impracticable and inconvenient to freeze the mercury so as to determine the point 0 in that way, the scale may be adjusted, by first finding the freezing point of water, and marking that 100, and then applying heat to the same water till it boils, and marking the boiling point 350 ; then let the interval between 100 and 350 be divided into 250 equal parts or degrees; and let 100 of those degrees be set off downwards from the freezing point, marked 100 on the scale; and let that point be marked 0, which will be as determinate and as exact, as if the same point were adjusted from the actual freezing of mercury; provided the tube be of an exactly equable bore throughout, and that mercury freezes at exactly 40° below 0, by Fahrenheit's scale; which by the experiments made at Hudson's Bay and reported in the *philosophical transactions*, seems to be the truth, or at furthest within one degree of it. Having thus found the two points, at which mercury and water freeze, and divided the interval into one hundred degrees, let the scale then be continued on, in divisions of the same extent, till we arrive at the point, at which quicksilver boils. This point is said to be 656 by Fahrenheit's scale, which is equal by our new scale to 962,5. Here then the scale must terminate, as at this point mercury loses its thermometrical capacity.

One hundred degrees of the proposed scale will then be just equal to 72 degrees of Fahrenheit, and equal to 32 degrees of Reaumur's scale in extent.

The more noted points of the Thermometer will then stand as follows, in the three different scales.

	New scale.	Fahrenheit.	Reaumur.
Quicksilver freezes at - - -	0	— 40	— 32
Fahrenheit's scale begins - -	*55,55*	0	— 14,2
Water freezes, and Reaumur's scale begins	100	+ 32	0
Blood heat - - - -	191,66	+ 98	+ 29,34
Spirit of wine boils - - -	291,7	+ 170	+ 61,28
Water boils - - - -	350	+ 212	+ 80
Melted Tin fixes - - -	666,66	+ 442	+ 182,22
Melted Lead fixes - - -	904,54	+ 612	+ 257,77
Quicksilver and linseed oil boil -	962,5	+ 656	+ 277,33

A scale thus adjusted to a mercurial Thermometer is capable of measuring every degree of heat, of which mercury can be a measure. The divisions appear natural, and the degrees are so minute as never, but on such occasions as require very great accuracy, to need any subdivision, or the use of fractional parts. The notation will be as simple and convenient, as the nature of things will admit, and always direct and affirmative; and cannot in any case call for the use of either the negative or positive sign; and is therefore less apt to lead into any error. So that it is hoped the proposed scale is free from all the objections, to which those now in use are liable, and is more natural and philosophical.

To reduce a given degree of Fahrenheit's scale to its corresponding degree in the proposed scale,

Add 40 to the given degree, multiply that sum by 100, and divide the product by 72. The quotient will be the corresponding degree by our scale, if the given degree of Fahrenheit be above 0. But if the given degree be below 0, or have the negative sign, then subtract the given degree from 40, and proceed as above.

To reduce a given degree of the proposed scale to its corresponding degree of Fahrenheit,

Multiply the given degree by 72, divide the product by 100, and subtract 40 from the quotient, the remainder is the degree of Fahrenheit sought, to which the positive sign must be prefixed. But if the quotient be less than 40, then subtract it from 40, the remainder is the degree in whole numbers; but if there be a fraction remaining in the division, *that* must be subtracted from the quotient, and the remainder will be correctly, the degree sought; to which the negative sign must be prefixed.

But the readiest and most convenient mode of comparing any two or more thermometers is by a juxtaposition of their scales.*

* The writer, having recently revised this communication, has made some small corrections, authorized by late discoveries.

VIII. AN ACCOUNT

OF THE SPRINGS AND WELLS ON THE PENINSULA OF BOSTON, WITH AN ATTEMPT TO EXPLAIN THE MANNER IN WHICH THEY ARE SUPPLIED:

In a letter to the Hon. John Davis, Esq. Recording Secretary of the American Academy of Arts and Sciences.

BY JOHN LATHROP, D. D. F. A. A.

Boston, May 10, 1800.

SIR,

HAVING employed some leisure hours in collecting materials for a statistical account of the place in which I live, agreeably to the plan of Sir John Sinclair, I send you the following account of Springs and Wells, which afford the inhabitants a great supply of fresh water.

Although the narrow limits of the ground, on which Boston is built, do not admit of a river, or even a small brook, the Author of nature, in his infinite wisdom and goodness, hath provided an ample supply of excellent water, which may be always obtained, and at little expense. This supply is either from springs, which rise to the surface, or from wells, which in some parts of the town are not more than 15 or 20 feet deep, although in other parts of the peninsula they are sunk to the depth of 100 or 120 feet.

The first writers of the history of New England tell us, Governor Winthrop and his associates were invited to leave Charlestown, and come over to Shawmut, by a Mr. Blaxton, who informed them he had found "an excellent spring." What spring Mr. Blaxton had respect to in his invitation we cannot say; it is probable however it was the spring now to be seen on the westerly part of the town, near the bay, which divides Boston from Cambridge.

In the early records of the town mention is made of *the great spring*, which discharged its water into what is now called Spring Lane, leading from Cornhill to Devonshire Street. The population of the town made it necessary many years ago to cover up this spring, the water of which now passes under ground and supplies many families, at a considerable distance from the place where it was open, when " our fathers drank thereof, with their children and their cattle." Springs and running streams have been found in many parts of the peninsula, and some of them but a few feet from the surface, which afford excellent water, and in great abundance.

In the history of the wells which have been dug in various parts of the town, there are circumstances to engage the attention of the naturalist. In a history of this sort, attention should be given to the *strata*, through which the workmen pass ; the *springs* and *currents* of water, which are opened ; the *elevation*, to which the water rises ; the *quality* of the water, whether fresh or salt, hard or soft, sweet or fetid, clear or foul ; together with the *temperature*. A complete natural history of the waters which supply the town would require more time than I can spare, and more knowledge than I possess. I will however relate such things on the subject as I have observed ; others I hope will bestow more attention, and furnish a more perfect account.

The first well, to which I have given attention, is the one lately dug on the southeasterly side of Beacon Hill, to accommodate the new State House. This well is opened at the side of the hill, at a level of about 35 feet from the top of the hill, and is 96 feet deep. The hill rises 138 feet and 6 inches above the level of the sea, which surrounds the peninsula. The bottom of the well is therefore 7 feet and 6 inches above the level of the sea.

The strata, as nearly as I could ascertain, are the following.

		ft.	inch.
1.	Mould and yellow earth . . .	0	6
2.	Yellow earth with sand	1	6
3.	Yellow sand with small stones, slate and quartz .	5	0
4.	Fine gray sand	6	0
5.	Gray sand of a coarser sort, with small stones .	6	0
6.	Fine, soft, yellow sand	4	0
7.	Gray sand with slate and quartz . .	5	0
8.	Blue clay, with small stones of the same colour, and very little variation	63	0
9.	Indurated clay, with larger stones, of the slate kind chiefly; one with ferruginous veins, and an incrustation of calcareous matter, which effervesces with an acid	3	0
10.	A mixture of clay and gravel and water, with smooth stones, like those commonly found on the sea shore, and appear as if rubbed against each other . .	2	0
		96	0

No spring was found in any of the strata, until the workmen entered on the last. After digging a foot, or a foot and a halt, in the last stratum, the bottom became so soft, and the water came in so fast, that the workmen were obliged to desist. The well was stoned and finished.

Having been informed, that the depth of water was different at different times, I determined, if possible, to ascertain the fact, and satisfy myself whether the ebb and flow agreed with the ebbing and flowing of the sea. On the tenth of October, 1797, at low water I measured and found 7 feet and 11 inches. The next day at high water I measured, and found 8 feet and 11 inches; difference one foot. On the twelfth of July, 1798, at high water, and on the day before the change of the moon, I measured, and found 12 feet and 5 inches. It not being convenient to measure again exactly at low water, I measured about an hour and a half after the tide began to come in, and found 11 feet and 9 inches; difference 8 inches. These several trials afford sufficient evidence, that the water rises and falls in this well, regularly with the tides. As the bottom of the well is 7 feet and 6 inches above the level of the sea, and the water is found to rise 12 feet and 5 inches, its elevation may be about 20 feet above the level of the sea. The water in the well is uncommonly soft: it has no fetid smell or taste: it readily dissolves soap, and is used for washing and drinking by the people who have access to it.

The clay which is held in suspension gives the water a bluish cast, but by dispelling the air, I found the sediment less, than from the water of the wells in general which I have examined. The faint effervescing of the sediment with an acid, showed the presence of a small quantity of calcareous matter.—By plunging a thermometer into a large bucket of water drawn from the well, I found the temperature, from several trials, to be between 48 and 50; varying not more than one and a half, with the extremes of heat and cold, in summer and winter.

The provision which the Author of nature has been pleased to make to supply the hills on the peninsula with water, and to raise it in some places to 75 or 80 feet above the level of the sea, is to be acknowledged with gratitude. On the north, as well as on the south side of Beacon Hill, and on the range of high ground connected with it, many springs are found, at a little depth from the surface, and some of them seem inexhaustible. Near the mansion house of the late Governor Bowdoin is a spring of this sort. The well, I am informed, is about 16 feet deep. It is supplied with a spring, which comes in near the bottom, and has never failed in the driest seasons. The water is of an excellent quality. It rises nearly to the top of the well;

and from the elevation of the ground, the water might be sent, in refreshing streams, to the greatest part of the town. The comfort, which the inhabitants might receive in the heat of summer, from streams sent to them from the hills, which the Author of nature hath given us, not more for ornament than for use, would be very great; but while this comfort is quite at command, it has hitherto been neglected. As advantages of high importance result, and may be caused still farther to result from the hills, which are placed on this peninsula, it is to be hoped, those hills will be regarded with a kind of religious respect, and that the municipal authority will never suffer their venerable heads to be brought low.

To give some account of the depths below, as well as the heights above the level of the sea, from whence water is taken for the supply of the town, I will mention what I have been told, relating to some of the deepest wells in the town.

An intelligent proprietor of the well made a few years since, near the old fortification, at the southwesterly entrance from the neck, gave me the following history of it.—Where the ground was opened, the elevation is not more than one foot, or one foot and a half, above the sea, at high water. The well was made very large. After digging about 22 feet in a body of clay, the workmen prepared for boring. At the depth of 108 or 110 feet, the auger was impeded by a hard substance. This was no sooner broken through, and the auger taken out, than the water was forced up with a loud noise, and rose to the top of the well. After the first effort of the long confined elastic air was expended, the water subsided about 6 feet from the surface, and there remains at all seasons, ebbing and flowing a little, with the tides.

Observing a small pump, placed by the side of a large one, in the same well, I was led to ask for what purpose it was placed there, and was told, that the water in the well, which was at first exceeding fine and soft, and without any fetid smell or taste, after some time was found to be less pleasant, and less fit for general us e. However, as it rose so near the surface, curiosity led the proprietors to let down a proof glass, to taste the water, and it was found much better, when taken thus from the top, than when pumped from the bottom of the well. Although from the same fountain they did not take " salt water and fresh," in the same well they found *soft* water and *hard*, *sweet* water and *fetid*. The small pump was then placed by the side of the large one, which, entering but a little way, took water fit for every use, and free from any unpleasant smell. Whether the water becomes unpleasant by a subtle *mephitick* vapour, which finds its way into it, or by being covered up, as wells commonly are, and thus deprived of *oxygen* from the atmosphere, is worthy of careful examination. I would just observe, the proprietors of the well last mentioned were led to exercise great caution in carrying on the work, by an accident which happened very near them a few years before. A few years before, an attempt was made to dig a well about twenty rods to the east, near the sea. Having dug about 60 feet in a body of clay, without finding water, preparation was made in the usual way for boring ; and after passing about 40 feet, in the same body of clay, the auger was impeded with stone. A few strokes with a drill broke through the slate covering, and the water gushed up with such rapidity and force, that the workmen with difficulty were saved from death. The water rose to the top of the well and ran over for some time. The force was such as to bring up a large quantity of fine sand, by which the well was filled up many feet. The workmen left all their tools behind, which were buried in the sand, and all their labour was lost. The body of water, which is constantly passing under the immense bed of clay, which is found in all the low parts of the peninsula, and which forms the bason of the harbour, must have its source in the interiour, and is pushed on with great force, from ponds and lakes in the elevated parts of the country. Whenever vent is given to any of those subterranean currents, the water will rise, if it have opportunity, to the level of its source.

But I must desist, having, I fear, taken up too much of your time; although there is yet *truth in the well*, sufficient to engage the attention of the humble inquirer.

With great respect and esteem,

I am,

Sir,

your most obedient servant,

JOHN LATHROP.

Hon. JOHN DAVIS, Esq.

SUPPLEMENT

TO THE FOREGOING COMMUNICATION.

Boston, August 18, 1800.

DEAR SIR,

THE force with which water is observed to rise in many of the wells which have been dug in the low parts of the peninsula of Boston, and the elevation which it holds in the wells on the hills, excite a strong curiosity to find the sources of the springs, and to understand the machinery, by which the water is forced so much above the level of the sea. I now hazard a few thoughts on this part of the natural history of springs, which you will please to consider as a supplement to the last communication on this subject.

On this peninsula there are what I shall take the liberty of calling, the *upper* and the *nether* springs. The upper springs are those which are found in the hills, and at a moderate distance from the surface, together with those which discharge their waters, at openings which they have worked for themselves. The nether springs are those which are found under a body of clay, from 80 to 120 feet deep.

We are now to inquire for the sources of the springs of both kinds, which are found on the peninsula, and endeavour to account for the height at which water rises in the wells. The sources, I believe, cannot be found on the peninsula. By the laws of hydrostatics, water can rise in wells no higher than the reservoir. Some of the ancients supposed all springs and fountains of fresh water have their origin in the sea, and that in passing subterraneous ducts, the sea water loses its saltness by percolation. But as sea water can be admitted into the wells in Boston, only through veins of sand or gravel, it is not conceivable, that in passing so short a distance, (in many places but a few feet) it can lose all its saltness. But were that supposable, there is an objection to the theory from the *height* to which spring water rises.

The sea can raise water only to its own level; whereas the water rises in some of the wells in Boston 75 or 80 feet above the level of the sea. Were the hills on the peninsula high and large enough to contain caverns in their bowels, or admit of basons, for ponds on their tops, the quantities of water, received direct from the atmosphere, might be sufficient to keep the springs at their foot always full. But Beacon Hill, the highest of the three, is only 138 and a half feet. Its shape is such, that the vapours which are attracted to it, and the rains which fall upon it, must run quickly down its steep sides to the sea. While the electric principle, which the upper strata possess, may be continually attracting the surrounding vapours, the sands, of which those strata are composed, cannot retain the waters they imbibe, but must discharge them either from the sides, or convey them to the deep stratum of hard earth and clay, which is found in the centre of the hill. As this stratum is very compact, and conforms, as all the others do, to the shape of the hill, the water, which is filtered through the sands above, cannot enter it; but must pass down its convex surface, without affording any supplies to the springs which are found below it. No reservoir can be found in the hills, on the peninsula, sufficient to raise water in the wells 75 or 80 feet above the level of the sea. Nor is it less difficult to find the sources of the lower springs, without going to some distance. Under a stratum of clay, generally more than 100 feet thick, which is found in all the low parts of the town, there are waters, either in veins of sand and gravel, or in currents, passing continually to the sea. Whenever those veins or currents are opened by the spade or auger of the well digger, water is forced up with violence, and in some cases flows over on the ground.

As reservoirs are not to be found on the peninsula, sufficient to supply the springs, and to raise the water in wells so much above the sea, where shall we look for them ? I believe we must look into the country. All the waters, which are collected in the mountains, and elevated parts of the earth, are constantly pressing towards the ocean. The waters in the rivers make their way without much difficulty ; while those immense bodies, which are confined in the great lakes, and in ponds, some of which are many miles in circumference, are constantly pressing on the sides and seeking a passage in veins of sand and gravel, which are found at different depths, and convey water wherever their courses are directed.

While we look to the mountains, some of which rise above the ordinary course of the clouds, in every quarter of the world, as the *original* sources of springs and rivers, the sources of the springs on our peninsula may be found nearer home. The ponds at the northward, at the west, and southward, have a sufficient elevation, and, as *reservoirs*, contain quantities of water, sufficient to furnish innumerable springs, between them and the sea. Let us suppose, that under some pond, several miles from Boston, there is placed a stratum of clay, which serves as a bason to prevent the water from sinking into the earth, and that next to the stratum of clay there is placed a vein of gravel, and over that clay again, or hard earth, (as we find strata commonly disposed) and we may conceive of a complete aqueduct, from the pond to the sea. If the pond be very deep, veins of sand or gravel, between strata of clay, at different distances from the surface, may furnish supplies for the springs on the elevated parts of the peninsula, as well as for those which are found at 100 or 120 feet under a bed of clay.

In the drawing annexed, the pond and stratum of gravel between strata of clay, may be considered as one leg of an inverted syphon ; the well dug in the side of the hill, and which just enters the vein of gravel and water, may be considered as the other leg. The pressure on the pond would raise the water in the well to the same level, if the syphon was complete. But it is to be remembered, while a part of the water is forced up the well, where the passage is easy, probably much the greatest part, which comes from the source, is still carried along in the vein of gravel. It is impossible for us to say *why* the water holds a certain elevation, and rises no higher, while we are unacquainted with the degree of obstruction, which it meets with in its original course. If the obstruction is great, so that the water has very little motion, where the vein is opened, it will rise high in the well ; but if the passage is comparatively easy, the depth of water in the well will not be great. At a certain elevation the water in the well will be a balance for the pressure at the source, (allowing always for the force which is expended in pushing along that portion of the water, which still keeps its original course). Although the drawing is not perfectly correct, it may serve in some measure to illustrate the theory of springs, and the manner in which water is raised in them.

On the preceding principles we easily account for the ebbing and flowing of the water in wells, near the sea. The pressure of the tide against the mouths of the subterranean aqueducts will prevent for a time the passage of the water ; of course the water will rise in the wells, which are supplied by those aqueducts. When the tide falls, the water will fall in the wells, situated as now supposed.

Thus does the Almighty " send springs into the vallies, which " run among the hills : they go up by the mountains, they go down " by the vallies, unto the place which is appointed for them."

With great consideration

I am

your obedient humble servant,

JOHN LATHROP.

Hon. John Davis, Esq.

REFERENCES TO FIG. XI.

a A pond of fresh water several miles distant from Boston.

b b b b Strata of earth, gravel, clay and gravel.

c Salt water between Boston and Cambridge.

d Beacon Hill.

e Part of Long Wharf.

‖‖ Wells of water, communicating with veins of gravel or sand at different depths.

--- Small veins of sand or gravel, which convey water from larger veins to the surface of the earth, and break out in springs.

– – Stones of different kinds ; chiefly slate.

IX.

ON THE ORIGIN AND FORMATION OF ICE ISLANDS AND THEIR DANGEROUS EFFECTS IN NAVIGATION;

Pointing out a certain and easy method of timely forewarning seamen of their approach, even in the darkest nights.

BY A. FOTHERGILL, M. D. F. R. S. A. P. S. &c.

——DIES DOCEAT——
INTERIM "CAUTELA NON NOCET."

On their origin and formation.

AS no philosophical work expressly written on the origin and formation of ice islands has yet appeared, the subject may be considered in a great measure as untouched. The present attempt, with so few materials, will doubtless be deemed as bold as it is novel. It is therefore not without diffidence, that I venture to lay it before this learned society, whose candour, however, will plead for its imperfections.

These enormous bodies are distinguished by mariners according to their apparent magnitude into continents, islands, and fields of ice, extending often to a vast distance, as far as the eye can reach from the mast head; some of which have been computed to be above a mile long and 200 feet high above the surface of the water, which is considered as only one fourteenth of their extent under water. How amazingly great then must be the real bulk of such islands, or rather continents of ice! They have been found within 36° or 37° south of the equator, and 39° or 40° north. In the year 1805 from April to June they occurred more frequently in the Atlantic Ocean, and particularly near the banks of Newfoundland, than had ever been remembered before. The disasters occasioned by them among ships during the above period were fully detailed in the public prints, and are still fresh in remembrance, particularly those of the Jupiter, Capt. Law, from London, in latitude 44° 20′ longitude 49°, and the Sally, Capt. Bigby, latitude 42° 30′ longitude 50°, both of which vessels bilged and sunk, with a considerable part of the crews! A British packet foundered, and many other ships were greatly damaged by the ice. From observation it appears, that during the spring of 1805 from latitude 40° to 47° and from longitude 44° to 57° (a wide expanse of sea) the navigation of the Atlantic was peculiarly hazardous. The preceding winter indeed had been uncommonly severe, and the cold weather extended more than usual into the succeeding spring. Part of the ensuing summer however was remarkable for a high degree of heat, being at times from 90° to 96° of Fahrenheit's thermometer.

Respecting their origin the general opinion is, that they are gradually formed by accumulations of ice within the arctic and antarctic circles, and are carried by tides and currents to different latitudes. But if they are found, as Erwin and others alledge, not only in the Atlantic, but also in the Baltic, the Euxine, the Asiatic, and the Pacific oceans, how can we suppose them capable of traversing such temperate seas and warm regions, without undergoing a more speedy liquefaction? Hence the frozen seas of the arctic aud antarctic circles cannot be considered as the only sources where ice islands are exclusively generated; nor can the liquefaction of the polar ices explain the regular periodical return of the tides, as the Abbe St. Pierre fancied, when he vainly attempted to overturn the doctrine of solar and lunar influence, established by the immortal Newton.

The origin of ice islands therefore still remains in obscurity, and may possibly, at length, be found, where it was least suspected. If it be true, according to some late observations, that the temperature of the sea decreases from its surface downwards so far as has yet been determined by the deepest soundings, where its coldness reaches the freezing point even of salt water, is it not probable that, at greater depths out of soundings it may be many degrees below the freezing point, and that where congelation is constantly going on, these enormous masses of ice may be gradually formed *stratum super stratum*, attaching themselves to the bottom till, loosened by currents or tides, they are detached, and being specifically lighter than water, like air balloons increasing in buoyancy in proportion to the increase of their surface, they will gradually rise, and at length rear their heads far above the surface? That here, floating in a warmer medium, with their summits exposed to sun and rain, the parts above water, according to the degree of latitude and temperature of the season, will gradually melt down to the water's edge, while the mass below, acquiring an increased specific gravity from the act of liquefaction above, and from stones or gravel brought up from below, will sink to the bottom?

Ice islands are not seen any where within the vicinity of the gulph stream for an obvious reason, viz. the superior warmth of its current. Shallows, as Dr. Franklin first demonstrated, are of a colder temperature than deep water. Is not this owing to their vicinity to rocky or earthy bottoms, which, being conductors, deprive the water of part of its heat? May not similar conducting bodies at the bottom of the deepest seas, which, for want of proper experiments, are wont to be pronounced unfathomable, produce similar effects? Thus the water over the banks of Newfoundland at 46 fathoms is generally found at 47°, yet a thermometer immersed in the belly of a cod fish just brought up marked 37°. This fact I had an opportunity of seeing verified in October 1803. But fishes being warmer than the medium in which they live, this fish being 10° colder than the water at the surface must have come from a much colder region below. In a hot climate the surface of the sea was at 84°, while Capt. Ellis at the depth of 3000 feet marked the temperature at 53° and at 5,346 feet of line out, he tells us, the temperature appeared the same, but there is reason to believe such a vast weight of line must have floated the lead in a horizontal direction and drawn him into a considerable error. For Lord Mulgrave at the depth of 4,680 feet found the thermometer marked 26°, which is 6° below the freezing point of fresh water, and even one below that of the sea water itself.

By means of the marine bucket with valves accompanied with a thermometer as proposed by Dr. Hales, sea water may be taken up at various depths and its temperature examined. That its coldness increases at great depths has been ascertained, and well known to navigators in tropical seas in very hot seasons, where they draw it up for the purpose of making a cold bath, and for cooling their liquors.

As the summits of lofty mountains, even in temperate climates, are constantly covered with snow, and the atmosphere itself at the altitude of less than four miles from the earth, although exposed to the direct rays of the sun, is nevertheless the region of perpetual frost; and as nature pursues a simplicity and uniformity in her operations, why may not the bottom of the ocean, so far removed from the influence of the solar rays, be also, in certain latitudes, the seat of constant congelation? But the art of sounding, indeed, is still very imperfect, and the mysteries of the great deep remain to be explored by future researches.

But it may be objected, that as the sea to a certain depth is warmer than shallows, it must be uniformly so to the bottom in consequence of the central heat of the earth; otherwise whence proceed hot springs and volcanos? To which it may be replied, experiments have already discovered very different temperatures at different depths, though the temperature of the earth in the deepest mines is 52°, and has never been found to exceed 53° that the most combustible materials contained in the bowels of the earth impart no sensible heat to the neighbouring strata till they are decomposed, and then probably may give rise to warm springs. Nor does a mass of gunpowder emit any heat till the moment of explosion. But effects of this nature are merely local, transitory, and circumscribed.

Besides, the received notion of central fire is entirely hypothetical, and apparently groundless, for hot and cold springs often issue from the same hill, and volcanoes have been known to burst forth from mountains covered with snow. The native heat of the earth and ocean then seems to be derived from a more steady, permanent cause, dependent solely on the sun, whose enlivening rays cheer all nature.

Were this source of heat totally withdrawn, all our rivers and the ocean itself would probably soon be converted into ice. Water by the mere absence of a certain portion of heat assumes a solid, crystalline form. Hence, by means of artificial cold, ice may be formed in the hot regions of the torrid zone.* Hence also in the frozen polar

* The celebrated cavern of Grace Dieu in Besançon, 146 feet under ground, presents a singular and curious phenomenon. Within it in summer ice is formed in large quantities, and this ice diminishes at the approach of winter. "The air within," says M. C. Cadet, "did not feel colder to me, than that of the open atmosphere; nor does the water, which filters into it, freeze as it falls into a cavity, formed below in the ice; neither does the water seem very cold, when drank." As no natural philosopher has yet been able to explain this interesting phenomenon, he conjectures that the abundant aqueous evaporation of the bushy trees, with which it is surrounded, cooling the earth and air around the cavern during summer, tends to produce this effect, till they drop their foliage, when the cooling process of evaporation ceases. He thinks it somewhat similar to the operation of cooling liquors in hot countries, by means of water evaporating through porous jars. *Annales de Chimie* 1803, p. 160.

regions ice may be deemed by the natives water in its natural state, and constituting a peculiar salt.

For according to the new chemistry, what is water, but a compound of vital and inflammable gas? Or, in other words, an oxyd of hydrogen? By the act of congelation it undergoes a decomposition fresh water losing its atmospheric and carbonic gas, and sea water its saltness. That a mixture of hot and cold water has a strong tendency to restore an equilibrium is readily allowed, because the colder particles naturally fall downwards, while the warmer mount upwards; but the ocean, subjected to tides and currents, with conducting bodies interposed at different depths and distances, must still be liable to considerable variation in temperature, as has been fully ascertained; a circumstance of no small consequence to navigation, as will probably appear in the sequel.

These enormous masses of ice, during their gradual liquefaction and evaporation,* powerfully absorb a large portion of caloric (the principle of heat), while the copious exhalation, which ensues, meeting a frigid atmosphere, generates thick clouds and vapours; hence the increased cold and dense fogs, which generally surround them, and frequently envelop the ocean to a great distance, particularly over the banks of Newfoundland.

Final cause of ice islands.

Are these mountains of ice then formed only to infest the ocean, impede navigation, and produce melancholy disasters? Are these stupendous operations of nature alone destitute of utility to the

* That ice evaporates in the low temperature of 31° even in the night with a N.E. wind to the amount of 110 grains in 9 hours appears from the experiments of Mr. I. Dalton. *See Nicholson's philosophical journal*, vol. vii. p. 15.

human race, and presented to their astonished eyes only to create terror and surprize? As no explanation of the final cause of these remarkable phenomena has hitherto even been attempted, it perhaps may be allowable in this place to offer a few conjectures. In the present chequered state of being, good and evil are every where blended, though the former is generally predominant. May we not suppose then, that these apparent evils are designed for some useful or beneficial purpose not yet discovered? Or, as Pope expresses it, "blessings in disguise?" That they are impediments to navigation cannot be denied; but it is no less certain, that by vigilance they may generally be evaded, and dangerous disasters prevented by due attention to the precautions hereafter to be mentioned.

As difficulties may be rendered useful to the prudent and enterprising, may not these grand obstacles serve to call forth the talents and exertions of our naval commanders and brave seamen, and inure them to encounter the dangers of the deep? affording also hints for improving navigation and the construction of ships destined to traverse the Atlantic and other seas, where ice islands abound? May not the gradual liquefaction of such vast masses of ice, divested of salt, add a large portion of fresh water to the ocean? And may not this occasionally be necessary to the well being of fishes and other marine animals, many of which at certain seasons delight to bask in fresh rivers? May not the melting ice by the action of the sun beams evolve copious streams of vital air, and thus contribute to the salubrity of the atmosphere? Finally then, may not the formation of ice islands be destined to the most important purposes, viz. the health, vigour, and refreshment of the animal and vegetable creation?

In hot and sultry climates ice is sought with avidity, not only as an article of exquisite luxury in elegant entertainments, but a most grateful remedy in allaying thirst and assuaging intemperate heat in ardent and malignant fevers.

In Bengal ice is formed artificially, and rooms are cooled by the continued evaporation of cloths, frequently sprinkled with water. That the evaporation and liquefaction of ice islands may affect the temperature of the adjacent climates to a great extent cannot be doubted.* The variable winds waft the atmosphere that surrounds them far and wide, diffusing cool breezes along the coasts of the inland countries. Hence the spring and part of the summer of 1805 was cool and temperate, while the evaporation from the immense bodies of ice continued.† But after they were wholly dispersed, about the first of July the hot season commenced, and daily increased till the 10th, when my thermometer, in the shade, reached 96°, and continued vibrating between 84° and 90° till August 27, when it suddenly with a northeast wind dropped to 75°.

Method of warding off the dangerous effects of ice islands.

Having already in a former work pointed out the chief causes of shipwreck and the means of prevention,‡ the present subject being postponed now justly claims a separate discussion.

Whatever theory philosophers may adopt respecting the origin of ice islands, the principal object of this memoir is to propose a few simple rules, by which seamen may be enabled to steer clear of them.

1. In order to avoid them in northern voyages the ship ought to

* Thus the wind, which passes over the polar ices, renders Siberia the coldest of inhabited countries. *Pennant's Arctic Zoology*, vol. i. p. 172.

† Accordingly the spring proved propitious to vegetation, as the crops of grain and herbage were allowed to be abundant, particularly through the Atlantic states.

‡ Prize essay on the preservation of shipwrecked mariners, second edition London, 1800.

bear to the southward of latitude 39, and in southern voyages the reverse even to within 36 degrees of the equator. This being the safest course, though at the expense of lengthening the voyage.

2. Ships destined to cross suspected seas, and particularly the banks of Newfoundland, in dark nights and thick fogs, demand peculiar circumspection, not only respecting the danger of striking against ice islands, but of running foul of other ships; and therefore ought to be well supplied with lamps with reflectors, during their dark and hazardous passage. The ship also ought to be uncommonly substantial, and the parts most liable to be struck, fortified in the best manner possible with a body of wool, hair, oakum, or other elastic substance, to enable the vessel to sustain, with impunity, any sudden or unexpected shock. On clear nights the ice islands are distinguishable at a considerable distance by gleams of light, reflected from their surface.

3. As the increased coldness of the water around ice islands depresses the thermometer, so the dense atmosphere above must raise the barometer, it certainly behoves commanders to have on board a set of accurate barometers and thermometers, at least two of each sort, and to mark the changes, as the sudden rising of the former and the fall of the latter might, either by night or day, or during the thickest fog, forewarn them of their approach to fields or islands of ice.

If we contemplate the dangers of navigation and the frequency of shipwrecks, particularly in the Atlantic ocean, where ships are sometimes surrounded by islands of ice, where rocks and shoals are often unnoticed, or erroneously laid down in the marine charts, and where the eddies and opposing current of the gulph stream, when entered unawares, often render the passage from Europe to America long and perilous, or in the opposite course so rapid as to outstrip the ordinary reckoning, surely when all these circumstances are considered we cannot too strongly recommend to all navigators the diligent use of the thermometer, by which they may be timely forewarned of the approaching danger. It must be acknowledged however, that there are two or three circumstances, which form an exception to the general rule respecting the thermometer, which, when previously understood, can scarcely occasion any embarrassment. 1. It fails in rivers and capes. 2. Near sand banks, which rise considerably above the surface of the water, and which, on being heated by the sunbeams, impart an increased degree of warmth to the surrounding shoal water, and consequently cause the mercury to rise contrary to its wonted motion in soundings and shallow waters. 3. In marine currents, which,. according to their course from warmer or colder climates, may produce a sudden and unexpected variation in the thermometer, though perfectly just to its principle of action. In other cases it marks the changes with the greatest accuracy. Thus the water out of soundings is always 8° or 10° warmer than within soundings. Thus also, the current of the gulph stream, from its superior warmth, raises the mercury from 16° to 24° higher than the adjacent water of the coast.* Accordingly the water over the grand bank of Newfoundland, from its superior coldness, depresses the mercury from 12° to 15° low-

* This remarkable stream is distinguishable not only by its warmth, which it retains in its course through the ocean for more than 330 leagues, almost to the banks of Newfoundland, where its condensed vapour adds to the fogs of that gloomy region. The weeds, brought down with it from its source in about 30 days, mark its course, and its water is never luminous in the night. The passage from Europe to America is expedited by avoiding to stem its stream, but from America to Europe by keeping in it. On this subject see Capt. Williams' experiments in three voyages across the Atlantic, who does not indeed appear to have met with ice islands, as he only just slightly mentions them. But his experiments, conducted with such uncommon attention, seem worthy the imitation of all navigators, and accordingly, in future, I mean to avail myself of their general result.

er than the adjacent deep water out of soundings. But the degree of depression in the vicinity of ice islands, though a matter of importance, which demands particular attention, seems to have been hitherto overlooked. The sea water in general, in point of temperature, near the surface, corresponds nearly with the temperature of the superincumbent atmosphere, varying a few degrees higher or lower according to climate and local circumstances, in summer the air being warmer than the sea, in winter the reverse ; but the condensation of the atmosphere over mountains of ice, and its rarefaction over the gulph stream cannot but materially affect the barometer, as we know the sudden change of temperature in the water does the thermometer. Therefore in a matter of such consequence, and where the lives and property of so many persons are so deeply concerned, we cannot too earnestly recommend to all navigators, particularly in long and hazardous voyages, the joint use of both instruments, as a necessary part of their nautical apparatus. That the temperature of the atmosphere and of the ocean at the surface and at different depths should be daily examined by accurate experiments, and regularly noted in their journals.

Thus might these two simple instruments be rendered subservient to the improvement not only of meteorology and the theory of the ocean, but more particularly to the safety of navigation, by pointing out rocks, shoals, and ice islands, where sea charts fail, and where neither lunar tables nor even the magnetic needle itself can convey the smallest information.

Recapitulation and conclusion.

From what has been advanced it would appear, that ice islands present a new and ample field of inquiry, which is only just beginning to be explored.

2. That the origin, formation, and destination of ice islands, hitherto unknown, may now perhaps admit of a probable explanation, that may excite others to complete the discovery.

3. That the arctic regions *alone* give birth to ice islands, and the liquefaction of the polar ices to the tides, as has been supposed, seems highly improbable.

4. That the ice islands observed in the more temperate seas, where the temperature decreases downwards, may originate where least expected, viz. at the bottom; especially where rocks and other conducting bodies overspread the surface.

5. That the notion of central fire is groundless; and that objections, drawn from it, or volcanoes, are alike inadmissible.

6. That ice in the open air evaporates even below the point of congelation, and that evaporation generates cold and accumulates ice in the curious cave of Grace Dieu most in summer.

7. That the evils, occasionally produced by ice islands, are complained of, while their beneficial effects on the animal and vegetable creation have hitherto passed unnoticed.

8. That winds, blowing over them, temper the intense heat of summer in the adjacent climates.

9. That ice islands may be guarded against by vigilance, and by ships well constructed.

10. That the thermometer may be rendered preeminently useful in pointing out the approach of rocks, shoals, and shores; but particularly of ice islands and the Gulph stream.

11. That the barometer may also greatly contribute, and that these instruments should jointly constitute a part of the nautical apparatus, and daily observations be noted in the journals.

12. Finally, that by due attention to the above rules those dangerous obstacles to navigation may be detected, which elude the magnetic needle and all other instruments; and thus might the art of navigation be improved, science promoted, and many disasters prevented.

POSTSCRIPT.

SINCE writing the above, on being admonished that part of my paper had been anticipated by M. Peron, I hastened to peruse his memoir,* which had till now escaped my knowledge, or I should certainly have noticed it. Much credit indeed is due to M. Peron's assiduity in marking the temperature of the ocean four times a day; but his assertion, that its temperature increases in approaching continents or islands, is diametrically opposite to what I have observed, and also to the experiments of Dr. Franklin and some of the ablest English navigators. They had long before, with great care and accuracy, explored the ocean to a far greater depth than M. Peron, and discovered the increasing cold even to the freezing point of salt water. But what is singular, neither they nor M. Peron have from thence attempted to explain the formation of ice islands in temperate climates, or their final cause, or, what is of much greater importance, the best method of guarding vessels against their terrible effects, or of pointing out their approach in dark nights by the use of the barometer and thermometer. In short, except what has been mentioned as highly improbable, I find nothing in M. Peron's memoir, that was not discovered long before by the authors I have mentioned, and on whose accuracy I have depended as a foundation of the doctrine I have ventured to advance. In which it seems evident, that instead of my being anticipated by him, he has been anticipated by them; of which, however, this learned society, to whom I have the honor to addres it, will judge. Should it be deemed unsuitable to their designs in their ensuing volume, they will please to return it inclosed to the care of Mr. John Warder, Race street, Philadelphia.

* Annales de Museum vol. v. Paris, 1804.

X. EFFECTS

OF LIGHTNING ON SEVERAL PERSONS IN THE HOUSE OF SAMUEL CAREY ESQ. OF CHELSEA, AUGUST 2, 1799;

In a letter to the Hon. John Davis, Esq. Recording Secretary of the American Academy of Arts and Sciences.

BY JOHN LATHROP, D. D. F. A. A.

THE morning was clear, the air moving gently from the southwest, the thermometer at 75°. About 11 A. M. a thunder cloud appeared in the west, stretching, as it rose, to the north and south. Between 12 and 1 the cloud separated. One division passed over Brooklyn, Roxbury, and Dorchester, towards the sea; but the wind, shifting south, brought it over Boston with heavy thunder, rain, and hail.

The other division of the cloud was carried by the southwest wind over Cambridge, Medford, Malden, and Lynn, approaching the sea in that direction. But the wind in that region, shifting suddenly to the northeast, turned the cloud towards Chelsea, discharging a plentiful shower, with repeated flashes of lightning.

Mr. Carey, perceiving the approaching storm, called his labourers from the field before the rain began. Three of his men went into a cellar, under the northwest part of his house, and were employed in removing a quantity of potatoes, which had lain in an arch through the winter. While thus occupied, an explosion took place, which forced one of the men forward to the ground, where he lay apparently dead. The other two were forced in opposite directions; one against the wall, and the other against a board partition.

Mr. Carey, Mrs. Carey, one of their daughters, and a domestic or two, were standing in the room directly over the cellar, where the explosion took place. Mr. Carey was forced backward, to the floor; Mrs. Carey was pressed down in an opposite direction, experiencing a severe stroke on her feet; her shoes at the same time were forced off, and driven to the other side of the room. Miss Carey experienced the same kind of stroke, but less severe. One of her shoes was driven off as she fell upon the floor. Mrs. Carey, supposing her husband was killed, exclaimed, " O, my husband !" And attempting to rise, exclaimed, " O, my feet !" At this moment the two men, who had been forced, the one against the wall, and the other against the partition in the cellar, came up and said Mr. Cheever, the man, who had fallen on his face, was dead. Mr. Carey ordered him brought up, and laid on a bed, where proper means were used to excite vital energy. There were for some time hopeful appearances of recovery. After the operation of an emetic and bleeding, the hopeful appearances vanished, and the next morning he died.

A few days after the storm I visited Mr. Carey, and from his account, as well as by examining the spot, endeavoured to ascertain the direction of the charge. It is to be observed, Mr. Cary's house stands on a gravelly spot of ground, with a high hill on the north, and flat ground, extending to the sea, on the south. About twenty seven years ago an iron rod, of sufficient thickness and well pointed, was fixed to the southwest chimney, and, passing down the end, entered the ground near the place in the cellar, where the men received the shock. No trace of the lightning could be found, except a mark on the side of a cedar tub, like that of burned gun powder, and a few pieces of stone, which appeared to have been forced from the wall, near the bottom. Had there been a breach in the wall near the foot of the conductor, it would be reasonable to suppose, the charge came dawn the rod, and, not finding moist ground, exploded, and produced the above related effects. But the wall near the foot of the rod had no breach. The stones were forced out on the northerly side of the wall ; the men being nearly between the place of the breach and the place, where the rod enters the ground.

In this case the probability is, that a portion of earth in the neighbourhood was *positive*. When the cloud from the northeast came to the striking distance, the electric matter, which had collected in great force under the dry, gravelly stratum, burst forth. A part of the charge, or whole of it perhaps, entered the cellar on the northerly side, forcing out the stones and affecting the men, as above related. The charge then passed from the cellar by the best conducting substances it could find, in its way to the cloud. The violent concession of the air, by the explosion in the cellar, might be sufficient to fling Mr. Carey and Mrs. Carey on the floor, and occasion the painful sensation, which they and their daughter experienced in their feet, although the charge might have taken the iron rod, which was not more than three or four feet from the place, where the men were at work, or have passed out at the cellar door.

Mr. Carey however fully believes the fire was from the cloud, and exploded in the cellar ; where he thinks it was aided by inflammable vapour. That the discharge was from the cloud, he says was evident to people, who saw it, and particularly to one of his sons, who was looking out at a northeast upper chamber window. But I would query, whether the motion of lightning be not too quick for any eye to discover its direction, whether from the cloud, or the earth. Although the stream generally, if not always, appears to be from the cloud, have we not reason to think there is an optical deception ?

But if the discharge in this case *was* from the cloud, and entered the earth not far from the house, not meeting with good conducting matter, there might be what is called the *returning stroke.* The explosion, which on this supposition must have taken place, when the charge left the bad conducting matter, and sought a stratum of cloud, or a portion of earth in a negative state, might have produced all the above effects. I mean however to relate facts, and leave it with others, who have had more leisure to acquaint themselves with the laws of electricity, to draw conclusions.

With great respect

I am, Sir,

your most humble servant,

JOHN LATHROP.

Hon. John Davis, Esq.

XI. EFFECTS

OF LIGHTNING ON THE HOUSE OF CAPT. DANIEL MERRY, AND SEVERAL OTHER HOUSES IN THE VICINITY, ON THE EVENING OF THE 11th OF MAY, 1805;

In a letter to the Hon. John Davis, Esq. Recording Secretary of the American Academy of Arts and Sciences.

BY JOHN LATHROP, D. D. F. A. A.

THE wind had been fresh at the southward and west the greatest part of the day, but the rain was not copious until the evening. Between six and seven o'clock, the clouds were thick and the thunder frequent; but there were no uncommonly heavy discharges, until a little after seven. About a quarter after seven, there were two very heavy claps, the latter but a few seconds after the former. The latter of the two claps now mentioned was so powerful, that many people, at a distance from the place of explosion, felt the shock, and supposed at the instant they were struck.

Some of the effects of this explosion are now to be related.

On the northeast side of the chimney of Capt. Daniel Merry's house, which is in ship street, a little distance from Hancock's wharf, there is a breach, beginning where the chimney appears above the roof, and extending above two feet upwards and almost as wide as the chimney, leaving the top unhurt. The rafter, which comes near the chimney, the plate, and the summer, are shivered to pieces; the boards and shingles of the roof appearing to be burst upwards. The expansion of air in the upper chamber, where the charge appears to have entered, was such as to burst out almost all the glass windows, and several of the sashes were broken. Whether the charge came in, or passed out at the breach now mentioned, is, and must remain problematical; but in narrating the effects I will suppose this breach in the chimney was the place of entrance. Part of the fluid passed down by the chimney to the next chamber, bursting off the wood work from the masonry; and from thence to the store below, and into the cellar, leaving the marks of its passage all the way. In the second chamber the fluid was divided; part of the charge passed down by the chimney to the cellar in the nearest course, and part took a bell wire, which it followed, making two right angles; then passing through another chamber, and down to the front entry, where it burst through the door into the street.

Mr. Murray's house is separated from the next house at the northward by a space, not more than eight or nine inches. In the second story of this house, which is occupied by Mr. Bullard, there is a breach in the wall, nearly opposite to the chimney of Mr. Murray's house, and the wood work, from the breach down to the cellar, is, in many places, very much damaged.

Between the house, occupied by Mr. Bullard, and the next at the northward, there is a passage way of twelve or fourteen feet down a wharf. Capt. Barns, who occupies this house, supposed from the tremendous shock, that the house must have been struck; but on examination no effects of the explosion could be found, except a small hole just under the cornice, over the fire place in the chamber. Over this fire place Capt. Barns had hung a picture of the late President Washington, the frame of which was newly guilt and burnished. A stream of fluid passed from the small hole above mentioned to the upper corner of the picture, which was just under it. Melting the metal, and leaving a dusky appearance on the paper, it went off at the lower corner of the frame, passing through a small hole into the breast work; and coming out again between the wood work and the stone mantle, where it left a black mark on the paint, it passed down to the iron tongs, which were by the side of the fire place.

Capt. Barns' house is joined on the north by a house belonging to Capt. Jonathan Merry. A part of the charge took an oak post on the top of this house, which is shivered and split from top to bottom. No mark however of the fluid is to be found from this post to the lower part of the house. In the kitchen, which is nearly under the post above mentioned, there is a pump, which has an iron handle. Persons, who were in the kitchen at the time, say, there appeared to be a stream of fire from the iron pump handle, which passed out at the door, then open, and across the passage way, down Mr. Parson's wharf, into the lower window of the opposite house. On examining the house, into which the stream of fire appeared to enter, I found several places, where the wood work was shivered by the explosion.

The good hand of providence is to be acknowledged in the wonderful preservation of so many lives, which appear to have been in imminent danger; several of whom were struck down, or forced to a considerable distance from the place, where they were standing. There were ten persons in the house of Daniel Merry, where the explosion was the most terrible. Mrs. Howard, the daughter of Capt. Merry, was in a chamber, where the whole breast work about the fire place was burst off, and a woman struck down with the force. Mrs. Howard was setting on a bed, and felt an extreme pressure and heat, but received no essential injury. She was on the side of the room, opposite to where the bell wire passed along; this circumstance was probably much in her favour. She was the same night put to bed with a fine son. Mr. Howard was in the store, and but the moment before moved from his writing desk, which was near the chimney. The fluid passed down just by the spot, where he was standing a moment before; and had he not moved, the probability is he would have been killed. It is to be observed, the bell wire, which conducted a portion of this charge, so far as it continued, was melted, and a great part of it consumed, leaving a black mark all along the paper, over which it had been fixed. The people all say, the smoke was for some time so thick they could scarcely discover any thing in the house where they were; the smell from consumed, inflammable air, was much like sulphur, and the smoke of gunpowder.

Several persons in the houses which were struck, and others in the neighbouring houses, say they saw something like a ball of fire, which appeared to descend and rise again in an instant. Whether the cloud was *positive* at the time, or the earth, cannot be determined by any of the effects. The boards and shingles of the roof appeared indeed to have been raised up by a force from beneath; but the splinters of the *oak post*, on the top of capt. Jonathan Merry's house, appeared as if the force had entered at the top. I have been inclined to think, very little evidence can be collected from the effects of lightning, to prove which is *positive* and which *negative* at the time of the explosion, the earth or the cloud. On the same trees, and the same buildings, we find splinters, and other effects, some of which look as if the force was from the cloud, and some, as if from the earth.—When two bodies, one *positive* and the other *negative*, approach to the *striking distance*, the explosion may be like that of gunpowder, or the thundering nitre, pressing the air in every direction, and rending those solid bodies, which are not calculated to receive and conduct the dreadful charge. The power of metal, to conduct this fire from the artillery of the skies, is evident in the case before us. A small wire, not thicker than a common brass pin, carried that part of the charge along in safety, which burst the door to pieces, where this conductor ended.

Although the wind was strong from the southward and west all the day before, and all the night, the motion of the thunder was evidently from east to west. The hardest thunder in Boston was about a quarter past seven; at Providence the hardest was about eight; at Newhaven the severity of the storm came on about one in the morning, as appears from the account published soon after. If it be a fact, that the thunder passed from east to west, while the wind in the lower region of the atmosphere was in the opposite direction, it will be natural to inquire for the cause. The following thoughts occurred to me, which are humbly submitted. The wind, which had been many hours strong from the south and west, must have put a large portion of the atmosphere in motion towards the east. The re-action, not only condensed the vapors in the eastern region, forming the clouds, which gave plentiful showers of rain; but the same re-action, which the body of the atmosphere, moving from the west, received from the opposing body of the atmosphere at the east, must necessarily give a different direction to the wind, probably turning the current upwards, where there would be less resistance, and thus, in a higher region, forming a current of air, from east to west. The longer the wind below shall continue to blow from the west, the farther, on the present supposition, must the upper current proceed from the east. While two such currents of air continue, one *below* and the other *above*, carrying with them all the materials for thunder, there will no doubt be frequent explosions from clouds passing at no great distance from each other. When certain tracts of cloud in the upper current are in a *positive* state, the explosion will be to a *negative* state in the lower current. When tracts of cloud in the lower current are positive with respect to the earth, the discharge will be to the earth. When certain tracts of the earth are positive with relation to the clouds above, the discharge will be from the earth to the clouds.

Thus may we contemplate those astonishing displays of the power and wisdom of God, which without doubt are ordained for the general good, while they amaze and terrify us, by their tremendous effects.

Your most obedient servant,

JOHN LATHROP.

XII. EFFECTS

OF LIGHTNING ON THE HOUSE OF THE REV. SILAS MOODY, IN ARUNDEL, IN MAINE, AUGUST 17, 1807.

In a letter to the Rev. John Eliot, D. D. F. A. A.

BY REV. SILAS MOODY, A. M.

Arundel, August 17, 1807.

REV. SIR,

I LEARN by the news papers, that the members of the Academy of Arts and Sciences solicit communications respecting the effects of lightning in certain places and circumstances.

Some years ago my house was struck with lightning at the ridge pole ; it ran down the principal and corner post ; shattered the casing of the post, and strewed the pieces over the bed, where a child lay asleep, within eighteen inches, or two feet, of the post. I sat in a room adjoining, separated only by a thin partition. Hearing the child make a noise, I immediately opened the door, found the room, where it lay, filled with smoke of a sulphureous smell, caught the child in my arms, carried it to an outer door for fresh air, awoke it (for it was still asleep) and could not perceive that it had received the least harm. The room was closely shut, and there was no fire place in it. Query, Whether the closeness of the room, or feathers in the bed as repellent, were means, under the protection of a gracious God, of preserving the child from injury.

The doors and windows in the room, where I sat, when the lightning struck, were shut ; but there was a large, open fire place in it. Some in the room felt great inconvenience from the shock, but were not quite stunned.

Your friend and servant,

SILAS MOODY.

XIII. EFFECTS

OF LIGHTNING ON THE HOUSE OF CAPT. THOMAS MANNING, IN PORTSMOUTH, NEW HAMPSHIRE ;

In a letter to the Rev. John Eliot, D.D. F.A.A.

BY REV. TIMOTHY ALDEN, jun. A.M. S.H.S.

Portsmouth, N. H. 14 *December*, 1808.

REV. AND DEAR SIR,

IT appears upon inquiry, that several persons have, at different times, been killed by lightning in Portsmouth and its vicinity ; but, in no instance, as I can learn, in a *close room.*

That the danger however from an electric explosion is as great in a *close*, as in an *open* room, seems evident from the circumstances detailed in the following narrative.

On Friday, in the afternoon of the twenty second of last May, the north front of captain Thomas Manning's dwelling house, near to Liberty Bridge in this town, was considerably injured by lightning. Commencing at the northwest corner, the lightning tore off several feet of the clapboards near the corner, between the eaves and lower story. It then took a horizontal direction, just above the window frame, and entered the lower room, shivering the moulding, and starting, for several feet, the plaistering of the planchment, contiguous to it. Between the two front windows it burst off the boards, externally, and the most of the plaistering, internally, from the planchment to the floor ; threw down a large looking glass, which was broken, seemingly, into a thousand pieces ; burnt a considerable part of a muslin covering, which was drawn over the face of the glass; and turned a table, which stood under it, upside down, casting it near-

'y into the middle of the room. A part of the fluid passed from the moulding before mentioned, three or four feet, to the ornamental wood work over the mantle piece, where it split off, about six feet from the floor, a strip of several inches in length, threw down a small picture, and greatly tarnished the gilding of an elegant picture frame, which was fixed directly over the fire place.

The room, of which we speak, is remarkably tight. The window shutters, which are of the sliding kind, were all closed. The door was bolted. The fire board, which is fitted very nicely to the jambs, was in its place, previously to the tempest, but was thrown forward a few inches by the percussion, and rested against the top of the andirons, which were not removed.

The members of the family, at home, were, providentially, in a part of the house remote from the scene of destruction, and were not aware of the injury done to the building, till informed by some of their neighbours. If they had been in the room, which was so greatly damaged, at the time of this explosion, their lives, I think, must have been in the most imminent danger.

I am, reverend and dear sir,

your humble servant,

TIMOTHY ALDEN, jun.

XIV. EXPERIMENTS

RESPECTING DEW, INTENDED TO ASCERTAIN WHETHER DEW IS THE DESCENT OF VAPOUR DURING THE NIGHT, OR THE PERSPIRATION OF THE EARTH, OR OF PLANTS; OR WHETHER IT IS NOT THE EFFECT OF CONDENSATION.

By NOAH WEBSTER, Esq. F. A. A.

IN the summer of 1790, I took three pieces of paper of equal weight; one I laid under a China saucer on the dry garden earth; another was laid on the dry garden earth in the open air; the third was placed on green grass under cover. In the morning the paper, which lay under cover, was covered with dew, as well as that, which lay in open air; and that, which was on dry earth, under the saucer, was a little the heaviest. The dew on all of them was mostly on the under side next the earth, and stood or rather hung in small globules. The surface of the earth was dry, but as the season was rainy, the earth just below the surface was moist. The result of these experiments was, to prove dew to be the perspiration of the earth.

In July 1791 I made other experiments. The season was remarkably dry, and the earth at and near the surface retained very little moisture. I laid two China plates upon the dry surface of the earth, and in the morning found no dew on either of them. Yet the green vegetables about them were covered with a light dew. By this I judged, that the moisture of the earth was exhausted to such a depth, during the superior heat of the day, that no evaporation took place during the night, when the air was cooler. To satisfy myself in this particular, I made another experiment; the state of the earth and air being the same. I dug below the surface several inches, and turned up earth moderately moist, over which I placed a China fruit plate. It was ten o' clock at night, when I did this ; yet in the morning the under side of the plate was covered with dew, so that upon turning it up on one side, seven or eight drops of water fell from it. This served to confirm my opinion, that the reason why no dew appeared on the plates, laid on the dry surface in the former experiment, was, that the earth was so far exhausted by the extreme heat of the sun, that the heat of the night would not carry on evaporation from a considerable depth ; but when moist earth was placed at the surface, the evaporation was copious. On the same night, I placed another plate over a fresh leaf of a plant, the earth below being dry. In the morning the dew was considerable upon the under side of the plate, and it was visible upon the leaf, more especially on that part of it, which was a little removed from the earth. On that part of the leaf, which was in contact with the earth, the dew was scarcely visible. I was at a loss to determine from this experiment, whether the dew was perspired from the earth or the plant; nor could I account for the appearance of more dew on that part of the leaf, which was a little raised from the earth, than on the other. I had repeatedly observed, that the under leaves of squashes, cucumbers, &c. were perfectly dry in the morning, when the upper leaves, which were open to the sky, were covered with dew. And from repeated examinations I found, that *both sides* of the leaf were alike, either dry, or moist with dew. When dew covered the upper side of a leaf, it likewise covered the under side, and when one side was dry, so was the other. This fact I believe to admit of few or no exceptions, and it deserves notice. For if dew is the perspiration of the earth, which some think probable, why should the under leaves next the earth be without dew, while the upper leaves at the distance of one or two feet from the earth are covered with dew? And even the under side of such leaves, as moist as the upper side, when a direct ascent of the vapor is intercepted by the leaves below? I was led by these facts to suspect that dew may be partly, if not wholly, the effect of condensation by cold.

The first experiment indeed does not seem to favor the theory of condensation; for the papers under cover, and the China vessels themselves were moist only on the under side, or side next the earth. Now if dew is produced by the condensation of vapor, why should not the upper side of a vessel, which is exposed to the external air, and thus to a greater degree of cold, be the best condenser and consequently form the most dew?*

Perhaps the result of the second experiment may be however explained upon this hypothesis. At the time this was made, a severe drowth prevailed; the earth to a depth of five or six inches was almost totally exhausted of its moisture, and of course must have been heated during the day to a very considerable degree. Being thus heated and covered at sun set from the surrounding atmosphere, the earth under the plate might retain warmth enough during the night to prevent any condensation.

The third experiment differed from the second in two particulars, viz. in that the moist earth from below was brought up to the surface, and the plates were not laid over it until ten o' clock at night. In this case, the atmosphere, which cools immediately after sun set, had access to the earth more than two hours later, than in the second experiment; and perhaps this circumstance, with

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* Some remarks hereafter may solve this difficulty. The vapor *under* the plates is supposed to perspire from the earth, during the night, and to be warmer, when first emitted, than the air *above* the plates, in the open atmosphere; if so, then it is more condensable. The plates might not be cold enough to condense the cooler vapor above the plates.

the turning up of the moist and cool earth below the surface, rendered the air under the plates cool enough to make them condensers.

The fourth experiment may possibly favor the same theory, on a supposition, that a green leaf, which in summer is much cooler than dry earth, is a good condenser of vapor, and the better condenser at a little distance from the dry, warm earth, than near it, or in contact with it. But there are many other facts, within every man's observation, which strongly support the hypothesis, that dew is produced by a condensation of surrounding vapor. The copious moisture upon the outside of vessels, filled with cold water in hot weather, is certainly the effect of condensation, and is no feeble confirmation of the hypothesis respecting dew. The hoar frost is merely frozen dew, that is, vapor first condensed into water, and then frozen, or vapor congealed without condensation. This frost appears when the surface of the earth is sealed with frost, and of course the vapor, from which it is formed, cannot, at the time, perspire from the earth.

I have lately moved into a new house,* the plaistering of which was not thoroughly dry, when I came into it. When I arose in the morning, I observed a copious dew upon the glass windows of the keeping room, on the inside. The phenomena of this dew correspond exactly with those of the ordinary dew upon the earth.

In the first place the moisture upon the windows, which were exposed to the external air and the action of cold, was copious in clear weather, and sometimes would collect in such quantities, as to run down in drops. But at the same time glass within the room, as the looking glass, and the face of the clock, was perfectly dry. This was uniformly the fact for a number of nights successively. Hence the conclusion, that the exposure of the glass to the cold external air was

* Written in December, 1791.

necessary to render it a condenser. Otherwise it is difficult to assign a reason why objects, in themselves equally cold with window glass, should not have been equally moist. In the second place, that glass, which was sheltered from the full effect of external air by outside shutters, was also dry. So striking was this phenomenon, that when one half of the external shutter was closed and the other half open, the half of the window, which was covered with the shutter, was perfectly dry, and that, which was exposed to the open air, was covered with a copious dew. And even when a single fold of the shutter was left open the glass exposed was moist, and the remainder dry; and *e contra*, when a single fold only was closed. These facts go a great length in confirming the hypothesis of condensation.

But thirdly, when the sky was overcast with clouds during the night, no moisture at all was visible on any part of the windows, though exposed to the external air. This fact, which appeared two or three mornings, but not in succession, as the sky was not clouded any two or three nights in succession, corresponds exactly with the phenomenon, which is within every man's observation, that a cloudy night produces no dew. This appears to me one of the most difficult and unaccountable phenomena respecting dew; and the fact now related totally overthrows the common solution of the phenomenon. The usual idea is, that in cloudy nights the vapor all ascends, and therefore none appears adhering to objects at or near the earth. But in the house, I am speaking of, the dew on the windows in clear weather proceeded from the damp walls, or inclosed air. Why should the same appearance fail in cloudy weather? The vapor could not escape from tight rooms and ascend to the clouds; at least, as great a quantity must have been thrown from the walls, and must have floated in the room in a cloudy night, as in a clear one. I suspect the reason for the phenomena, both in the house and in the open air, is, that in cloudy weather the principle of condensation is wanting, whatever may be the cause. I state facts from repeated and uniform observation; but I dare not in this instance undertake to assign the cause of their existence.

The foregoing facts were confirmed by the phenomenon, which took place after the season was so far advanced, that the dew on the windows would freeze, except one night, when some frost appeared on the glass, notwithstanding the sky was somewhat overcast. In all other respects the phenomena were the same. Wherever the glass was exposed to the action of the external air, though for a breadth of three inches only, there the inside of the glass was covered with a thin frost. But wherever the outside shutters shielded the glass, there was no frost or dew.

From these facts one is naturally led to conclude, that condensation is the principal, if not the sole cause of dew. If condensation is the sole cause of dew, then it depends on the same principle as distillation, or the condensation of vapor in the worm of a still; as also on the same principle, with the dew on the outside of vessels, filled with cold water in a hot summer's day. If so, the inquiry is, whether a certain *fixed* degree of cold, in the air or object condensing, be necsary to form dew? Or whether the degree of cold be only *comparative*, that is, in a certain proportion to that of the vapor condensed? From such observations, as I have been able to make, I am inclined to believe the degree of cold *comparative*.

The water in the worm-tubs of common distilleries is taken from rivers, and not from wells. This water is considerably warmed in the tubs, yet is cold enough to condense the vapor, that rises from the boiling fluid in the stills. But the same degree of cold would by no means condense the vapor of the atmosphere in the hottest summer's day. Yet cold water, fresh from a deep well or spring, will condense it rapidly.

I remarked one morning in January, when the weather was very cold, the mercury in Fahrenheit standing at 12° below 0, that when I first rose, or about sun rise, the windows of my keeping room were perfectly free from frost. Soon after, a large fire being kindled, the glass of the windows was covered with a fine frost. This phenomenon is commonly ascribed to human breath; if this solution is just, it proves my supposition; for the breath issuing from the lungs is warmer than the air, and therefore more easily condensed. But this solution cannot be the just one; for the same phenomenon takes place, when no person is in the room. I rather ascribe it to the warmth communicated to the air by the fire, which renders the vapor more condensable.

Every person must have observed, that in extreme cold weather the glass windows of cellars collect frost on the inside. In a series of very cold weather in January 1792, I saw an instance of frost thus collected more than an inch thick. The vapor in the cellar, being comparatively warm, was of a temperature suitable for condensation.

I have a small room adjoining my office, which is kept shut; in which there is a window opposite to a chimney, at the distance of eight or nine feet. There is no fire kept in this room, nor does any person lodge in it; yet by means of a fire in an adjoining room, which communicates a degree of warmth to the inclosed air, the vapor becomes condensable, and in the morning this window is covered with dew, when no such phenomenon is visible in rooms not thus warmed.

Every person must have noticed the frost, shooting in the form of spiculæ through the little crevices, leading from cellars into upper and colder rooms. The comparatively warm vapor of the cellar, issuing, in extreme weather, through small openings into cold rooms, is immediately condensed and frozen.

We observe, that in hot weather dew is perceivable long before sunset. The laborer feels the moisture on his clothes and on the grass, while the sun is above the horizon. But I am doubtful whether the same phenomenon is observable in the morning, when the temperature of the air is the same. On the contrary, I suspect the dew *evaporates* in the morning, with a temperature of the atmosphere, in which vapor will *condense* in the afternoon. In the morning both the *air* and the *earth* are cool; and as soon as the sun begins to warm the air and earth, a small degree of evaporation is begun. But when the earth has been heated almost to the temperature of blood, the water near the surface partakes of the heat. Soon after the warmest part of the day is past, the atmosphere begins to cool, while the earth retains the heat. The earth emits a *warm* vapor; the atmosphere is *cooled* to a condenser. This is the distillation of nature; and thus dew is formed. It seems to be the comparative coolness of the atmosphere, which renders the vapor condensable in the afternoon. This is the case also in the evening; the earth retaining its heat longer than the air, and the warm vapor, constantly ascending into the cooler atmosphere, is speedily condensed. I suspect therefore, that a great portion of the dew, which is formed during the night, is composed of particles, that proceed from the earth *during the night.* So far then dew may be said to *rise,* and not *fall.* But it is the vapor in fact, which rises, in an *imperceptible* form, as during the day; but in the night it is condensed, and *falls;* whereas in the day time it continues imperceptible.

Perhaps these remarks will lead to a solution of the difficulty before mentioned, viz. the appearance of dew on *both* sides of the *upper* leaves of plants, while none appeared on *either* side of the *under* leaves. The upper leaves, being exposed to the direct action of the cold air, were rendered *condensers ;* the lower leaves, being covered from the air, and near the warm earth, might not be rendered cool enough for that purpose.

After all, I would not speak with much confidence on these subjects, nor suppose that I have offered satisfactory solutions of the several phenomena. So far as I have stated *facts*, I trust my labors will not be wholly useless.

XV. ACCOUNT

OF RAIN, &C. THAT FELL AT CHARLESTOWN, MASSACHUSETTS, IN TEN YEARS.

By JOSEPH BARRELL, Esq.

	1792	1793	1794	1795	1796	1797	1798	1799	1800	1801	average
January	550	3587	5671	2677	2390	2670	1535	1930	900	4060	2597
February	1500	3393	1423	1048	2212	4330	2700	1165	3130	3125	2402·6
March	5212	5905	4068	2916	2526	5240	3476	2570	1680	6530	4012·3
April	3144	1791	829	7115	722	3805	2980	2800	7460	3450	3409·6
May	2440	2840	831	3609	3915	3405	5612	4648	6100	2443	3584·3
June	2171	2022	2542	2087	1222	2090	3832	4360	1045	2730	2410·1
July	1825	1212	2132	5357	2285	2962	3810	2535	1770	5158	2904·6
August	1690	1087	4035	6077	1455	5090	860	2835	6936	3825	3389
Septemb.	3482	2860	1782	5266	4800	1300	1907	2460	4620	1720	3019·7
October	2020	2272	4175	4088	1995	5135	7710	3240	4426	465	3552·6
Novemb.	6324	4248	1364	2201	1020	3055	1880	1555	3620	4567	2983·4
Decemb.	130	1119	2257	3198	1225	2100	2010	3390	3740	2525	2169·4
	30488	32336	31109	45637	25767	41182	38312	33488	45427	40598	36434·6

Note. The rain gauge measures to $\frac{1}{1000}$ of an inch. It was in an elevated situation, about sixty feet above the level of high water, and so entirely detached, that it could receive no rain, but what fell immediately over it. The rain was generally measured as soon as the weather was clear.

Account of rain, that fell in the year 1802.

January	2669	June	1810	November	1660
February	453	July	2645	December	3305
March	4820	August	3790		
April	1075	September	3050		34797
May	6300	October	3220		

Account of snow from the year 1786 *to the year* 1802, *both included.*

1786 Sixteen snows this season; the first 21 Nov. 1785, the last 1 April; this last by far the most severe for the season.

1787 Twenty eight snows this season; the first 30 Oct. 1786, the last 22 April.

1788 Eighteen snows this season; the first 7 Dec. 1787, the last 9 March.—There were a few flakes the 21st of April.

1789 Twenty three snows this season; the first 1 Dec. 1788, the last 1 April.

1790 Thirty two snows this season; the first 3 Dec. 1789, the last 28 April; the last as severe as any in the season. Coldest day this season 14 Feb. Glass 9° below 0.

1791 Twenty one snows this season; the first 27 Nov. 1790, the last 19 March. *Mem.* Within thirty miles of Boston the snow fell over shoes the 27th of April. Coldest day in Feb. Glass at 4°.

1792 Eighteen snows this season; the first 23 Oct. the last 16 March. Coldest day 22 Jan. Glass 8° below 0. *Mem.* The ice was the eighth of an inch thick the 14th of April.

1793 Thirteen snows this season; the first 23 Nov. 1792, violent, the last 21 March. Coldest day 26 Dec. Glass at 6°.

1794 Thirteen snows this season; the first 28 Oct. 1793, the last 31 March. Coldest day 5 March. Glass at 1°. The 17th of May ice made considerably thick. This was said to have been the coldest season known for many years.

1795 Sixteen snows this season; the first 14 Nov. 1794, the last 16 March. The fifteenth snow was on the 14th of March, and as severe a storm, as had been known for many years. Coldest day 26 Feb. Glass at 2°.

1796 Twenty four snows this season ; the first 14 Dec. 1795, the last 10 April. The twenty first snow was on the 17th of March, the most severe in the season. Coldest day 24 Dec. Glass 4° below 0.

1797 Twenty five snows this season ; the first 24 Nov. 1796, the last 18 April. The two last, 13 and 18 April, very severe storms. The last frost this season 15 May. Coldest days 21 and 28 Dec. Glass 2° below 0.

1798 Twenty one snows this season ; the first 11 Nov. 1797, the last 17 April, a very severe storm, continued on the ground till the 18th at night. Coldest day 2 Feb. Glass 5° below 0. *Mem.* On the 19th of May there was a white frost.

1799 Eighteen snows this season ; the first 1 Nov. 1798, the last 12 May, a shower only. Coldest day 5 Jan. Glass 11° below 0.

1800 Eighteen snows this season ; the first 1 Dec. 1799, the last 23 March, a very severe storm, and much snow fell. Coldest day 29 Jan. Glass 6° below 0. *Mem.* A frost 2 May. *Mem.* From the 3d of April to the 3d of May, just thirty days, there fell $9\frac{1}{10}$ inches of rain.

1801 Ten snows this season ; the first 11 Nov. 1800, the last 10 April, when the snow in the country fell very deep. This season was so fine, that no extra cold was attended to so as to be minuted.

1802 Thirteen snows this season ; the first 2 Dec. 1801, the last 15 April. There was a frost the 6th of May. Coldest day 6 Feb. Glass 5° below 0. *Mem.* Ice made $\frac{1}{4}$ inch the 29th of April.

☞ I have no way to measure the snow.

XVI. ACCOUNT

OF METEOROLOGICAL OBSERVATIONS, MADE IN GEORGIA AND SOUTH CAROLINA.

By ABIEL HOLMES, D. D. F. A. A.

FROM meteorological observations, made during my residence in Georgia, I respectfully offer to the ACADEMY the following selections and results. For the imperfection of them, my ill health, my absence from that country during the summer and autumnal months, and the accident of breaking my thermometer, must be my apology. Imperfect as they are, they give some general idea of the temperature of the climate of Georgia, and are confirmatory of the accounts, which have been published, of the temperature of Carolina. I have taken the liberty to subjoin a few thermometrical observations, made at Savannah, in 1785, by Timothy Matlack Esq.* who favoured me with a copy of them. These, with some additional observations of other literary men respecting the heat and cold of South Carolina, will, I persuade myself, make some amends for the deficiency of my own memoir.

Cambridge, 10 *January*, 1809.

* Formerly Secretary of the American Philosophical Society.

Observations, made at Midway, in Georgia, thirty miles southwestwardly from Savannah. The thermometer used was Fahrenheit's, exposed in a north shade.

1787	Highest.	Lowest.	Remarks.
Dec.	62	30	Winds generally N. W. Observations from the 14th through the month.
1788 Jan.	64	22	Winds generally N. W. On the 6th the mercury was at 32°, wind N. the ground was frozen, and ice remained in the ditches all day. Observations for 10 days only in this month.
Feb.		20	Observations three days only. Thermometer broken.
1789 Dec.	76	28	Winds generally N. W. and weather fair. Latter part of the month easterly winds, cloudy, and some rain. Mercury at and below 32° four days in this month.
1790 Jan.	81	26	Winds S. W. and N. W. Jonquils, jessamins, and woodbines in blossom. Mercury at and below 32° seven days in this month.
Feb.	82	28	Winds N. W. and S. W. On the 23d the mercury rose to 81°; and on the 17th and 18th it rose to 80°.
March	80	31	Winds southerly. Frost on the 4th, when the mercury was at 31°; but the weather generally mild, sometimes warm.
April	66		Only one observation this month.
May	93	70	Winds southerly. The mercury rose to 93° on the 28th and 29th; and was at and above 90° four days in the month.
June	96	64	Winds generally S.E. Weather fair. Mercury was at and above 80° twenty days in this month. On the 2d I was at Sunbury, where at 3 o' clock P. M. there was a violent thunder storm, attended with hail. Two white men and one negro were killed by lightning. The wind was at N. E. The mercury, at 2 o' clock, at 84°; at 3 o'clock, at 74°.
July	86		The highest ascent of the mercury in observations of nine days only.
Dec.	64	26	Winds from N. W. to N. E. Observations begin at the 13th. On the 19th the mercury fell to 28°; wind N. E. and fair. Great frost. Ice. Frost also on the 23d; mercury at 31°. The mercury was at and above 32° four days in this month, after the 13th. On the 31st a snow storm began five minutes before 8 A. M. and continued until 11; but did not whiten the ground.

1791	h.	l.	Remarks.
Jan.	79	17	Winds generally N. W. Weather fair. The mercury rose twice to 79°. It was at and below 32° eleven days in this month. On the 31st pease were up in the garden.
Feb.	81	28	Winds variable; generally N. W. and S. W. The mercury was at and below 32° three days in this month. On the 9th a luminous column in the south, rising from near the horizon to an altitude of about 45°, continued 12 minutes, and gradually disappeared.
March	87	31	Winds chiefly southerly. Mercury was at 87° five days in this month; at and above 80°, thirteen days; and below 32° two days. On the 21st frost killed cucumber vines; mercury at 33°; wind N. W. On the 3d there was an Aurora Borealis. It appeared in the N. E. 15 minutes before 7 in the evening, and continued until 10.
April.	94	45	Winds variable; chiefly S. W. The mercury was at and above 90° six days in this month; and from 80° to 90° 7 days.
May	97	60	Winds principally N. E. from the 7th to the 18th, with clouds and rain. The rest of the month chiefly S. W. The mercury rose twice to 97°; and was at and above 90° 13 days in this month.
June	99	67	Winds generally S. E. and S. On the 11th the mercury was at 93° at 1 o'clock P. M; and at 3 fell to 67°. A heavy thunder shower produced this great and sudden change in the atmosphere. Observations from the 1st to the 21st, during which time the mercury was at and above 90° ten days.

During seven winters, I never saw the ground whitened with snow; but on the tenth of January, 1800, there fell at Savannah the deepest snow, accompanied with the severest cold, ever remembered in the lower parts of Georgia. By a letter from an intelligent friend, dated Midway, 17 February, 1800, I was informed, that the snow had been three feet deep in particular places, and from sixteen to eighteen inches on a level. A sleet, the same winter, loaded the trees with ice from Broad river (South Carolina) toward the Savannah, a space of ten or fifteen miles, and made great devastation in the forests.

Observations at Savannah, with Fahrenheit's thermometer, in the year 1785, *by T. Matlack, Esq.*

May 29 S	M	T	June W	T	F	S
64	67	84	86	85	76	85
83	84	86	84	82	81	76
81	85	78	74	84	84	89
82	84	86	84	92	91	85
					July	
82	85	76	74	80	82	84
86	88	90	96	96½	96	90
85	88	94	83	84	88	86
89	86	82	79	82	92	86
86	84	86	84	86	91	83
78	82	82	83	86	86	

The wells in the town are from sixteen to eighteen feet deep, through a fine sand, and the water is 66 and 67°. This spring having been uncommonly cold, no heat in the air could, at the end of May, have raised that of the water beyond the true medium heat of this country, which, I should think, may be fairly estimated at 66°.

N. B. The initial letters indicate the days of the week ; the figures, the highest ascent of the mercury.

Thermometrical observations, by Fahrenheit's scale, in the shaded air, taken at Charleston, South Carolina.

1750		1751		1752		1753		1754		1755		1756		1757		1758		1759	
h.	l.	h.	l.	h.	l.	h.	l.	h.	l.	h.	l.	h.	l.	h.	l.	h.	l.	h.	l.
96	25	94	23	101	18	91	28	93	22	90	27	96	26	90	25	94	25	93	27

1791		1792		1793		1794		1795		1796		1797		1798	
90	28	93	30	89	30	91	34	92	29	89	17	88	22	88	31

Additional remarks.

The greatest range of the mercury in 24 hours, according to observations in Charleston, South Carolina, is said by governor Drayton to be	46°
Greatest range in Salem, according to Dr. Holyoke,	41°
Difference between the greatest range at Charleston and Salem	5°

The coldest day, according to my observation, was 2 January, 1791, when the mercury was at	+17°
The coldest, according to Dr. Holyoke, was 17 January, 1786, and 23 January, 1792, when the mercury was at	—11°
Difference between extreme cold at Midway and Salem	28°

On the 23d of January, 1792, when the mercury fell to 11° below the cypher at Salem, it fell to 20° at Montreal.* The difference therefore between the extreme cold at Montreal and Midway is 37°.

Limited as the MIDWAY observations are, they probably reach nearly to the *extremes* of heat and cold in the climate, in which they were made. In the eighteen years' observations at Charleston, South Carolina, it is observable, that the mercury at no time rose above 101°, or fell below 17°; the greatest ascent being two degrees only above my *maximum* of heat; and the greatest descent, in exact coincidence with my *maximum* of cold. Drayton says however, that the mercury has fallen as low as 13° in the lower country of South Carolina.

In the coolest summers of Carolina, it appears, that the mercury reached 88°; and in eight years (from 1791 to 1798) it never rose above 93°, or fell below 17°. Hewatt† says, he has seen the mercury in Fahrenheit's thermometer rise in the shade to 96° in the hottest, and fall to 16° in the coolest season of the year. "In 1788," governor Drayton says, "it rose to 96°, which is the greatest heat we know of since the year 1752. The difference therefore between our coolest and warmest summers at this time may be supposed to range between 89° and 96°; and the difference of our mildest and severest winters between 17° and 34°."

....

* Memoirs of Academy, ii. part 1, p. 118.

† Author of the History of South Carolina and Georgia; whose residence was in Charleston.

Dr. Chalmers, who in 1766 published an account of the weather and diseases of South Carolina, says, that in the remarkably hot summer of 1752 he exposed a thermometer, at the distance of five feet from the ground, to the rays of the sun ; and in 15 minutes the mercury rose to the utmost height of the instrument, which was graduated to 120 degrees only, and would have burst the vessel, had he not withdrawn it. From experiments, which he made afterward, he judged that the mercury would have risen 20 degrees higher.

The mean diurnal heat of the different seasons, Hewatt observes, has been, upon the most careful observation, fixed at 64° in the spring, 79° in summer, 72° in autumn, and 52° in winter ; and the mean nocturnal heat in those seasons, at 56° in spring, 75° in summer, 68° in autumn, and 46° in winter. According to this estimate, the medium heat of Charleston is 64°, that is, 2° less than Mr. Matlack estimates the medium heat of Savannah. This difference of temperature might be expected from the difference of latitude of the two places, and the proximity of Charleston to the sea.

The quantity of rain, which fell in Charleston, South Carolina, in seven successive years, according to governor Drayton.

Years	inches	Years	inches	Years	inches
1795	71·8	1798	45·2	1800	51·6
1796	58·1	1799	75·4	1801	42·9
1797	55				

Mean quantity of rain in Charleston for ten years, viz. from 1750 *to* 1786, *inclusively, according to governor Drayton.*

Spring	6·09 inches	Winter	6·01 inches
Summer	12·73		
Autumn	16·90	Year	42·03

XVII.

METEOROLOGICAL OBSERVATIONS, AT GROVE PLANTATION, FIVE MILES SOUTH OF NATCHEZ.

By WINTHROP SARGENT, Esq.

Late governor of the Mississippi Territory.

Communicated by the reverend President Webber.

Days of rain and no rain, with quantity of water falling, &c. Snow reduced to water, and measured as rain.

Years	1798		1799		1800		1801		1802	
Months	No rain	Rain or snow	No rain	Rain or snow	No rain	Rain or snow	No rain	Rain or snow	No rain	Rain or snow
Jan.			22	9	24	7	20	11	19	12
Feb.			16	12	23	5	18	10	17	11
March			21	10	20	11	25	6	20	11
April			19	11	21	9			15	15
May			25	6	21	10			20	11
June			20	10	22	8			25	5
July			21	10	21	10			15	16
Aug.	18	13	20	11	24	7			13	18
Sept.	27	3	17	13	23	7			24	6
Oct.	22	9	26	5	24	7			26	5
Nov.	26	4	23	7	23	7			19	11
Dec.	19	12	18	13	23	8			16	15
			248	117	269	96			229	136
			2d.sn Feb. & De.		3d.sn. J. F.& Dec.				Dec. 1st d. snow	

Years	1803		1804		1805			1806			1807		
Months	No rain	Rain or snow	No rain	Rain or snow	No rain	Rain or snow	Rain on a level in 225 parts of an inch	No rain	Rain or snow	Rain in 225 parts of an inch	No rain	Rain or snow	Rain in 225 parts of an inch
Jan.	24	7	25	6	23	8		26	5	861	26	5	634
Feb.	18	10	24	5	25	3		20	8	402	14	14	1313
March	24	7	20	11	25	6		24	7	421	23	8	959
April	21	9	23	7	26	4		22	8	533	22	8	1352
May	20	11	24	7	22	9		16	15	2067	29	2	180
June	26	4	24	6	17	13		17	13	506	23	7	975
July	20	11	22	9	12	19		19	12	942	24	7	185
Aug.	26	5	13	18	14	17		17	14	876	24	7	270
Sept.	18	12	23	7	23	7		23	7	209	24	6	755
Oct.	21	10	28	3	23	8		25	6	658	31		
Nov.	18	12	20	10	23	7		20	10	951	23	7	380
Dec.	22	9	21	10	19	12	1427	18	13	1002	24	7	1300
	258	107	267	99	252	113		247	118	9428	287	78	8303
	Jan. 1st d. snow		Mar. 1st d. snow		Jan. 3days snow			Dec. 2d d. snow					Jan. 17 snow

1808.

	No rain.	Rain.	Rain in 225 pts. in.		No rain.	Rain	Rain in 225 pts. in.
Jan.	19	12	1679	Aug.	20	11	940
Feb.	22	7	931	Sept.	21	9	189
March	23	8	907	Oct.	23	8	640
April	20	10	2005	Nov.	24	6	695
May	24	7	1132	Dec.	24	7	1961
June	11	19	1200				
July	19	12	1779		249	116	14058

Jan. 27, snow.

Latest vernal and earliest autumnal frosts and state of the thermometer; also lowest state of the thermometer, from 1798 *to* 1808, *both inclusive; the thermometer never above* 96° *in the shade.*

		Thermom.
1798	Sept. 29 frost	
	Dec. 10	27°
1799	Feb. 22	22
	April 6	38
	7	38
	Nov. 13	41
	Dec. 30	23
1800	Jan. 3	20
	March 11	38
	Oct. 6	36
	7	41
	19	43
	Nov. 21	21
	Dec. 12	11
1801	Jan. 3	25
	March 29	35
	Nov. 7	30
	Dec. 12	28
1802	Jan. 10	27
	Feb. 23	25
	March 28	34
	Sept. 24	38
	Nov. 28	20
1803	March 2	20
	April 5	37
	Nov. 6	36

		Thermom.
	Dec. 3	27°
1804	Jan. 25	19
	March 3	20
	April 1	35
	Oct. 19	49
	26	39
	Dec. 10	26
	30	25
1805	Jan. 12	21
	April 23	46
	Oct. 21	40
	Dec. 29	36
1806	Jan. 9	19
	April 11	42
	18	44
	Oct. 31	32
	Dec. 1	29
	13	29
1807	Jan. 18	24
	19	13
	20	20
	Feb. 7	12
	March 19	30
	31 light frost	38
	April 2 severe frost	39
	3	32

	Oct. 27 frost	40°	22	do	34°
	30	39	April 17	do	38
	31	39	27	do	49
	Nov. 28	29	Oct. 13	do	44
	Dec. 19	28	23	severe frost	39
1808	Jan. 15	16	24	do	32
	Feb. 9	29	Nov. 24		32
	March 21 light frost	38	Dec. 25		20

XVIII. ABSTRACT

OF METEOROLOGICAL OBSERVATIONS, MADE AT MICHILLIMAKKINAK, IN THE LATITUDE OF ABOUT 46° N, AND LONGITUDE OF ABOUT 84° 30′ W.

From August 1802 *to April* 1803, *both inclusive.*

BY JOSIAH DUNHAM, Esq.

Months.	Thermometer.					Course of wind.			Weather.
		Day	☉ ri.	noon	☉ set	☉ ri.	noon	☉ set	
August	Highest	24	76			W			No. of fine days 17
		23		80			W		Of rain 6
		23			79			S W	Fog 4
	Lowest	13	36			S			Thunder 3
		5, 28		61			N&E		
		11			38			NW	
	Mean		63	71	67				
Sept.	Highest	13	72			E			Fine days 11
		14		72			W		Rain 6
		12			73			S	Fog 1
	Lowest	23	48			N			Thunder 1
		24		50			S W		
		24			50			S W	
	Mean		56	62	57				
Oct.	Highest	6	66			E			Fine days 8
		3		72			W		Rain 7
		13			69			N	Snow 2
	Lowest	30	30			S			Fog 2
		30		30			S		
		31			30			S	
	Mean		48	51	54				

Months.		Thermometer.				Course of wind.			Weather.	
		Day	☉ ri.	noon	☉ set	☉ ri.	noon	☉ set		
Nov.	Highest	6	59			S			No. of fine days	10
		6,7		60			S		Rain	4
		6			60			E	Snow	3
	Lowest	2	29			N			Fog	4
		26		32			W			
		3,26			30			W		
	Mean		40	43	42					
Dec.	Highest	1	49			N				
		1		46			N		Fine days	7
		1			40			N		
	Lowest	16	—11			N			Snow	7
		16		—8	—2		N		Fog	1
		16						N		
	Mean		19	22	21					
Jan.	Highest	11,14	32			E				
		11		36			E		Fine days	5
		13			36			W		
	Lowest	27	—14			N	—		Snow	8
		2,3		—7			WN		Blustering	9
		2			—8			W		
	Mean		11	15	14					
Feb.	Highest	12	38			E				
		21		50			W			
		21			48			W	Fine days	22
	Lowest	4	—24			S			Snow	1
		4		—12			S			
		3			—12			S		
	Mean		12	21	20					
March	Highest	20	43			W			Fine days	15
		20		48			W			
		19			49			W	Rain	5
	Lowest	5	—10			N			Snow	3
		1		—6			N			
		5			—4			N	Fog	4
	Mean		21	29	25					

Months.		Thermometer.				Course of wind.			Weather.	
		Day	⊙ ri.	noon	⊙ set	⊙ ri.	noon	⊙ set		
April	Highest	20	55			S			Fine days	9
		28		57			S W		Rain	9
		12			55			NW		
	Lowest	7,9	20			S&E			Snow	3
		20		25			S			
		6,8			28			N	Thunder	1
	Mean		35	44	39					

XIX.

METEOROLOGICAL OBSERVATIONS, MADE AT BOWDOIN COLLEGE;

In a letter to Mr. Levi Hedge, F. A. A. *Tutor in Harvard College.*

By PARKER CLEAVELAND, A. M.

Professor of Mathematics and Natural Philosophy.

Bowdoin College, 29th Sept. 1808.

DEAR SIR,

I SEND you a short extract from my meteorological journal; by which you will be enabled to form some opinion of the extremes of temperature in this section of the District. I well know that a series of observations for several years is necessary to the forming of a correct estimate; but such a series is not yet attainable in this part of the country. The mean temperature of our climate, deduced from the greatest heat and the greatest cold, is a little lower, perhaps from $\frac{5}{10}$ to $\frac{9}{10}$ of a degree, than that reduced from three observations a day. This extract consists of observations of the greatest heat and the greatest cold during the months of January, February, and March in the years 1807 and 1808. I am informed by those, who have for a long time resided in this place, that the cold of the aforementioned months in the year 1807 was unusually severe; and, on the other hand, that the same months in 1808 were milder, than in common years. The thermometer, which I use, was made by Mr. Six; and is sensible and accurate. It is constantly exposed to the air, suspended at the northern side of a building, about seven feet above the ground. There is no large object near it, excepting that, to which it is attached. Its height above the ground, and the very small quantity of snow, which usually lodges underneath it, effectually prevent the influence of any cold, in addition to that derived from the atmosphere. The degrees are those of Fahrenheit. In settled weather I have invariably found the greatest cold to be a little before the appearance of day break.

1807. January.		1808. January.	
Mean of the greatest cold	+ 4°·46	Mean of the greatest cold	+10·91
Mean of the greatest heat	+24°·29	Mean of the greatest heat	+27·10
Mean temperature	+14°·37	Mean temperature	+19
Greatest range in 24 hours	+54°	Greatest range in 24 hours	37·5

Mean temperature of January from both years +16°·68·

February.		February.	
Mean of the greatest cold	+10°·4	Mean of the greatest cold	+19°·58
Mean of the greatest heat	+29°·83	Mean of the greatest heat	+33°·48
Mean temperature	+20°·11	Mean temperature	+26°·53
Greatest range in 24 hours	40°	Greatest range in 24 hours	41°·5

Mean temperature of February from both years +23°·32·

March.		March.	
Mean of the greatest cold	+21°·56	Mean of greatest cold	+23°·37
Mean of the greatest heat	+42°·35	Mean of greatest heat	+47°·77
Mean temperature	+31°·95	Mean temperature	+33°·57
Greatest range in 24 hours	42°·5	Greatest range in 24 hours	35°

Mean temperature of March from both years +32°·76.

The frost has commenced very early with us this season. Several plants in my garden were destroyed as early, as the middle of August; at which time we had frost on two successive nights. On the 22d instant ice was formed two tenths of an inch thick.

Doctor Holyoke, in his " Estimate of the heat and cold of the American atmosphere, beyond the European, in the same parallel of latitude," suggests that this excess is in part attributable to the large number of evergreens growing upon the continent. If this be true with regard to the continent at large, some particular sections of the country, in which evergreens abound, may have an excess of cold above those parts of the same country, which have fewer evergreens. Surrounded as I am by trees of the aforementioned description, I design to pay further attention to this subject by observation and experiment.

Should you think this short extract worthy of any other preservation, than on your private files, it is at your command

as well, as your friend and

humble servant,

PARKER CLEAVELAND.

XX.

THE QUANTITY OF WATER (INCLUDING THE SNOW REDUCED TO WATER) WHICH FELL IN STOW FROM 1792 TO 1804,

According to the observations of

Rev. JONATHAN NEWELL, A. M.

A.D.	inches	A.D.	in.	A.D.	in.
1792	33·912	1793	33·587	1794	34·981

	1795	1796	1797	1798	1799	1800	1801	1802	1803	1804
Jan.	3·060	3·110	1·070	2·081	1·895	·860	3·965	2·700	2·875	3·340
Feb.	2·120	2·255	3·800	2·000	2·155	3·105	2·490	0·975	5·205	3·720
March	3·600	2·415	4·559	3·765	4·325	2·200	8·270	5·410	2·670	2·575
April	7·430	1·037	4·461	2·520	3·105	5·155	2·500	0·740	2·065	6·240
May	4·713	5·930	3·330	3·895	3·600	3 955	4·320	6·265	2·165	2·305
June	3·080	1·480	1·895	3·740	8·185	2·040	2·585	2·625	·880	3·340
July	5·790	5·260	1·700	2·530	2·700	2·714	4·050	3·060	8·085	2·580
Aug.	4·826	2·100	3·951	1·275	1·275	4·510	2·530	7·725	1·760	1·990
Sept.	4·920	5·578	1·850	2·715	2·805	4·705	1·110	4·145	1·250	2·215
Oct.	4·341	1·674	5·970	7·300	1·850	5·050	0·910	3·580	3·820	6·172
Nov.	1·735	1·035	3·100	2·370	2·560	2·880	3 320	1·020	2·145	3·110
Dec.	2·761	2·600	1·840	2·310	2·830	3·690	2·810	3·700	4·295	3·460
Total	48·376	34·474	37·526	36·501	37·285	40·904	38·860	41·945	38 215	41·047

XXI.

A CURIOUS PHENOMENON OF VISION.

In a letter to . . . .

By Rev. PERES FOBES, LL.D. F. A. A.

SIR,

AS a lover of science, and especially of optics, I have been careful to observe whatever has appeared to have any connexion with it. As such, the following instance of a *telescopic eye* has arrested my attention and curiosity, and may probably affect others in the same way. I have therefore sent the case to the American Academy. It happened a few years ago to a man about forty six years of age, whose name is Preserved Pierce, of Somerset, near Slade's Ferry, in the county of . . . .

He was painfully exercised with a kind of ulcer collected in his head, on account of which he was for several days confined to his house ; in which time his eye sight was extremely weak and tender, in so much that he could not, without great uneasiness, endure any degree of light. The room was during the whole time constantly darkened. At length however the supposed ulcer broke. This happened in the night. The next morning he was entirely free from pain, and in a state of sensible ease and comfort ; his mind, which before had been greatly depressed and confused, was now quite free and composed. On the return of the morning, the sun being about an hour high, he arose and went to a south window, through which he looked, and to his great surprise he saw, at a place called Reed's warehouse, near the ferry, at the distance of near two miles, a cart and yoke of oxen. He could plainly discern the colour of the oxen, the rounds in the cart, the stones on the beach, and even the courses and joints in the shingles on the ware-house. This extraordinary degree of acute, telescopic vision continued for about one hour ; after which his sight returned to its usual state. His health, which continued for some time after this in a low state, was finally restored ; but from that memorable period to the present time he never could see to read or discern small objects without glasses.

I received this account from Mr. Pierce, and from others acquainted with him. I am told that he is a man of judgment and veracity. I should have risqued an attempt to account for this curious phenomenon from the structure of the eye and principles of optics, but time was wanting. But if the fact should be admitted, its solution may be the subject of a future dissertation, with which I hope to offer a communication, that was intended for this meeting, on the production of ore, in which is attempted a chemical investigation of its nature, growth, and generation, founded on experiments ; from which it is rendered more than probable, that the farmer will hereafter be able to raise a bed of bog ore as easily, as a bed of carrots.

I am, sir, with esteem,

your most humble servant,

PERES FOBES.

Raynham, August 21, 1793.

XXII.

HARD WATERS SOFTENED BY A FARINACEOUS SOAP, WITH THE PROCESS FOR MAKING THE SAME.

By Rev. DANIEL LITTLE, F. A. A.

Wells, May, 1787.

IT is well known, that the waters from many springs and wells, not only in populous cities on the sea coast, but in many parts of the country remote from sea water, are hard and unfit for washing. And so great are the advantages of soft and pure water for washing, bleaching, &c. that any method, by which rough and hard water may be rendered more fit for use, if only in the laundry, may deserve some notice, and lead the way to farther experiments.

My well for family use has been dug about thirty years. It is four miles from the sea and twenty rods from a salt water river; fifteen feet in depth; the bottom of which is eight feet above the tide at high water mark. This well has afforded a plenty of water in the driest seasons; but so unfit for washing, that we have always been dependent on the rain or snow for that purpose. Not far distant from this well there are some large pans and deep beds of iron ore, to which we have in part ascribed the bad quality of the water. But of late we have used a different kind of soap, by which the water of this well is rendered nearly equal to river or rain water for washing linen. The soap is made without oil or animal fat; in lieu of which we use about the same quantity of the fine meal of indian corn, or other farinaceous substances.

The process is very simple. The quantity of meal must be in the proportion to the quantity and strength of lie. If the lie will bear an egg, let the quantity of meal be near the same, that is commonly used in making water gruel, or such quantity as the lie willfully dissolve; and most intimately incorporate with itself. Mix the meal first with cold lie, to the consistence of a thin paste; then pour the same into the pot or kettle of boiling lie, which you intend for soap, so gradually, that the boiling may be discontinued as little as possible; then let it boil three or four hours, and when cold it will appear much like common soft soap.

Although the hardness of some other waters may arise from different causes, to which this soap may not have so great an affinity; yet the poor, who often have good water, but a scarcity of oil or animal fat, may avail themselves of a new and easy process for making soap, fit for almost every family use. Although it will not lather like the soap made with grease, yet for washing and bleaching linens, for scouring floors and wooden utensils of the kitchen and dairy, it has been found equal to any other kind of soap. As the aqueous part of this soap will more easily evaporate, than that, which is made with animal fat, let it be well covered, and kept in a cool place. A little experience will ascertain its utility, and perhaps suggest new and more useful improvements.

XXIII.

MINERALOGICAL OBSERVATIONS, MADE IN THE ENVIRONS OF BOSTON, IN THE YEARS 1807 AND 1808.

Inclosed with a letter to the Hon. John Davis, Esq. F. A. A. and by him communicated.

BY S. GODON, F. A. A.

Introduction.

A KNOWLEDGE of the physical objects, which compose the mineral riches of a country, is so much connected with the well-being of the people, who live in it, that we cannot reflect, without amazement, on the inattention to this study, which so long prevailed among nations in general. It is but a few years since men have begun to perceive its importance, and its connexion with public and private utility.

One of the most happy results of the improvement of natural history at the end of the last century is, undoubtedly, its procuring to the present age the way of discriminating and describing minerals with exactness and perspicuity ; so that a mineralogical description may circulate and be understood in the several parts of the world, where the language of natural sciences has penetrated. And while the present generation enjoys the labours of the modern naturalists, we indulge the comfortable hope, that the fruits of our own observations will not be lost to posterity.

Few publications of this description have been yet attempted, and these have been almost entirely limited to Europe. It is to be expected, that the example, given by this part of the world, will be followed by every other enlightened people, who may begin to perceive the great interest they have in the investigation of their soil. These local observations become even worthy of general attention, when we consider, that from the insulated descriptions of several parts of the earth we may expect in time an universal mineralogical map, which will afford in some measure, under a single point of view, a representation of all the riches in the world.

The observations, which I now present, are the sketch of a mineralogical description of the country, which surrounds Boston, to which a too short stay in that part of the United States prevented me from putting the finishing hand. I offer them to you in their state of imperfection with the hope, that they will be completed by some of your fellow citizens, whose increasing taste for mineralogy presages to the people of Massachusetts a flourishing period for this science.

The result of my observations, and the wish of communicating them in the most brief and plain manner, have induced me to make a slight alteration in the nomenclature of some rocks. I consider the principal aggregate mineral, as a distinct *genus*, which should have a single name, to which may be added a *specific* one, taken from the accidental occurrence of some element, or from some striking property. This binary denomination, which prevents troublesome periphrasis, agrees with the basis of general nomenclature, established in natural history.

These changes are limited to the rocks, described in the following dissertation ; and I present them to those, who are dedicated to mineralogical meditations, as an essay of a reformation, which observations, made in this vast continent, appear to render necessary in the nomenclature of the rocks, which compose the primordial soil, and even which form the whole series of the geognosical table.

—Si quid novisti rectius istis,
Candidus imperti ; si non, his utere mecum.

Definitions and preliminary explanations.

Primordial soil. I call primordial, that part of the surface of the earth, formed of some of those simple or aggregate mineral masses, commonly called *rocks*, which have never been found containing *remnants of organized bodies*, and which are supposed to have been preexistent to the formation of animals and vegetables. I take this definition in its most extensive sense, without admitting any gradation in antiquity, among primordial rocks, for fear of bending my observations to some systematic opinion.

Amphiboloid. (Amphibolic rock, Haüy; Grünstein, Graustein, Werner.)

An aggregation, most frequently of amphibole and felspar, admitting in its composition quartz, epidote, talc, mica, and almost always sulphurated iron. Amphibole, which characterises this rock, is supposed to be the predominant substance. When the felspar is in greatest proportion, it takes the name of *felsparoid.*

Felsparoid. (Felspathic rock, Ha.; Syenite, Wer.)

An aggregation of felspar and amphibole; sometimes of felspar quartz, amphibole; also epidote and mica. When the felspar loses its laminary aspect, and assumes a compact texture, the rock takes the name of *petrosilex.*

Petrosilex. (Petrosilex and compact felspar, Ha.; Lametherie; uncertain among other mineralogists.)

A rock, homogeneous, or apparently so, of a splintery and semiconchoidal fracture, sparkling most frequently with steel, and of a great variety of colours. It often includes small crystalline particles of felspar, quartz, epidote, and even metallic substances. *Fusibility* before the blowpipe is the characteristic of this rock. When destitute of fusibility, it belongs to opaque-compact quartz (Hornstein of the Germans.)

When crystals of felspar exist in it, in notable proportion, it takes the specific designation of *porbhyritic*. The denomination of porphyry, being relative to an accidental disposition of elements, is reduced to a specific name.

Argilloid. (Thonschiefer, Wer.)

It has a degree of softness, which permits it to be deeply scratched by the knife, complete opacity, and an argillaceous smell, when breathed on. It presents, as well as petrosilex, a great diversity of colours, and has most frequently a foliated texture. Petrosilex and argilloid unite by an insensible transition.

Wacke. (Wern.)

A conglutination of orbicular, elliptical, and sometimes angular kernels or nodules of all sizes, commonly of the same nature as the primordial rocks above mentioned, particularly felsparoid, petrosilex, argilloid, and quartz.

Amygdaloid. (Mandelstein, Wern.)

Round or elliptical kernels of felspar, carbonated lime, quartz, epidote, united together by a cement, apparently homogeneous to the sight.

NOTE.—I have placed between parentheses the name of the town, where the observation is made.

The sign ▭ indicates that the mineral is found in place.

The sign ○ indicates that it is found in loose fragments.

The numbers, in the table, refer to the corresponding numbers of the different paragraphs of the geognostic description.

For the simple minerals, I have adopted the nomenclature of Haüy ; but, for greater clearness, I add, to each species, a synonym, either vulgar, or adopted from some known author. The word *species* must not be taken in too rigorous a sense, particularly with regard to rocks. The divisions established, among natural beings, exist not in nature ; and are merely intended to facili tate their study, or to simplify the language.

Vegetable earth. Alluvial deposits. Waters.

1. Some alluvial deposits, and the stratum, often light, of vegetable earth, excepted, the environs of Boston, and even the greater part of Massachusetts, present, almost every where, the primordial soil to the sight. The country is not mountainous, but its surface is largely and often deeply undulated. The springs, which arise from the most elevated part of the ground, often unite in basons, sometimes surrounded by hills, and form a multitude of ponds, which contribute to the embellishment of the landscape. The natural irrigation, which originates from the even disposition of the ground, maintains a constant moistness, which renders the land fertile and fit for several kinds of culture.

2. The alluvial deposits are commonly formed of a coarse quartzose sand, often mixed with a proportion of clay sufficient to permit their being made directly into bricks. They include, almost always, a great quantity of fragments of rocks, the nature of which indicates their origin from the great masses, which form the frame of the country we are describing. These alluvial heaps repose sometimes on a stratum of blue clay [Charlestown] impregnated with the oxyds of iron and manganese.

The proportion of clay, which forms a part, often considerable, of all the alluvial ground, on which rest almost all the buildings of the town of Boston, is a happy circumstance, which prevents the infiltration of sea-water, and which thus permits our obtaining, at a very short distance from the harbour, and even from under the sea itself, fresh and sweet water.

3. The waters, which flow under the ground, or which issue in springs at its surface, are frequently impregnated with foreign principles. These are principally *carbonic acid*, *carbonated lime* and *iron*, *sulphated magnesia*, and sometimes *muriated lime* and *magnesia*.

Amphiboloid.

4. In a western direction from Boston, the rock, which occurs first, is amphiboloid, which passes frequently to felsparoid, and sometimes so abruptly, that it is very easy to get them both unifed in the same specimen. These two rocks, which always alternate, appear predominant in the northern as well as western part of Massachusetts. They appear in some islands of the harbour [outward Brewster], and are directed, even under the enclosure of the town of Boston, where they break through the mossy ground of the common.

5. Amphiboloid is very variable in its aspect, and in the proportion and disposition of its constituent principles. Amphibole, which is considered as its base, is commonly dark-greenish, grey, or black, of great intensity, frequently with a lamellated texture. The rock appears sometimes consisting of this substance alone, of an uniform colour, or intermixed with light spots or veins of white and rosy felspar, and magnetic sulphurated iron [Waltham]. I then call it *common amphiboloid.*

The two elements are frequently fitted together in such a manner, as to present irregular black and white spots. The felspar is commonly white, with a shade somewhat greasy, but preserving, almost always, its laminary texture. [Menotomy ▭, Waltham ▭]. The external part of this rock, long exposed to the air, presents the felspar in a state of decomposition; but, when fresh broken, it shows great compactness, and even lustre. It is susceptible of a good polish, and may be considered as perfectly analogous to the black granite of the ancients, (*granito nero*, of the Italians). I think proper to give it the name of *granitic amphiboloid.*

7. The two elements, which compose the preceding species, are sometimes promiscuously blended together, in particles so fine and imperceptible, as hardly to permit the magnifying glass to evidence that it is a compound mineral. [Brookline O, Concord turnpike ▭]. This rock, which is an instance of the aggregation of two single minerals in a kind of moleculary state, breaks commonly into acute angular fragments, sometimes prismatic. On account of the resemblance of this aggregate with the Trapp of the Swedes, I give it the name of *Trappine Amphiboloid.*

8. Amphiboloid, considered as of an uniform colour, often includes crystal and felspar, presenting white parallelopipeds imbedded in a dark field. This variety, found contiguous to the preceding, [Lynn ▭] is ranked under the generic title of amphiboloid, with the specific name of *porphyritic.*

Porphyritic amphiboloid is frequently mixed with sulphurated iron (common pyrites).

9. A feature, which seems characteristic of the amphiboloid and felsparoid of this country, is their being frequently intercepted by veins of a substance, generally of a compact texture, and of a green colour, of various degrees of intensity. The thickness of these veins varies, from that of a sheet of paper, to two, three, or more inches. The characters, derived from the external appearance, and even those

from the chemical nature, of an earthy mineral, in an amorphous state, being insufficient to ascertain, decisively, to what species it corresponds, I remained long uncertain of the nature of this mineral; till, at length, some crystals of well characterised *epidote*, found in a small cavity of a vein of this substance, dispelled all my doubts on the subject. Soon afterward, an attentive examination of several amphiboloids demonstrated to me, that they admitted in their composition, epidote, sometimes even in a great proportion. This observation justifies the importance attributed, by Haüy, to the character of the crystalline form.

From the concurrence of epidote, among the other elements of amphiboloid, originates a rock, of a fine dark green colour, susceptible of a good polish, and which, at first sight, may be confounded with some variety of serpentine. When the elements are so entwined together, as to present a colour almost uniform, it may be considered as analogous to the rock, called *Egyptian basalt* by antiquaries, which was employed by the ancients in making figures and busts, several of which are seen in collections of the antiquities of Italy. But, commonly it consists of small acicular crystals of amphibole, imbedded in a kind of cement, composed of felspar and epidote. Some specimens present those three substances in distinct and separate state, like the elements of the granite.

This rock, which I denote by the name of *epidotic amphiboloid*, does not form so extensive masses, as the preceding species. It is found contiguous to felspar [Brighton ▭]; or in the form of veins, running across a porphyritic wacke [Brighton ▭, Dedham turnpike]. It, almost always, includes magnetic sulphurated iron, often crystallised in small striated cubes [Roxbury ○], and appearing constantly sensible to the magnet. It is of great tenacity, with a rough fracture. It falls into polyedrons, which sometimes present a prismatic shape. Fragments of this rock, exposed at the surface of the earth, seem more forcibly to resist decomposition, than most of the other species of amphiboloid.

Epidotic amphiboloid is susceptible of admitting crystals of felspar, and thus becoming *porphyritic.* Such are some fragments, found in loose pieces, particularly on the Blue Hills. This remarkable variety presents crystals of white felspar, sometimes of an inch in one dimension, accompanied by cubic sulphurated iron, and globules of laminary carbonated lime of a perfect transparency ; the diameter of these globules not exceeding three or four lines.

By comparing the green antique porphyry, with a variety of porphyritic amphiboloid, found in this country, and which includes epidote, I am induced to consider this rock, the locality of which is unknown to the moderns, as also admitting epidote in its composition, and, probably, as receiving its fine colour from this substance. I place this variety, which I have not observed in place, near the porphyritic amphiboloid, with the designation of *ophites.*

10. Sometimes amphiboloid admits quartz in its composition, *(quartzose amphiboloid)* and even appears formed entirely of amphibole and quartz. This rock is distinguished by some light veins of quartz, by a fracture somewhat conchoidal, and by its resisting, more than any other, spontaneous decomposition [Menotomy ○]. When these elements exist in fine mixture, so as to present as it were an homogeneous paste, it is hardly possible to distinguish it from *trappine amphiboloid* when found in insulated pieces [Roxbury ○, Brighton ○]. Both these rocks, when conveniently cut and smoothed, may be used as *touch-stone.*

11. I give the name *micaceous* to the amphiboloid including mica. This last mineral appears not uniformly distributed, but accidentally disseminated in some parts of common and granitic amphiboloid [Menotomy ○, Concord turnpike □]. Its most usual colour is the

yellow of tombac. Some fragments of this species, when struck by the hammer, emit a remarkable metallic sound. I will no longer insist on these two rocks, which I have not observed in masses of considerable magnitude.

12. I terminate the series of the species of amphiboloid, by that which admits talc in its composition (*Talcous amphiboloid*). This rock seems to consist entirely of black amphibole, and talc of a dark green colour, which, when the rock is fresh broken, is perceived even under the form of thin hexagonal lamina. All the parts of this rock appear sensible to the magnet, though the magnetic sulphurated iron, which exists in it, may not always be discernible.

This aggregate has neither the hardness, nor the tenacity, ascribed to amphiboloid. When exposed at the surface of the soil, it undergoes a rapid decomposition, and occurs with a spheroidal or elliptical shape, the surface of which is formed of thin, concentric strata without adhesion, involving a kernel of the some rock, which had not suffered alteration. This decomposition is similar to that of some rocks, observed in volcanic countries, and considered sometimes as lavas.

Talcous amphiboloid is observed forming, in *felsparoid*, a subordinate stratum, directed from northwest to southeast. [Braintree, on the Braintree and Weymouth turnpike ⌓]. The surface of the stratum occurs with an appearance somewhat slaty, and some parts of it present an uniform texture, with the same hardness and colour, which indicates that this rock unites to that, which will be described under the name of *argilloid*.

Felsparoid.

13. The above description spreads some light on the nature of this rock, which is distinguished from the preceding, merely by an artificial consideration. In fact, by observing it attentively we find,

that it admits occasionally, and sometimes in its whole mass, the several minerals mentioned among the species of amphiboloid.

The general aspect of this rock approaches it to the granite, from which it differs sometimes only by its geognostic situation. It predominates north of Boston, and on the south side of that place (about nine miles), where it forms an extensive ridge, which appears to be spread from the east to the west, beginning from the sea coast.

14. Felsparoid is often formed of nothing but felspar and amphibole. It then occurs principally north of Boston. The felspar in it is sometimes red-brown, but more frequently whitish, with an imperfect lamellary texture, and an aspect somewhat greasy [Chelsea □]. Sometimes white and red felspar are united in the same specimen. To this kind I give the name of *common felsparoid.*

15. This rock is more frequently found consisting of uncoloured felspar, hyaline quartz, amphibole, and sometimes small particles of talc of a light green colour. Felspar, which forms the greatest proportion, is frequently whitish, but often with a light brown or reddish brown colour. Quartz is the next in proportion; and amphibole, of a dark blue, or an imperfect black colour, exists sometimes, but in rare crystals, disseminated through the other elements. This amphibole is sometimes *attracted* by the magnet. Such is the composition of the rock, which exists in vast body at Weymouth, Braintree, and Quincy, (□) from whence it is transported to Boston for the purposes of civil constructions, particularly for making the first courses of buildings. There is a variety consisting of crystals of amphibole of a bright black colour, disseminated through white felspar of a pearly aspect. It is susceptible of a good polish, and is found beautiful on the north side of Boston [Newburyport turnpike □].

I consider also as of this species a variety of a pleasant reddish, sometimes rosy colour, which occurs commonly, not in large masses, but sometimes in powerful veins across the amphiboloïd. [Menotomy □, Lexington ○]. In this rock, which I found almost always including quartz, the felspar exists in large lamina, often interrupted by layers, commonly thin, of compact epidote. Amphibole and quartz are, sometimes, in but slight proportion in this rock.

I unite the above varieties under the specific denomination of *quartzose.*

16. Epidote enters sometimes into the composition of felsparoid. Many specimens present this substance, easy to be known, distributed, in equal proportion, with felspar, quartz, and amphibole ; but most frequently it is intimately united with felspar, which then assumes a more or less intense shade of green, from the usual colour of this mineral [Dedham □, Lynn □]. This species, which, according to the basis adopted for this nomenclature, takes the name of *epidotic felsparoid*, contains sometimes sulphurated iron.

17. Mica also appears among the elements of this rock, and communicates to it, in some cases, the aspect and characters ascribed to granite. Many instances of this aggregate are to be observed in several spots [Brighton □, Roxbury □, Dedham □]. The mica often exists in small scales [Newton ⊙], and frequently it occurs in plates, of an inch in diameter, and of a smoaky colour. Sometimes the rock seems a mixture of mica and felspar alone. In some cases it includes garnet, rarely tourmaline [Dorchester, Roxbury ○] ; also oxydulated iron. (Magnetic iron ore, Kirwan) [Brighton □].

This species, which I call *granitic*, does not form so extensive masses, as the preceding. It is found contiguous to argilloid [Brighton □] ; alternating with, or rather interposed in the middle of porphyritic wacke [Brighton □, Roxbury □].

An insulated specimen of granitic felsparoid may be taken for true granite ; but geognosists agree in considering this last, which alternates with gneiss and micaceous schistus, as belonging to another order of rocks, and to another formation. Time will determine what is the value of this distinction.

18. Felsparoid presents in general no distinct stratification. It includes often veins of amorphous hyaline quartz, sometimes full of cavities, where this mineral exists with a crystalline shape. (Commonly var. prismoid). It falls most often into polyedrical fragments, the faces of which are often very smooth. Exposed to the contact of the air it moulders; and, when the felspar is in great proportion, its whole surface consists of an argillaceous crust. In a fresh state the several kinds of this rock are susceptible of a fine polish, even superior to that of granite.

When the elements of felsparoid begin to be entwined together in a confused state, so as to take the appearance of a homogeneous paste, it assumes the characters ascribed to petrosilex. [Brushhill turnpike]. When crystals of felspar remain imbedded in this uniform paste, it constitutes the porphyry about to be described among the species of petrosilex. The transition of felsparoid to petrosilex and porphyritic petrosilexis frequently observed in the compass of the present observations. [Milton □, Blue hills □, Malden □].

Petrosilex.

19. Mineralogists have generally considered petrosilex as a simple mineral, and respectable authorities agree in placing it among the varieties of felspar. But if we consider, that most of the great mineral masses of the globe consist of an aggregation of distinct species; that petrosilex accompanies these rocks, and forms itself vast masses and even mountains; that among the specimens of it, which are found in nature, or seen in collections, hardly one is ever observed perfectly free of foreign substanses visible to the eye; we may entertain

some doubts on the supposed simplicity of this mineral, and endeavour to inquire from the circumstances, which accompany it in nature, whether an apparent homogeneity may not conceal an aggregation of elements (I mean of simple minerals), in a state of tenuity, which will not permit them to be perceived by our senses.

The mineralogic soil, which is now under our observation, appears well adapted to diffuse some light on this subject. Most of the different varieties of petrosilex known, being found in great plenty in this part of Massachusetts, and their intimate analogy with the *feldspath porphyre* and *klingstein porphyre* of Werner being evinced by observation, I unite them all under the general title of *petrosilex*, admitting only of two divisions, viz. *simple petrosilex* and *porphyritic petrosilex*, under which I arrange the several species and varieties, which I distinguish.

1. *Simple petrosilex.*

20. It exhibits an infinite variety of shades of yellowish, whitish [Quincy □, Dorchester □], greyish, greenish, brown, reddish-brown, blackish. It is sometimes found of a fine texture and semi-transparency, with a white colour, slightly tinged with green [Milton □]; sometimes with rosy spots [Chelsea ○]. I denote this kind, which strikes fire with steel, and may be confounded, to the sight, with some variety of agate-quartz, by the name of *flinty*. Sometimes the same variety presents a slight red colour, verging to the carnation [Dorchester □, Brushhill turnpike ○].

21. A variety of a greenish colour falls sometimes into tabulary fragments [Dorchester □], which become sonorous by percussion. I give to this variety or species, which is analogous to the *klingstein* of the Germans, the specific name of *sonorous*, agreeably to the opinion of some mineralogists, who consider it as a distinct mineral.

But I observe, that the property of emitting a sound somewhat metallic appears dependent in this mineral on a certain degree of cohesion, together with its tabular shape, which might be easily obtained by art from several other stones. Some thin tables of black marble are imported from the East Indies, which are used in China instead of bells; and even ice itself possesses the same sonorousness, when in large plates and condensed by a great degree of frost. Some fragments of sonorous petrosilex are found interrupted by veins of compact epidote.

22. I give the name of *jasper-petrosilex* to a species, which presents a red brown or dark red colour, with but very little translucency on the edges. This kind, fusible before the blowpipe, sometimes into a white enamel, often presents several veins of different shades of reddish [Malden ⌑] ; sometimes white and red veins, running parallel to each other, in straight or curved lines [Chelsea beach O]. Most of the varieties of jasper petrosilex are susceptible of an high polish.

From the likeness of the *veined* jasper-petrosilex with some stones, which were used by the ancient Greeks and Romans in making basso-relievos, called camehuja, we are induced to admit, that most of the stones, called antique engraved stones, consist of a mineral of this kind. An ingenious naturalist has before observed, that the jasper, veined red and green from Siberia, was a petrosilex.

Some fragments of jasper-petrosilex include often spots of a flesh colour [Milton ⌑], perfectly analogous to the petrosilex of Carlshakt in Sweden.

23. Petrosilex of a homogeneous texture and a middling hardness, when smoothed conveniently, is susceptible of being used as whetstone. Some is found exactly analogous to the Turkey-stone, which, as Bened. de Saussure first observed, ought to be considered as belonging to this genus. It is probable that this part of Massachusetts

could supply the whole United States with this kind of mineral, which is sold at a pretty high price in commerce. To this species I attach the name *novacular.*

24. The naked eye, and still better the magnifying glass, discovers, in almost all the above described species of petrosilex, small particles of simple minerals; such as quartz, epidote, amphibole, small crystals of felspar, arsenical and simple sulphurated iron, &c. The grains of quartz appear particularly abundant, when it adjoins to the wacke. A variety is observed [Brushhill turnpike,] which falls into pieces, the faces of which are coated with dendrites of black manganese, which is rendered very apparent by the almost white field of the stone.

Simple petrosilex abounds principally on the north and south of Boston, where it sometimes forms hills. It is observed contiguous to wacke and felsparoid, where it appears confounding itself with these two rocks. [Quincy O, Malden □, Dorchester □, Dedham □].

2. *Porphyritic petrosilex.*

25. Most of the petrosilex above mentioned [Quincy □, Dorchester □], presenting some chrystals of felspar scattered in a whitish or brownish cement, might be considered as porphyries; but, agreeably to the common meaning we shall restrict this term to the kind, which presents crystals of felspar in a notable proportion, cemented by a petro-siliceous substance, commonly of a dark colour, as reddish, brown-red, greenish, black, &c.

26. The reddish brown variety, with white felspar, is the most abundant. It forms vast masses [Malden □, Lynn □], contiguous to felsparoid and jasper petrosilex, which evidently constitute its cement. Some fragments of considerable bulk are found, of a deep red

color, and equal in beauty to the best antique prophyry [Chelsea O, Lynn O]. This variety sometimes contains crystals of amphibole, and some particles of a deep green colour, which seem to belong to epidote.

27. Some loose fragments of porphyritic petrosilex are found of a greenish and black colour [Chelsea O, Islands of the harbour O]. This last, which presents white shining crystals of felspar, appears analogous to the black porphyry of the ancients, porfido nero of the Italians. Perhaps it is but a variety of porphyritic amphiboloid. A variety is found in the northern part of the Blue hills, presenting small crystals of a light red colour, cemented by a dark brown petrosilex, fusible into a black enamel. It is observed running across the main rock of this part of the country.*

28. The surface of petrosilex, simple and porphyritic, exposed to the contact of the air, moulders, and presents almost always an earthy crust, sometimes adhering to the tongue. In its primitive state, however, this rock is commonly so hard as to sparkle with steel, and then it is susceptible of a high polish. This polish protects it against de-

* The Blue hills are in Milton, about ten miles south from Boston, and are the highest ground in this part of Massachusetts. From the most elevated, as from an observatory, an extensive portion of this picturesque country is presented to the view. They appear to consist of felsparoid, verging to petrosilex, simple and porphyritic. This rock is often interrupted by powerful veins of quartz, full of cavities, coated with small crystals of the same substance, some particles of oligist iron, and signs of carbonated iron (brown spar).

The observations, made in this part, are common to the Hon. Judge Davis, Messrs. Joseph Tilden, Richard Webster, T. Capt, and Charles Davis. I hope these gentlemen may give more extent to the yet imperfect description of those interesting heights.

composition, generally arising from the contact of water, which has less adherence to a smooth than to a rough surface. Hence some of the ancient porphyries, which were, so many centuries past, transported from Asia to Greece, and from Greece to Italy, are still found among the ruins of this last country, sometimes in an unaltered state.

Argilloid.

29. The transitive point, which forms the limit between this rock and petrosilex, is very uncertain; and these two rocks are often found uniting themselves in the same spot [Dorchester □, Milton □]. It is highly probable they are formed of the same constituent parts, only with less cohesion in the argilloid. A property, which seems characteristic of this rock, is its tendency, when it exists in large body, to fall into thin plates; whence the vulgar name of slate commonly given to this mineral.

Its common colour is grey, [Roxbury ⌷, Brighton □], greenish [Newton ⌷], blackish [Weymouth ⌷, Governor's island ⌷]; also brown, reddish brown [Malden ⌷, Dorchester □]. A variety is found presenting thin white strata, in alternate order with brown red ones [Dorchester ⌷]. This last kind has the property of being used as whetstone, and may replace the Turkey-stone. The mineral, of both colours, has the same property.

I distinguish only two species in this rock,—the *common argilloid*, the most common kind, found in Brighton, Newton, Roxbury; and the *novacular*, that which may be used as *whetstone*.

30. This mineral often includes sulphurated iron; some fragments are found presenting veins of compact epidote, or compact carbonated lime; and others exhibit little fissures, in which a multitude

of small scales of green talc are perceived [Dorchester]. Perhaps the colour, often greenish, of this mineral, arises from the substance of talc disseminated in its mass; this colour appearing, in fact, the same with that, which would result from the mixture of a green powdered talc with a white body, such as chalk or white clay.

The property of argilloid, of being adapted to sharpen instruments of steel, that is, to produce the effect of a file, whilst it is soft enough to be cut with a knife, indicates, that it is formed of an aggregation of substances, different in their nature, notwithstanding its apparent simplicity; and we are induced to admit that one of those substances is silica in the state of quartz.

31. The observations of several chemists having ascertained the presence of fixed alkalies in several rocks of Europe, and Klaproth, in particular, having found soda in the klingstein (analogous to our sonorous petrosilex), I was desirous to verify these observations in a mineral of America. The specimen I selected was of the hardest kind of argilloid, very much like sonorous petrosilex. Its specific gravity was 2.746. Its surface was covered with a light white crust. It was taken at Roxbury, about seven miles from Boston, not far from the line, which separates this town from Dorchester.

Chemical examination of argilloid.

32. One hundred parts of this mineral (600 grains), reduced to a subtile powder, were mixed with equal parts of concentrated sulphuric acid. The mineral having been previously warmed, the mixture acquired a degree of cohesion nearly equal to the former hardness of the stone. Exposed for some time (about 15 days) to the open air, cautiously defended from the access of foreign bodies, the mixture

grew softer, and the supernatant liquor appeared of a yellow colour, indicating that the mineral had been attacked.

The part remaining solid of this mineral was separated from the liquid. Well washed and dried, it weighed 85 parts ; its loss was consequently 15. Its colour was not much altered.

The solution presented a deep yellow colour. United to the water of lixiviation, and submitted to evaporation till dryness, it abandoned a precipitate consisting of sulphat of lime, which, when dry, weighed 17,058 (effective lime 5,50).

A new quantity of water being added to dilute the remaining salts, this solution, again submitted to evaporation, when concentrated, gave a light precipitate with a concentrated solution of muriat of platina, and some traces of alum. This proves the presence of potash.

Ammonia in excess poured into this solution, occasioned a floccous precipitate of a yellowish brown colour, consisting of alumina and the oxyds of manganese and iron. Calcined in a crucible, it weighed 6,075.

The liquid, separated from this last precipitate, was submitted to desiccation, and the sulphat of ammonia, vapourised in a crucible of platina, a fixed saline substance remained, weighing nine grains. This substance, diluted in water, and abandoned to crystallization, presented a mixture of two salts well characterized sulphat of potash, and sulphat of soda.

The difficulty of an exact separation of these two salts in so small a bulk, and the uncertainty of the proportions of the component parts the sulphat of soda, which arises from the great proportion of water it absorbs and loses by exposure to air and calcination, do not permit a rigorous estimation of the quantity of each alkali. From the proportion of sulphat of potash rated at two-thirds of the saline mixture, and according to the basis taken from Bergman, the quantity of alkali has been valued at 2,50 grains for the potash, and 0,90 for the soda; or 0,41 parts potash, and 0,11 soda, of the original weight of the mineral employed.

In uniting the above results, we may admit that argilloid has given, in the fifteen hundredth parts diluted by sulphuric acid,

Lime	5,50
Alumina, stained by the oxyds of iron and manganese,	6,75
Potash, ...	,41
Soda, ...	,11
Loss, consisting of water and carbonic acid, . .	2,23
	15

The proportion of silica existing in argillaceous schistus, petrosilex, &c. being ascertained, by many analyses, never less than 55, if we suppose, that those parts beyond 55, which had not been attacked by the acid, contain a quantity of the other substances proportional to that above mentioned, we may calculate, on an average, at about *one hundredth*, the proportion of alkali contained in the argilloid submitted to this examination.

This analysis, to which the situation of a traveller did not permit me to give a greater degree of accuracy, is sufficient to establish the important fact of the existence of potash and soda as elements in some rocks in this part of the world.

Klaproth, in his analysis of the klingstein of Dounerlberg, a mountain in Bohemia, supposes the quantity of soda contained in this mineral to be a twelfth. The result of the present observations differs from that of this celebrated chemist. But if we consider the petrosilex and argilloid as aggregates, we shall not be surprised to find so great a variety in the results of the analyses of these minerals, though placed under the same title.

Wacke.

33. One of the predominant rocks of the country, and undoubtedly the most remarkable, is that bordering upon Boston in a south direction, which appears to spread itself from northwest to southeast, and which is observed, in full display, principally in the towns of Brighton, Brookline, Roxbury, Milton, and Dorchester, when it disappears under the sea.

This rock, denoted in the country by the name of plum pudding stone, is formed of conglutinated kernels, of different sizes, colour, and nature. The most apparent are,

1. Quartz, mostly opaque, compact or granulated, of a great diversity of colours (whitish, blueish, greenish, reddish, of different degrees of intensity), sometimes with the aspect of petrosilex (but without fusibility), and presenting, now and then, some small bright crystals of felspar.

2. Petrosilex and argilloid, variously coloured (greyish, blueish, reddish, 20 & 29). When the fragments of these two are predominant, the rock presents the aspect of breccia, sometimes analogous to the diaspro breciato of the Italians, antique breccia.

3. Nodules, consisting of grains of whitish, greyish or reddish

laminary felspar, often with an aspect somewhat greasy; grains of hyaline quartz, commonly uncoloured; small particles of amphibole; and sometimes a green substance, which is epidote.

4. Nodules of petrosilex involving small crystals of felspar, and sometimes grains of quartz, and presenting a perfect analogy with some porphyritic petrosilex above mentioned (25); whence I have drawn the specific name of *porphyritic.*

34. The nodules or kernels, which compose this rock, have sometimes more than a foot diameter [Brookline], with almost always an orbicular or elliptical figure. Those, which present a polyedrical form, have their angles commonly rounded. These nodules are closely fitted and joined together, without leaving any empty spaces. They are not united by a cement; for, notwitstanding the aspect of some varieties of this rock, the naked eye may observe, that the spaces which exist between these kernels, are filled, not with an homogeneous paste, but with small comminuted fragments of minerals of the same nature as the large one. Sometimes the kernels present an uniform and progressive size, down to that of sand stone, and from these this rock, in an insulated specimen, may be confounded with a free stone. I give to it the designation of *granulated.*

35. The surface of this rock, in contact with the air, is soon altered. The felspathic and petrosiliceous parts moulder into clay, and the quartzose nodules, with commonly a rough surface, remain in projecture, or come off, leaving empty the cells, in which they were included.

It falls commonly into vast polyedrons, the faces of which are sometimes smooth, as if they had been polished by the friction of a stream of water.

This rock often contains veins, sometimes very thin, of white hyaline quartz, carbonated lime and iron, (brown spar), rarely of compact epidote. Epidotic amphiboloid, felsparoid, argilloid, and amigdaloid form subordinate masses to it, or rather are interposed in the great masses of this rock. It is found contiguous to amygdaloid [Brighton]; the joining line being interrupted with large lumps of quartz, accompanied by chlorite talc, pyritous copper, and olygist iron.

36. How much attention soever I have paid to the examination of this rock *in situ*, I have never observed in it any distinct stratification. It commonly unites with the rocks previously described, and with amygdaloid, often by an insensible transition. I possess specimens, which, on pieces of four inches square each, present its different passages to felsparoid, amphiboloid, simple and porphyritic petrosilex, argilloid, &c.

On account of the difficulty of giving to this rock a name, taken from its nature, I have been induced to adopt the name of *wacke* used by the German mineralogists, who have observed this rock better than others. It corresponds to the brecia saxosa of Crousted, and to the rock of Vallorsine (pudding of Vallorsine) of Saussure. When unaltered, it is susceptible of an high polish.

37. An examination of the nature of this rock, together with its geognostic situation, concur in inducing us to consider it as belonging to primordial soil. In fact, the freshness of the substances, which form the elements of its kernels, when the internal part of it is opened, and their rapid decomposition, when in contact with air and water, prevent the supposition, that it has been formed by a union of the fragments of primordial rocks, rounded by friction, transported and deposited by waters, and joined or soldered together by a secondary operation; a supposition, which has been adopted to explain the origin of the pudding stone and sand stone, which belong to seconda-

ry soil. Besides, its bordering upon rocks considered as primordial, to which it unites by insensible transitions, and which it sometimes includes, confirms that it has a common origin with them.

If permitted to venture an opinion on the mode of its formation, we may suppose, that, as we find in it specimens of almost all the rocks, which predominate in the country, it originated from a motion, which disturbed and divided the vast deposits of felspathic, porphyritic, petrosiliceous, &c. rocks, while they were passing from the state of fluidity to that of solidity. This motion ought to be supposed as having taken place, before the complete solidification of these rocks; since the compactness of the wacke indicates that its elements were in a state of softness, which permitted the union of these heterogeneous bodies to form a solid mass. Moreover this aggregation cannot be supposed to have been formed after the last cast of the primordial deposit, because the rents, which took place in its mass, have been filled by veins or rather strata of amphiboloid and felsparoid (some specimens of this last entirely resembling granite), which demonstrates, that these minerals were still depositing themselves, at a period later than the formation of the wacke. After all, I give to this explanation respecting the formation of this rock, only the value it will receive from naturalists themselves; persuaded, that the destiny of all theories respecting geological facts is to remain hypothetical, until the surface of the earth shall be more attentively and more generally observed.

Amygdaloid.

38. This rock is the least abundant. I had an opportunity of examining it only in one place [Brighton ▭]; but several fragments, scattered in many parts, indicate that it exists in other spots.

It consists, most frequently, of rounded or irregular nodules, composed of quartz, felspar, laminary carbonated lime, epidote, and sometimes chlorite talc. These substances often exist in insulated concretions; but, sometimes, two or three are united in the same nodule. Some of them, consisting of quartz, appear as if enchased in the substance of epidote; some others present a cavity in their centre, the surface of which is coated with microscopic crystals of quartz and epidote.

The cement, apparently homogeneous, which unites these globules, is commonly reddish brown, sometimes verging to greenish. It often contains particles of a blood-red coloured substance, which seems of the same nature as the jasper petrosilex (22.); some spots of carbonated copper; and now and then, crystals of amphibole and chlorite talc. Sometimes it contains veins of felspar, lamellated or almost compact; sometimes of quartz, accompanied by thin lamina of oligist iron, carbonated copper, pyritous copper in small particles, and chlorite talc. This rock is found contiguous to felsparoid, epidotic amphiboloid, and porphyritic wacke, on which it is observed resting [Brighton ▭]. Sometimes it occurs with a schistous texture, and even emits an argillaceous smell, when breathed on.

This rock is analogous to the toadstone of the English. When of great compactness, it is susceptible of a fine polish.

Conclusion.

I present the description of this series of rocks, which evidently belongs to primordial soil, without any hypothesis on the comparative order of its formation. In the course of my observations, in this and other countries of America, which appear remarkably well suited for geognostic investigations, I never had an opportunity of verifying that arrangement of superposition in primordial rocks, from which is inferred the order of antiquity, supposed by some systems introduced in Europe.

A peculiar interest in the study of this part of America arises from the relation, which exists between its rocks and those, which were in great repute among the people of Asia, Greece, and Italy. A view of the table, which accompanies this memoir, will indicate that it includes almost every stone, which had celebrity among those nations. We may therefore infer, that a description of this part of Massachusetts would agree with the place, now unknown, where the Greeks and Romans procured those articles, which their luxury has transmitted to the moderns.

With respect to social utility, we observe, that metals, which form so extensive a part of the national riches of a country, appear by no means abundant in this soil. Iron and copper in particular, so plentifully distributed in other parts of America, are quoted here merely as mineralogical notes. But some other substances, found here, and neglected as useless, may be employed in society ; one mineral, which may replace the turkey stone ; another, which may be used in painting ; a set of rocks, susceptible of an high polish, fit for elegant ornaments, whose hardness and durability may render them useful for many other purposes, and which may even form articles of export, when some process of cutting and polishing them in a large and cheap way shall be found, &c.

I conclude here the account of those minerals, which recal to my mind the pleasant moments I have spent in this part of America. I hope their description may have some interest for the respectable citizens of New England, from whom particularly I have received so many marks of benevolence and friendship. It always will be a great satisfaction for me to remember, that I reckon some friends among those, that present the fair example of a people, who know how to advance in civilization, and preserve the respect for morals and domestic order, which distinguished their ancestors; and who appear still worthy of the high destinies, which await the American people.

TABULAR VIEW

OF THE SUBSTANCES, WHICH CONSTITUTE THE MINERAL SOIL OF THE ENVIRONS OF BOSTON.

Simple minerals.

Acidiferous substances.

Carbonated lime.

A *Lamellary* (calcareous spar), forming veins in wacke (34), kernels or globules in amygdaloid (38), in amphiboloid (9).

B *Compact* (Lime stone), in thin veins in argilloid (30).

N. B. Some salts diluted in spring water (3) excepted, carbonated lime is the only acidiferous substance I have observed in the environs of Boston, where it appears existing but in a very slight quantity.

Earthy substances.

Quartz.

A *Hyaline* (rock crystal), often found with crystalline shape (var. prismoid) in the cavities of some blocks scattered on the surface of the soil.

B *Compact*, most often *opaque* (hornstein of Werner) very diversified in its colours. The variety A is found sometimes mixed with chlorite talc, and also with epidote. In this last case it constitutes the *praser* of Germ. (Brighton, Menotomy). Quartz is one of the elements of several rocks, and is found frequently disposed in veins running across them.

Felspar.

One of the predominant elements of the rocks, which constitute the frame of the country, commonly with a lamellary texture, with a great diversity of colours; found with crystalline shape (var. ditetraedral) accompanied with epidote and asbestos. (Brighton).

Amphibole. (Hornblende Wer.)

One of the most diffused elements of the rocks of Massachusetts; commonly with a lamellated texture, and a dark blue or black colour. (4 to 19).

Epidote (Glassy actinolite Kirw. Glasartiger Hahlstein Wer.)

A *Crystallised*, sometimes in six sided prisms deprived of summits (the diameter of the prisms about 4 or 5 lines, Brighton) or in four sided rhomboidal prisms, the measure of the angle of which agrees with the primitive form of this substance. (Swt. Elements of Haüy) or in small striated longitudinally needles, imbedded in carbonated lime (Brookline), but more frequently

B *Compact*, disposed in veins, running across several rocks, (9, 16—21) or forming one of their elements (9—16). Its common colour is green of several shades.

Mica.

One of the elements of some varieties of rocks, as felsparoid, amphiboloid (11, 17), but commonly in small proportion. Its common colour is whitish, smoaky, yellow of brass.

Asbestos.

A *Flexible* (vulg. amiant) with a yellowish white colour. It accompanies epidote and crystallised felspar (Brighton ○). Its gang is argilloid or epidotic amphiboloid.

B Stiff (Actinolite Kirw.), with a greenish colour. The gang is argilloid (Newton ▭).

Talc.

A Laminary, in small hexaedral lamina, of a bright green colour (12).

B Chlorite (chlorit erde Germ.). It accompanies carbonated lime, laminary, and quartz. (Brighton) (38). This last variety, which appears abounding in some places, may afford a solid green colour for painting. (An essay of this colour is sent to the Academy).

Garnat.

Commonly in small trapezoidal crystals in some loose fragments of felsparoid.

Tourmaline.

Found, scarcely, in some loose pieces of felsparoid (Dorchester), sometimes with the form belonging to the variety isogone.

Emerald.

Some loose fragments of felsparoid give some signs of this substance.

N. B. These three minerals, found in great plenty in other parts of North America, may be considered here, as exceptions.

Combustible sub.

Peat.

Found in great plenty in several parts of the environs of Boston, principally in places where stagnant waters in contact with aquatic vegetables favour their decomposition, so soon as they are deprived of their vegetative faculty.

No signs of other combustibles found yet in the compass of twelve or fifteen miles from Boston.

Metallic substances.

Copper.

1 *Pyritous* (Kupferkies of Germ.). Its matrix is quartz, which accompanies amygdaloid (38) generally in small particles, but some signs more worthy of attention found in the north west direction.

2 *Carbonated green* (vulg. malachite) in light spots, which accompanies the preceding var. sometimes disseminated in the whole mass of amygdaloid (38), or coating some faces of its fragments.

Iron.

1 *Oligist.* (Specular iron ore Kirw.). In small lamina in some fragments of quartz (27, 38).

2 *Oxyduled.* (Magnetic iron ore Kirw.) (17).

3 *Arsenical* (Mispikel of many miner.), sometimes prismatic, common matrix argilloid, or petrosilex (24).

4 *Sulphurated* (common pyrites), often crystallised in cubes, gang. commonly argilloid or petrosilex (24).

A Sulphurated magnetic (vulg. magnetic pyrites), embodied commonly in amphiboloid (4).

5 *Carbonated.* (Brown spath of Germ.), found but rarely in small lenticulary or rhomboidal crystals (27, 35).

Manganese.

Oxyded black and brown, forming mamellary concretions on the surface of some rocks, as petrosilex argilloid (24), or in superficial dendrites. Manganese appears the chief colouring body of most of the minerals and rocks of this part of America.

Aggregate minerals.

Primordial soil.

Amphiboloid.

1 Common (5).

2 Granitic (6)] analogous to the black granite of the ancients. Granito nero of Italians.

3 Trappine (7), when of a fine grain it affords the touch-stone, and may be confounded with lapis lydius.

4 Porphyritic (8).

A Ophites (9), analogous to the porfido verde antico-ophites of the Greeks.

5 Epidotic (9), analogous to the Egyptian basalt.

6 Quartzous (10), when uniform in its texture and colour, it may be used, as well as the species 5, as touch stone. Many Indian's axes consist of this species.

7 Micaceous (11).

8 Talcous (12).

Felsparoid.

1 Common (14).

2 Quartzous (15).

3 Epidotic (16).

4 Granitic (17).

Petrosilex.

Single with a great variety of calours.

1 Flinty (20).

2 Novacular (23), a variety perfectly analogous to Turkey stone.

3 Sonorous (21) Klingstein of Germans.

4 Jasper (22).

Porphyritic.

A Deep red, analogous to the antique red porphyry (27).

B Reddish brown (26).

C Greenish (27).

D Brown black (27).

E Black analogous to the black porphyry. Porfido nero.

Argilloid.

1 Common (29).

A Compact.

B Foliated.

α Grey.

β Greenish.

γ Blackish.

2 Novacular (29) susceptible of being used as turkey stone.

A Whitish.

B Brownish.

C Veined, formed of white and brownish red layers.

Wacke.

1 Porphyritic (33).

A Breccia, sometimes analogous to antique breccia. Diaspro breciato of Italians (33).

B Granulated (34) α greyish (Grauwake of Germ.)

Amygdaloid.

1 Common (38), sometimes analogous to the toadstone of the English.

Alluvial deposits.

Consisting of fragments of rocks, which form the frame of the country (2), sand and clay.

XXIV. ACCOUNT

OF FOSSIL SHELLS, WITH THE AUTHOR'S REASONS FOR ATTENDING TO THE SAME;

In a letter to Levi Hedge, F. A. A.

BY PARKER CLEAVELAND, A. M.

Professor of Mathematics and Natural Philosophy in Bowdoin College.

Bowdoin College, 10 *October*, 1808.

DEAR SIR,

AT your request I transmit you an account of the fossil shells, which you saw in my possession, when I had the pleasure of your visit at Brunswick. Previous however to a relation of the particulars, I will take the liberty of mentioning the reasons, which have induced me to pay attention to facts of so common occurrence.

The universal existence of marine shells and other fossil bodies, at considerable depths below the surface of the earth, satisfactorily prove that very great changes have taken place in the exterior parts of our globe, either by sudden and powerful convulsions, or in some more gradual manner. In every system of geology fossil bodies have deservedly received a large share of attention; and it is perhaps true, that further discoveries of fossil shells on mountains and in very elevated situations, under circumstances precisely similar to those, in which they have been found, would afford very little assistance in forming more correct geological systems. But with regard to the discovery of shells in plains and small elevations near the sea, the preceding remark may not be true. Concerning these it may be inquired, whether the changes, to which the shells owe their existence as fossils, be of ancient or modern date; whether they were produced by great convulsions and sudden inundations, or by gradual alterations of many successive years. It has been suggested that important advantages would result from possessing a geographical map, indicating the different species of fossil shells, and the places, in which they were found. I think the idea important, and practicable at least with regard to any country or coast, which may be thickly inhabited. With such a map before us we should be better enabled to compare individual facts, and hence to draw several conclusions. Under this view of the subject the discovery of shells, which are merely fluviatile, will be worthy of attention. For the preceding reasons I have endeavoured to collect all the facts in my power. I will now give you a description of two wells, which I have examined the last summer, while digging.

One is in Bowdoin, at the distance of three or four miles from the nearest salt water, which is at the termination of the tide in Cathance river; the distance of the well from the sea is probably about twenty miles. Its elevation above the tide in Cathance river is estimated by gentlemen, living in that part of the country, at seventy or eighty feet. The land about the well is very uneven, and abounds with gneiss and a coarse granite. A small stream passes about fifty rods from the well; and, after a long and winding course, assists in forming the Cathance. This well is twenty feet deep. Through the first ten feet from the surface a hard gravel is found, stratified and interspersed with layers of coarse, yellowish sand. At the depth of ten feet commences a stratum of blue clay, into which the workmen dug ten feet, but without passing through the clay. When first taken from the ground, it is nearly black, and very tenacious. This clay both in appearance and smell resembles that dug on flats, or near salt marshes, or on the margin of salt water rivers. The shells also have the same smell, when first taken from the clay; and, as far as I have seen, are the clam, and two varieties of the muscle; and another kind of shell, whose genus I know not. It is large, of a conical form, about three inches in length, and passing in a double spiral line from the larger part to the vertex. The same genus is found on our sea shores. These shells are in general well preserved, and in almost every instance filled with clay; which must have entered them with the water, in which it was suspended. I saw very few valves lying by themselves. When carefully taken from the clay, the shell is either whole, or the valves opened and lying contiguous to each other at the hinge. I also took from near the bottom of the same well a large rock, to which were adhering many of those shells, which the seamen call barnacles.

The other well is situated in Brunswick; at an elevation of about eighty feet above the tide water in the Androscoggin; and about half a mile westward of the same river above the falls. It is on the side of a hill. Several gullies take their rise at the foot of the hill, and lead to the river. This well is twenty two feet deep. After cutting through the soil, the first twelve feet consist of alternate strata of yellowish sand and common brick clay. At the depth of twelve feet commences a stratum of blue clay, which is four feet thick. This clay is plentifully interspersed with shells, similar to those before mentioned; and has the same appearance and smell. This is followed by a stratum of grey sand, similar to that often seen upon beaches. The next three feet consist of thin, alternate layers of common brick clay and a reddish sand. The last stratum, and that, in which the well terminates, is a brown sand, resembling that, which is frequently found at the surface.

I have selected these two wells from several others, because I had better opportunities of examining them.

I have a few specimens, which I should be happy in sending you, were the opportunity convenient.

I am, dear sir,

you friend &c.

PARKER CLEAVELAND.

XXV. ACCOUNT

OF PAWPAW OR COWRY SHELLS, FOUND IN DORCHESTER.

In a letter to the Hon. John Davis, Esq.

By Rev. THADDEUS MASON HARRIS, F. A. A.

Dorchester, October 22, 1806.

DEAR SIR,

AGREEABLY to your request I make the following statement, which you may communicate to the American Academy of Arts and Sciences, if you think worthy of their notice.

In the summer of 1802 I procured several loads of mud from a kind of pond-hole in Dorchester for the purpose of making a compost manure for my garden. As it lay in a heap in the barn yard, I found my children busily employed in picking from it the small shells called *pawpaws,* or more properly *cowries;* and, in raking open the pile, they gathered, I believe, more than a quart. As the pile was levelled, many more were collected; and we are daily finding them on the ground, where it was spread. My curiosity was much excited by the circumstance; especially as I had never met with the *cyprea moneta* on our shores, and did not know that it had been discovered on the coast. Accordingly I visited the place, whence the mud was taken, and found it full of water in consequence of a heavy shower of rain; and indeed it is rarely quite dry; but on the bank there were many more shells of the same kind in the mud, that had been thrown out. Upon examination it appeared, that this was once the head of a creek, and, within the recollection of an aged man in the neighbourhood, was filled every high tide. About two rods below the pond, and on the border of what was formerly salt marsh, is a road, which was laid out at the first settlement of the town. Sixty years ago, my informant used to stand on the bridge over the creek, and catch alewives. The bridge has for many years been taken away, and the road made solid ; so that the tide is quite excluded. The marsh itself has been in part converted into tillage ground, by a dam about one third of a mile lower down. The creek, in its windings below the dam, must be more than a mile in length, and has its mouth at the flats, which separate Dorchester from Boston. When open all the way, it was only wide enough to admit a small boat to its head.

I feel a hesitancy in pronouncing, that the shells were natives of the pond ; and yet it is past conjecture how they should have been brought there. It cannot however be amiss to record the fact, which I have stated.

The name *pawpaw*, I believe, is given to the shell, only when the convex part is broken or ground flat, that it may be used by the negroes among us in a game, which perhaps is original to their own country. In Africa and the East Indies, where it passes for money, it is called *the cowry*. Large quantities of these shells are said to be collected annually in the Maldiva Islands, for exportation to Africa, Bengal, Siam, &c. for the purposes of commerce.

With much respect, I am, dear sir,

your friend and humble servant,

THADDEUS MASON HARRIS.

XXVI.

OBSERVATIONS ON A SINGULAR NATURAL PRODUCTION, IN WHICH ONE PART APPEARS TO BE A PLANT AND THE OTHER AN INSECT, ACCOMPANIED WITH A SPECIMEN.

By Rev. MANASSEH CUTLER, LL.D. F. A. A.

"IT often happens that things, which at first view seem miraculous, are found on examination to be not miraculous, but produced in the regular course of nature. This has been lately remarkably demonstrated by the example of a certain insect, which the French collectors call the Vegetating Fly. The story goes, that in America is produced an insect, which, laying aside its animal nature, is transformed by a more than Ovidian metamorphosis, to a vegetable ; so that we are no longer to consider as idle tales the transformation of Daphne to a laurel, or of Narcissus to a flower.

Not long since Capt. Melvil, returning from the island of St. Domingo, brought with him to London some small productions of a mixed nature, whose lower part was a real insect, but the upper part a plant. The insect was equal in magnitude to a bee, and the plant was an inch in length. The collectors of these wonderful productions, who brought them to Mr. Melvil, informed him, that the insect was a species of wasp, which, having lived to a certain period, lost all motion, and was changed in the upper part into a plant, which gradually increased, while the figure and substance of the insect were retained in the lower part.

The admiration of the most sagacious naturalists in England was very much excited by this then unheard of naturæ miraculum. Many doubted both its probability and possibility, and suspected some fraud at the bottom; others were unwilling to admit this suspicion, because something not entirely foreign to this subject had been advanced by the Rev. Father Torrubia in his Natural History of New Spain,* who relates, that in a certain field in the island of Cuba, not far from Havanna, he had found numerous dead wasps, which perfectly retained their form, but from the abdomen there was produced a small plant, furnished with very acute prickles, which was called by the inhabitants *Gia*, and that it grew to the height of some hand breadths. The prickles were supposed by the Spaniards to originate from the sting of the wasp.

The similarity of these productions seemed to favour the opinion of those, who were inclined to believe a real metamorphosis, but on examination by the celebrated Hill (perhaps Sir John), the nature of them was detected, the clouds of mystery dispersed, and the real truth brought to view. He found the insect was a Cicada of that kind, which Aristotle and the ancients called Tettigometra, and that the plant was a fungus of the family of Clavaria, which he called *Clavaria sobolifera*, from its putting forth new shoots from the middle of the stem. Small fungi of this genus are found growing in various animal matters in a state of decay; as for instance that in the hoofs of horses, called thence by Ray, *Fungus e pede equino*. The Cicadæ enter the earth in order to pass from the larva to the winged state. If the season is unfavourable, vast numbers of them perish, and the seeds of Clavaria, finding in the decaying insects a proper soil and nutriment, grow into the state, in which the specimens abovementioned were found. Thus far is the operation of nature; but being seen in an extravagant light, it has been pretended to be a miraculous transforma-

* This work was published in Spanish, Madrid, 1754.

tion. It will prove no doubt, that Father Torrubia's wasps from Cuba have passed through the same process, and the growth of a Clavaria from the dead insect will be found no more a miracle than the growth of the misletoe on the bark of trees." These subjects are figured in the last volume of Edwards' birds and in the Nova Acta Nat. Cur. Append. ad Tom. 3. Tab. 7. fig. 12, 13.

The above is a hasty translation of the eighty eighth paper in the third volume of the Nov. Act. Nat. Cur. and throws great light upon a subject, which, though noticed in Europe half a century since, is very little known among us. In the above paper two species of insects are spoken of, viz. a Vespa and a Cicada. The specimen, which I herewith beg leave to present to the academy, is different from either. The vegetable part seems to be the *Clavaria militaris* of Linnæus, and the animal part is the larva or grub of the *Lucanus Capreolus*, which is commonly known by the name of Dor or Horn-bug, and is the Stag Beetle of New England.

The form of the larva is perfectly preserved, the legs are entire, the rings of the abdomen perfectly well defined, and the lateral stigmata or spiracles are very conspicuous. But it is proper to observe, that the form and cuticle only of the larva are preserved; for the body is completely filled up with a fungous substance of the Clavaria. The ascending stem pierces the head of the larva, where one of the palpi was inserted, and a descending one passes downward from the corresponding point on the other side of the head; but its direction downward may be accidental.

This curious production was discovered some years ago by Samuel Danielson, Esq. of Killingly in Connecticut, who has been so obliging as to favour me with these specimens. They were found on his farm in a grove of oak and walnut wood, in a loamy soil. In digging up the roots of *Aralia nudicaulis*, or Sarsaparilla, he observed, as he imagined, some insects with sticks in their mouths; so unusual an appearance attracted his attention, and though they appeared to be living animals he found them motionless. He has since found them repeatedly in the same place, but only in the spring. Fig. 12 represents a specimen of this curious production, found at Killingly. Bomare in his Dict. d' Histoire Naturelle, under the article *Mouche vegetante*, observes, that the Clavaria rises from the head, but sometimes from the back of the insect, and in either situation gives at first sight an idea of some identity of the plant and animal. The article in Bomare is worth reading.

It is a fact well known to botanists that fungous plants are chiefly parasitic and that they attach themselves of preference to certain animal or vegetable substances in a state of decay, and it must be recollected, that the Clavaria is such a plant. As this curious production is rare in this country, I have thought it would be proper to take some notice of it. It is true that the boundary between animal and vegetable bodies is very difficult to define. Their natures approach most nearly in the lowest and most imperfect individuals of each, as in the confervæ and some of the vermes; but a plant of the lowest order, as Clavaria, and an animal so elaborately constructed as an insect, can never be transformed into each other; nature never unites links so immensely distant as these; and in order to form correct ideas of any natural production, we should ever remember, that

Nunquam per saltus agit natura.

XXVII. ACCOUNT

OF THE WRITING-ROCK IN TAUNTON RIVER;

In a letter to the Hon. John Davis, Esq. Recording Secretary of the American Academy of Arts and Sciences.

BY Mr. E. A. KENDAL.

Hallowell, Oct. 29, 1807.

DEAR SIR,

I LEAVE in this neighbourhood, according to promise, a copy of my transcript of the writing-rock in Taunton river. Mr. Vaughan will obligingly forward this letter, and the inscription will be delivered to you through the care of Mrs. Gardiner.

You are already aware, that I indulged, in several successive visits, during my stay at Dighton, my curiosity concerning this singular monument; a curiosity strongly excited by your communication of facts, papers, and draughts.—I proceed to inform you of what I have seen, heard, and thought.

The writing-rock is a block of gneiss, a species of secondary granite, lying on Asonet neck, on the eastern side of Taunton river on the land of a Mr. Deane, within the township of Berkeley, county of Bristol, and state of Massachusetts. Its foot, in front, is about ten or twelve feet from low water mark, and its top is covered, at high water, to a height of two or three feet, or more. Its face measures eleven feet seven inches at the base, five feet one inch in its extreme height, and is an inclined plane, having an inclination of about sixty degrees. The two ends correspond, or nearly correspond with the face; so as to present, on three sides of the rock, the base of a pyramid. The top or back shelves, in irregular ledges and fractures, from its summit to the surface of the soil, giving a thickness, which increases, in the descent, from one inch to perhaps six feet. The base of the rock, at the northeast angle, is partly above, and partly incumbent on the surface of the ground; and, with respect to the remaining and more considerable portion, is sunk to a small depth.

As to colour, the rock, to speak generally, is of a purple red. To describe it more particularly, the face, as low as rather more than a foot from its summit, has a dark tint, of the hue mentioned. Below this is a region of a much lighter tint; and toward the base is another, somewhat green. The *internal* colour of the rock, which is a light grey, no where appears, except where laid bare by recent fracture. The several colours, the diversity of which forces itself upon the eye, are bounded horizontally; and are occasioned by the difference of the periods of time, during which the parts of the rock are exposed to the air. The summit, which is first abandoned by the water, and last covered again, is purple; the middle region is less acted upon by the oxygen of the atmosphere, and the lowest is most favourable to the growth of the byssus. Were the rock beyond the reach of the tide, its surface would be grey, like that of others, of the same stone.

On approaching the rock for the first time, I suffered no disappointment; my respect for it was not lessened, but increased; and in particular I was greatly struck with the regularity of its figure. Three of the sides, as I have already described, are uniformly inclined, whence it proceeds, that the breadth of the face, which, at the base line, is eleven feet seven inches, is diminished, at the height of four feet, to ten feet three inches. The two ends, though fashioned to this general figure, are indeed very uneven; but the face, near the summit, is as smooth as the saw could leave it, and, beneath, as much so as might justify the belief of ruder workmanship. After all I am of opinion, that this configuration is from the hand of nature, and that the artist, who engraved the inscription, rather chose his rock on account of the symmetry, which he observed in it, than prepared it to his taste ; a conclusion, to which I am the rather inclined, not only from a disposition to avoid a too eager aggrandisement of this ancient relic, but from some internal evidence of the sculpture. First, that in more than one instance the drawing appears to have been accommodated to the irregular outlines of the rock, such as we now behold them ; and secondly, that on the end, fronting the northeast, there are two or three figures, resembling the letter O, sculptured, not upon the remaining part of what might be esteemed the original surface, but within one of the recesses, or parts, where that surface has been broken or worn away. Indeed, if the face and ends had been the work of tools, it is scarcely to be imagined, that the same tools would not have been employed to form the summit according to an horizontal line ; and that such horizontal line ever existed the situation of the upper figures, partly made to follow the actual line of the summit, and partly deficient in precision, as to their base line, renders altogether improbable. It might however be contended, that the figures representing the letter O, and formed on the northeast end, are modern ; that is, engraved since the surface has been worn or broken ; or perhaps, with less danger of overthrow, an opinion might be maintained, that nature bestowed only the general pyramidal form, and that art has smoothed the face, and done no more. Against such a theory the lateral figures, when or by whomsoever executed, would prove nothing ; and in its favour it might be argued, with plausibility, that to smooth the surface of a rock is a work of less art, than to engrave that surface ; and that, what it was thus comparatively easy to execute, it was in the highest degree natural to desire ; for the value of a smooth surface, as well for execution as for legibility, must be obvious to the rudest artist. If we are to attribute the inscription itself to an Indian hand, we know, from many specimens of Indian workmanship in our possession, that it would be idle to dispute either an Indian's inclination or his skill in smoothing, polishing, and even fashioning the rock. A fact also, which might be adduced on this side of the question, is, that at the southwest angle of the rock, where it is sunk below the surface of the sand, the inclined figure of the face, after descending about six inches, is terminated suddenly by an horizontal ledge, affording an appearance precisely similar to what might be expected from every workman, who, after giving form and finishing to what is exposed to view, leaves in a state entirely or partially rude, what is concealed from the eye. Precisely indeed, as every block of stone, partly exposed, and partly hidden, is treated by every mason. On the whole, I permit myself only to observe, on the one hand, that the present condition of the work, in many respects, is very much what it probably would have been, had it anciently received even a complete pyramidal form ; on the other, I freely add, that I have seen many rocks, where no suspicion of art could attach, of figures equally regular, and even equally approaching the pyramid. I end therefore, as I have already premised, by supposing the rock to have been selected, on account of that very symmetry, or approach to symmetry, which leads to this inquiry.

I have dwelt, without hesitation, upon this natural or artificial pyramidal figure (a particular hitherto, as far as I am apprized, undiscussed, and even unnoticed), because it appears to be capable of being made of some importance in the history of the rock, and therefore in the historical evidence, which the rock may at any time be thought to offer. That where there was means of executing the inscription, there should also be means of fashioning the rock, would be nothing remarkable; but if, as there may be reason to believe, the pyramid is a figure in masonry, originating in Egypt out of local circumstances, and from that alone derived to those circumjacent, the fact of a pyramidal figure in the rock, artificially produced, might be made to give support to theories, false or true, of the transatlantic origin of the inscription, and thus affect the great point or points of history, which it may one day be found sufficient to elucidate. Independently too on the hypothesis, which respects the exclusive origin of the pyramid, the state, in which the rock was found or left by the artist, must necessarily influence our judgment in a variety of particulars.

I come now to speak of the inscription; and first, of its execution. Before I saw the original I had seen the several copies made by Messrs. Sewall, Winthrop, and Baylies. I found that the first conveyed too mean, and the third too high an idea of the execution. The execution, an adequate instrument supposed, is nothing extraordinary; but it is not entirely unworkmanlike. The lines, though most of the draughts, including Mr. Winthrop's, have represented them as true, are not so; but they are firm. As to the mode of execution, that appears to be no other than the use of a pointed tool, of necessity harder and less brittle, than the very hard and brittle rock, on which it has wrought. In some parts of the inscription the marks of a pointed tool are still distinctly visible; and where this is not the case, the *chissel* at least will be excluded from the calculation. The upper figures, on inspection, on the rock may be thought rather the work of the *gouge*, than of a pointed tool. It is certain, that the use of the latter is not so obvious in these, as in the lower figures; but the surface of the lower region of the face is more worn, than the upper; the figures are consequently less sunk, and I suppose, that through this cause and effect the pecking of the tool is rendered more conspicuous. Be this as it may, the lines, forming some of the lower figures, are double rows of pecks, and but slightly hollowed between; while the lines of the upper figures are broader, and more or less regularly concave. Among the lower figures however that, which is apparently a human figure, and is placed under the left shoulder of the bust, is peculiarly well defined, has the edges somewhat sharp, the lines are sunk below the surface rather in a flat, than a concave form. The depth of the lines never exceeds the third of an inch; and the breadth varies from half an inch to a whole one.

By what has been said, an account of the *style* of execution is nearly anticipated. It has appeared, that the lines are cut into the rock, or the term of art is, are *en creux;* and that they are hollowed, not in the triangular form, making two sides of a prism, such as lines are produced by the chissel; but generally in that of the segment of a cylinder. To these particulars it should be added, that the figures are represented by mere outlines, and consequently in the simplest mode of sculpture.

Having glanced at the degree of excellence, and at the mode and style of the execution or sculpture, I come to the design or plan of the drawing; to its degree of excellence, and to its style or character.

With respect to the design or plan, I have two observations to offer. The execution or sculpture I have represented as nothing remarkable; but I must subjoin, that the design is intricate or artificial in the extreme. This will probably be confessed by those, who inspect the copy; and it is still more undeniable, when the rock itself is under the eye. The figure, formed of so many triangles, which is at the top and nearly in the centre of the inscription, goes far, I think, in bearing out my assertion; *it has a character eminently peculiar, and strongly marked.* We cannot but fix our attention on the boldness as well as singularity, with which the artist, after intending through the greater part of the figure a correspondence of parts, abruptly quits in the upper limb on the right this careful uniformity, and runs at once from right lines and angles into curvilinear figures of the freest sweep.

The curvilinear figures give birth to my second remark. I conceive them to authorise a conclusion, that the design has proceeded from an artist not unacquainted with pen or pencil ; or at least from one, whose taste has been influenced, though possibly without his knowledge, by the use of those instruments, in other hands than his. I rest this opinion on the general proposition, that curved lines in sculpture proceed from imitation of the other graphic arts, in which the material and the instrument used are of a nature to give less check to the suggestions of the fancy. When therefore a sculptor forsakes the short road of right lines, he attempts, with his reiterated strokes and lagging pace, to follow the wanton excursions of an instrument gliding over an unresisting surface, and leaving, without effort, the traces of its course. This is what, I believe, may be affirmed of all sculptured inscriptions ; and yet, in the inscription before us, not only there are curved lines, which appear on the draughts, but in contemplating the rock with the advantage of certain lights, I have thought that I discovered in every part curvilinear ligatures, conjoining all, or nearly all the figures, which compose the inscription. But the very idea of *joining-hand* in sculpture presupposes, upon the principles laid down, the prior existence of a more facile mode of writing ; and even without this idea, the mere frequence of curved lines is sufficient testimony.

Passing from the design to the drawing, I shall observe, that we must not depreciate the merit of the artist, because of the uncouthness, and still less of the unintelligibility of his picture. The figures are less ill drawn, than they are uncouth and unaccountable. The style of drawing appears to be technical or conformable to some artificial mode of representation, and not such as aims at the natural forms of things. If this be so, then we must try the artist in other points, than in the beauty of his outline, which was not within his control, or in its fidelity, of which we can form no opinion. We must look solely to what is to be termed his *pencilling ;* to the decision and masterlike protraction of his lines ; and, in this view, though nevertheless I think but humbly of the work, I shall risk nothing in declaring, that the ordinary artists of our own age, our sign-painters, our sculptors of grave-stones and mill-stones, and others, exhibit less ability, than the drawer of the inscription on the writing-rock in Taunton river. As to the drawing of what appears to be human figures, it ought to be observed, that if what purports to be a human head, namely a circle or an oval, with two holes for the eyes, and one, which serves for a nose and mouth together ; if what purports to be a human head, be only a very rude and imperfect representation, we shall find on looking lower, that all effort to produce the human figure is utterly declined. Forms wholly unintelligible, and to the last degree remote, supply the place ; and force us to acknowledge, that the want of will is more certain, than the want of capacity. The curved lines have a freedom not to be equalled by every hand among ourselves.

On the contents of the inscription, I have little or nothing to offer. To describe would, in a majority of instances, be to explain ; and this last is beyond the limits of my pretensions. The figures must remain, for me, just what every man pleases to call them. I shall only repeat my opinion, that some of them are mere ligatures between others ; and remark, in further proof of the tincture of imitative betrayed in this sculpture, and consequently of the implied previous and known existence of other works of art, that each of the three figures, bearing human heads, may be observed to stand upon a foot or pedestal. Now this support can never have been imitated from nature, or suggested by any thing incident to even any one of the graphic arts ; but necessarily indicates, either that the thing intended to be represented is a piece of statuary, or that the habit of contemplating statuary has introduced this servile following of one of its resources.* In surveying a monument, like this in question, the mind naturally becomes curious, as to its history and signification ; and more than one attempt has been made, as to the writing-rock, to satisfy us as to the first by clearing up all obscurity as to the second. For my own part I think, that we are still in perfect uncertainty, as to both. The few opinions, which, relatively to certain points, I venture myself to entertain, I shall here submit.

It appears to be uncontroverted, except by the ignorance of some of those, who live in the neighbourhood of the rock, that this is a monument of an antiquity antecedent to the settlement of Europeans on this continent ; and I am of opinion, that it is of an antiquity considerably higher.

I am of opinion also, that it was wrought on some solemn occasion, or for some solemn purpose, either civil, military, or religious. It may be a memorial, a monition, or an offering of piety.

I am of opinion further, that it bears, even now, sufficient traces of the people, by whom it was produced ; and consequently, that, to ascertain this, we need only to discover from whom any similar works have proceeded.

The first of these opinions is founded on a comparison of the great durability of the stone with the great inroads of time ; the second, on the orderly and yet arbitrary arrangement of the figures, the unity of the composition, and the labour necessary to the execution ;

* There is an Indian bust in the nature of a basso relievo in the museum at Hartford in Connecticut, and a piece of Indian statuary at Yale college.

the last, on the extreme peculiarity of several of the figures ; a peculiarity so exclusive, that, were any similar to be found, of which the origin was certain, I should without difficulty claim the same origin for this inscription. The technical character of the figures contributes largely to this peculiarity. They have in them nothing of calligraphy ; nothing of an universal alphabet. They are the property of some one people, and of no other. The strange configuration of the objects having human heads, and the complicate and artificial construction of those made up of triangles, are clearly entitled to this character.

But to what quarter are we to look for this peculiar people ? Shall we attribute it to the savage follower of the fishery and the chase, or to learned circumnavigators ? To the inhabitants of the surrounding forests, or to sojourners from the ancient seats of arts and civilization ?

I am decidedly of opinion, that this monument is in no respect derivable from the opposite side of the Atlantic. I discern in it nothing of the alphabets, or the drawing, or the taste of Europe, or Asia, or Africa ; and my belief on this head has been greatly strengthened by the knowledge of a fact, communicated to me by the reverend Mr. Bentley of Salem. This gentleman, in speaking of the writing-rock, and of professor Sewall's visit and draught, lately assured me, that professor Sewall, in reply to a question put by himself, declared to him, that he had seen nothing on the rock, which reminded him of any ancient alphabet.

Three difficulties present themselves, if we suppose the inscription to be the work of the people known as the inhabitants of the north east coast of America. First, that nothing similar has been described, as existing among them ; secondly, that no disposition to produce any thing similar has been observed ; and thirdly, that it is scarcely possible to conceive the execution of this inscription, upon a block of gneiss, without the use of iron, or at least of hardened copper.

Concerning all these points however, it will be proper for us to suspend our judgment. We may yet be convinced of what we at present cannot understand, the possibility of engraving an inscription like the present, with no better tools, than those of stone; further inquiry may satisfy us, that there is nothing on this rock above the contrivance, or inconsistent with the taste of the present aborigines; and facts are not wanting to lead to a suspicion, that the writing-rock is not a solitary instance of antique inscription discoverable in America. I have read, either among the papers of the late President Stiles, of which you were so good as to afford me a perusal, or in some other place, of *painted rocks*, among the Indians, known to the ufr-traders of Canada; and I have collected from the MSS. of President Stiles, and other sources, a list of no less than ten places on this continent, where sculptured rocks are found, or are reported so to be. The first is the writing-rock in Taunton river; the second in Tiverton; and the third in Rutland, all in the state of Massachusetts; the fourth is near Newport in Rhode Island; the fifth at Scaticook on the Housatonic in the township of Kent, and state of Connecticut; the sixth in Brattleborough on the Connecticut, in the state of Vermont; the seventh on a large stratum of rocks on the southeast side of the Ohio, about two miles below the mouth of Indian or King's Creek, and fifty below Pittsburg; the eighth on the Alatamaha in Georgia; the ninth on the Alleghany, fifteen mil.s below Benango, one hundred and ten below Fort Pitt, and seventy miles south of Lake Erie; the tenth on the Cumberland, near Rock-castle neck.

This list, as I flatter myself, will not be unacceptable. It is of a nature to excite inquiry, and to concentrate the results. A collection of all the sculptures would be highly interesting, and they might perhaps elucidate each other. It would at least discover to us, whether they are or are not the works of the same people, scattered over a wide extent of country. The painted rocks of the north are also objects of interest. A people may change, according to circumstances, the materials they employ, and yet retain their style. We ought to know the style of these painted inscriptions. Do they contain rude drawings of natural objects, or of conventional signs, or of technical and emblematic figures?

My own wish and design is to visit all the sculptured rocks. This I may never be able to accomplish; but I presume to urge you to lose no opportunity of procuring information and drawings of their contents.

The list itself exhibits an almost unbroken series of coincidences in one particular, and inquiry may fill up every chasm. The writing-rock stands on the side of a river, and below high water mark; and nearly all the remaining nine are described, as likewise seated on a river. This may be owing to the predilection of the savages, in common with all men, for the banks of rivers; it may be owing to the open and conspicuous situation of the rocks so placed; but it may also be owing to the nature and purpose of the sculptures, which may have reference to something nautical.

But further coincidences present themselves between the written rocks on Taunton river and on the Ohio. Those on the Ohio are said to be on the southeast side of the stream, and this is the situation of that on Taunton river. The latter fronts the northwest; and so, in all probability, do those on the Ohio. Add, that the rocks on the Ohio are said to be close to the river, and sometimes entirely covered, and that the rock in Taunton river is covered every tide.

If it should be found, that the rocks are generally so seated as to be covered *sometimes* by water, this fact itself will throw some light upon their history ; and at least induce us to relinquish the attempt to show, that the water of Taunton river did not always overflow the soil, upon which the rock is found, and still less the summit of the rock itself.

There is no doubt but that, generally speaking, the rivers of America have rather retired from, than risen upon their ancient margins ; but this is no evidence against particular instances of usurpation, which must necessarily occur, even in a river, which on the whole diminishes. That part of Taunton river, in which the rock is found, is so circumstanced, as easily to be admitted among these exceptions. The river, as it passes the west side of Asonet neck, suddenly widens from twenty five rods to ninety, entering this gulf with a current from the northwest, and therefore setting on the neck. A great proportion of the bed of the river in this wider part is composed of flats, on which, at ebb-tide, there is only a foot and a half or two feet of water ; and beyond these flats, and also beyond a lesser channel at the foot of a gently ascending shore, is seated the rock. If we suppose that the current has worn away any natural mound, which formerly lay between the great channel and the rock, we immediately restore, in imagination, the river to its proportionate width, and the rock to dry land. Thus too we get rid of the difficulty of conceiving, that so much labour should have been bestowed, in producing something to be seen in a situation, which, from the natural course of the tides, could only allow it to be exposed, at short and varying periods, sometimes by day, but as often by night.

But as to the probable state of Taunton river at the period of engraving the inscription, and as to the difficulty of conceiving that a rock, covered at every tide, was chosen for this purpose, other language may be held.

It may be said, that at least the level of the soil immediately surrounding the rock, has not materially altered ; and that inquiry concerning other rocks may show, that the preference was deliberately given to such, as were actually liable to be overflowed. It is certain, that such rocks were secured from the danger of being covered by the branches, and split by the roots of trees ; and, on the whole, among a savage people, they might be the most certain of being seen, and of remaining always visible. A river was the only highway ; and a rock, placed out of the reach of the tide, would have been speedily overgrown.

That the writing-rock was never surrounded by a soil materially higher than that, which we now see, is clear from indubitable evidence. The inscription reaches to within a short distance of the present level. Mr. Winthrop in his account, communicated to the academy, makes that distance only eight inches ; and though, from recollection, I should scarcely have made it so little, and though I have been able to trace nothing with distinctness at a greater height, yet I agree, that there are marks of the tool, at a level very little above the present surface of the soil. The rock obviously stands as it originally stood ; the soil therefore cannot have been washed from beneath it ; and the rock must always have possessed its present level. But the level of the soil in the neighbourhood of the rock is the same with that of the bank of Asonet neck, above and below. That level rises nearly to the bottom of the inscription, and therefore it rises as high, or very nearly as high, as it did at the period of inscribing ; for though we may believe that the Indians were content to work below high water mark, it is not credible that they worked below the level of the sands. The inscription therefore, so far from disposing us to believe, that where we now see water, there was formerly dry ground, ought perhaps itself to demonstrate to us, that no alteration has taken place ; and this in corroboration I can add, that, though vague assertions are made on the spot, purporting, that some years ago there were several rods of dry land between the rock and the river, yet on direct inquiry I found, that the oldest person neither remembered to have seen nor to have heard of any thing different from the present state of the banks and stream.

I submit with deference, that Mr. Winthrop is inconsistent with himself, and has too hastily relied on the information given him, when, after stating, that the inscription reaches to within eight inches of the ground, he relates, that the country people by digging, in the vain hope of finding treasure, have let in the tide upon the rock. It is, I believe, acknowledged, that forty years ago much labour was expended in digging about the rock with the view described ; but it ought to occur to us, that the fact of letting in the tide implies, not only the removal and disturbance, but the *carrying away* of an enormous quantity of earth ; that to produce any thing like the effect pretended (the digging being unquestionably around the rock), the previous level of the soil must have been, not only eight inches, but more than eight feet above the present, (since nothing less would exclude the tide) ; that the rock, the height of which is five feet, instead of being, as now, sometimes under wrter, must then have been always under ground ; and lastly, though not essential to the question, it implies, that a few money hunters, with their tiny shovels, have pared away for two miles the entire banks of this river, so as to admit from eight to twelve feet of water, with which, twice a day, they are at present covered. The tide is not, as the reader of Mr. Winthrop might imagine, merely let into a pool or cove surrounding the rock, but is let in upon the whole of Asonet neck. If ever the writing-rock stood upon dry land, it is nature alone, that has made the alteration.

In affording entertainment to the hypothesis, that the writing-rock may have been the work of Indians, I have been led into the enumeration of other works, appearing to possess some similitude, and scattered over this country. The list having shown, that nearly all of them are described as being in or near rivers, I have admitted the possibility, that a preference was uniformly given to rocks seated within reach of the tide, and this has led me to an examination of the site of the writing-rock. From this digression I return.

The writing-rock is to be ascribed either to those inhabitants of America, whom Europeans have denominated Indians, to inhabitants more ancient than these, or to navigators more ancient than Columbus.

The easiest solution is that, which supposes a visit from the navigators of antiquity, who, after entering Narraganset Bay, found leisure to explore Taunton river, and chose an anchorage at Asonet neck. In this case the skill of the artist is no mystery, and we easily dismiss, with the breaking up of the ice, or the first fair wind, the authors of so extraordinary a monument. But exclusively of the objections already adduced, if similar rocks exist on the Housatonic, the Connecticut, the Ohio, the Alleghany, the Cumberland, and the Alatamaha, we shall be compelled to seek another theory.

We look next to a nation more ancient and more cultivated, than the Indians, inhabitants of this country. The writing-rock is not the only vestige, from time to time discovered, of such a people. But this silent stone, and other monuments equally silent, are all. If ever they existed, they have left nothing behind to give a tongue to their works, so that they might say to posterity, " these were theirs !" Our last resource is in the Indians.

Confining myself to criticisms on the artist, I leave it, as I find it, undetermined to what nation he belonged. Of that nation however, if what I have to remark shall have any weight, I am about to raise the character in suggesting, that this artist was not the most accomplished workman of his tribe. I could even believe, that he was without the usual and convenient tools and instruments. I think that he was not unacquainted with works of art, of a better and higher character. I have mentioned what I suppose to be imitations, in this inscription, of pen writing, drawing, and statuary ; and I cannot but go on to believe, that the artist had seen designs executed with more accuracy, than this, which he has left us. He has evidently intended to describe equilateral angles, planes parallel to the horizon, and right and perpendicular lines; but he has failed in almost every instance. In the drawings, which I have seen, and which I had full opportunity of comparing with the inscription itself, errors of this sort were corrected. The angles were adjusted; and the horizontal and perpendicular lines made what they had been intended to be; but it appeared to me, that this was no other than an important misrepresentation of the original. One of the facts, most interesting to be known, concerning this inscription, is the degree of advancement in the arts, of which it may afford testimony ; and in removing the possibility of doubt, as to the conspicuous inaccuracy of what was designed to be accurate, I have satisfied myself, that the artist worked wholly by his eye ; that his eye was not the best ; and that he had been accustomed to see, and wished to imitate figures, determined with the precision of the rule and compasses.

Among other inquiries, having reference to the rock, and naturally made in its neighbourhood, and in which I had the advantage of the polite and friendly assistance of Major Baylies of Dighton, were such as tended to discover some explanatory tradition. In this however I was unsuccessful ; nothing, which I could gather, affording a satisfactory or even specious clue. Respecting Asonet neck, on which the rock is seated, the tradition is, that it was a place of banishment among the Indians ; but whether the practice of banishment was known to the subjects of king Philip, I leave to those, who are more conversant in Indian polity. Respecting a spring, called White spring, rising near the foot of a hill to the northeast of the rock, at the distance of a quarter of a mile both from the rock and the river, and a diminutive brook, called White man's brook, running from the neighbourhood of the spring in a southwest direction, and entering the river a little above the rock, a long, connected story is in a few mouths, but seems to have reached but few ears. It is pretended, that, according to an Indian tradition, there arrived in ancient times some *white* men in a *bird;* that the white men took some Indians into the bird, as hostages ; that they filled water at the spring ; that the Indians fell upon and slaughtered the white men at the spring, which thence derives its name ; and that the hostages escaped from the bird. The era of this event is however rendered modern by the additional particular, that during the affray *thunder and lightning* issued from the bird ; and upon inquiry of one of the family of Mr. Asa Shove, to whom the spring belongs, I could hear no repetition of this history of its name. My new informant had never heard the story ; but understood, that the spring received its present appellation from the death of a white hunter, who, having been heated, drank freely of its water, and expired. The tradition of the *bird* meanwhile may have some foundation in the adventures of an early exploring voyage ; with another relation, that a ship's anchor, nearly eaten away by rust, was many years since discovered near this place ; and with the still more obscure account of a ship's ribs, which lay and rotted there. In this place I should mention, that some Mohawk Indians, having been shown, as it is said, a draught of the inscription, declared its meaning to be, that a dangerous animal, represented by the animal on the rock, had been killed at the place immortalized ; that the human figures represent the persons, whom the animal killed ; and that the others denote other parts of the affair. An objection to this interpretation will be perceived, if the ordinary rules of criticism may take their place, in the trivial appearance and humble situation of the animal, which it is attempted to make the hero of the piece ; a station, which it might be conjectured belongs to the bust on the left. Of the animal I shall take this occasion to remark, with a view both to investigation and to the merit of the artist, that its character is strongly, and it may be presumed faithfully marked. Its body is crossed, in nearly equal divisions, with bars or stripes. It is spotted. Its head is long and delicate. It wears horns. Its feet are paws.—Already we see reason to suspect, that this is a creature of fancy, made up of the members of different animals ; and this must assuredly be the case, if the line above its back, and which is wanting in all the previous draughts, forms, as it strikes the eye, the wing of an insect.

A second subject of inquiry is the possibility of other written sculptured rocks, in the neighbourhood of that, which is known. Something of the sort is to be seen, as has been intimated, within the adjoining township of Tiverton ; but near the writing-rock there is none. I found several persons, who had heard, that a little to the south and further out in the stream a rock, being rarely visible, contained a fuller inscription than the writing-rock. All persons agreed in naming, as the author of this account, a Mr. Perry, who lives in Dighton, at an advanced age, and who has, for fifty years, visited all the rocks in the stream in search of oysters, the shells of which he sells to the kilns at Taunton. Upon inquiry of Mr. Perry, not only he had never seen such a rock, but, on the score of his experience, he ventured to affirm, that no such rock was to be found. It turned out, that no sculptured rock has been discovered ; if we except a slab, which lies to the southeast of the former, within the distance of twenty feet. On an upper corner of this is a figure, resembling a cross, or the letter X, and one or two others.

Availing myself of the kindness and the pencils of Mrs. Gardiner, I have made my sketch in oil. It represents the face of the rock, set upright and bearing the inscription. The lower corner, on the left, being fractured, I have made use of the space, to introduce a reduced figure of the whole rock. By this, as I flatter myself, you will be still further assisted, in placing before your eyes the real bulk, form, condition, and general appearance of this highly interesting monument. On the right hand of the rock, and half way up its side, I have also shown, in its actual situation, the prostrate slab, just above described.

On casting an eye over my transcript two remarks immediately present themselves to those, who are acquainted with the former draughts, and particularly Mr. Winthrop's.—The figures are fewer, and they are dissimilar. That the figures are fewer is partly true, and partly only in appearance. It is in part only in appearance, because upon a ground, representing the face of the rock, they are less obtrusive on the eye, than when they are drawn in black upon white paper; and those, who draw, are aware, that an outline always looks fuller, than a finished picture. The peculiar paucity of the figures is however in a great degree real; arising partly from my inability to discover all, that some gentlemen have seen; and partly from my willingness to leave in indistinctness, obscurity, and invisibility, what is indistinct, obscure, and almost wholly invisible, on the rock. The figures, which are distinct in my transcript, are distinct in the original. To these I have given definite forms; while in the other instances my [illegible] care has been to depict the obscurity of the original. If you [illegible] yourself obliged to approach close to some of my figures, and can at last arrive at no certainty as to their outlines, I must beg you to remember, that this will always be your situation, when examining the rock itself. If, on the other hand, I have sometimes made definite that, which in the original is undefined; if I have rendered incapable of being seen in more than one form that, which on the rock may be seen in twenty, my excuse must be found in the extreme difficulty of the attempt to make a representation of any object, without giving it a shape.

The figures you will find variously coloured. In this also I have followed my original. The figures, though sunk, are almost every where of a light but corresponding tint, of the colour of that part of the face, upon which they are found; and, as the surface of the face is variously coloured, so are the figures. The figures near the summit, where the rock is purple-red, are of a ferruginous yellow. This lighter tint of the figures produces a consequence, to which I have submitted. The figures are formed of lines *en creux*, and should therefore be shaded on that side, which is next the light; but being rendered by their colour lighter, instead of darker than the surface, below which they are, they are apt, when shaded, to appear embossed, not hollowed. I observed this delusion on the rock itself, where the touch removes it; but on the canvass I have omitted the shadows.

My sketch contains many inaccuracies; some in the colouring; some in the outlines and fissures of the rock; and some in the figures themselves; but notwithstanding, I believe it free from important errors, such as might frustrate my design of conveying a faithful idea of the contents, style, execution, and condition of the inscription.

If Mr. Winthrop's were the only other copy, I might feel some hesitation at the variations of mine; but the truth is, that all the copies differ, in extraordinary particulars, from each other and from the original. Dr. Cotton Mather, who published, as I am informed, a wood-cut of what he called *two lines* of the inscription, and which two lines are to be found in the fifth volume of Jones' Abridgement of the Philosophical Transactions; Dr. Cotton Mather substitutes for figures, at this day as plain as if they had been yesterday inscribed, others, of which it is impossible to recognize a single feature. In comparing, as Judge Baylies was so obliging as to enable me to do, the copies already mentioned with the original, Professor Sewall's appeared to be, on the whole, the most faithful, though not the best executed.

It must be inconceivable to those, who have never seen the rock, that these differences can appear in the draughts, without impeaching the veracity of the gentlemen, by whom they have been severally made. Nothing however is more possible. Some of the errors indeed are such, as can have proceeded only from haste and inattention; but a great majority are consistent with the most elaborate but ill directed endeavours. Of all others the method of procuring a copy, described by Mr. Winthrop, is the one most infallibly adapted for producing a deceitful issue. When we are told, that printers' ink was put into the lines on the rock, paper wetted and rubbed upon them, and an impression procured, we may believe, *of course*, that impression is an indisputable copy; but the delusion fades the moment that we see the rock. No such expedient can succeed. The greater part of the inscription is so much worn out, that the forms, of which it is composed, are wholly subject to the fancy; and in several places, where the figures are plain, they are made out, rather by difference of colour, than by difference of surface. Figures of the latter class can yield no impression; and those of the former will take any shape, into which the printers' ink may be spread.

Another method has been tried, with almost equal ill success. It is that of chalking the supposed lines of the inscription, and then copying from the chalk. It is true, that in this method the figures to be drawn are rendered sufficiently distinct; but it does not follow, that these figures are the same with those, engraved upon the rock. The chalker is in the situation of a restorer of ancient readings; he undertakes to connect and to supply; but the real antiquarian will prefer the original, with all its obscurities and chasms. An attempt at restoration is one thing, and may be valuable; but a true copy is another. I attempted the use of chalk myself; but I found that I completely confused the sculpture, and that the first thing necessary was to wash all the chalk away. The inscription is to be copied only with the pencil.

While I make every allowance for the adoption of fallacious methods, for haste, and for inadvertence, there is one course of defence for what is erroneous in the draughts, against the tolerance of which I presume seriously toprote st. It is that of attributing the diversities between the copies and the original to the injuries of time upon the latter; and particularly of supposing, that when figures are found in the copies, of which no trace can be discovered on the rock, that they must have once existed there, and that they have been since obliterated.

I am satisfied, by a variety of evidence, of the over liberality of this argument, which goes to falsify antiquity, for the mere end of sustaining the credit of gentlemen's eyes. I appeal with confidence to the testimony afforded, by a comparison of the several copies with each other; and which copies it is of importance to preserve for the very purpose of meeting the imposture. By examining the inscription on the rock, by comparing with it the older copies, by sifting the assertions of those, who represent it as having within their memory decayed, we shall be convinced, that no material alteration, within the preceding century, has really taken place. The decay no doubt is continual; but it is very slow.

But if, losing sight of the rock, we content ourselves with comparing the draughts with each other, we shall soon be ashamed of assuming facts upon so unworthy a basis. Admitting the authenticity of the draughts, we must prepare ourselves for some curious consequences. We should be able to show, upon their testimony, that in a variety of instances the inscription, so far from having decayed, has advanced with the progress of years, both in the number and distinctness of its figures. We should be able to show, that figures, which at the beginning of the last century appeared as they now appear, decayed in the course of fifty years into others totally dissimilar, and have since grown again into their original features.

Dr. Mather, who took or received his copy in 1712, divides the inscription into lines; but that it is wholly insusceptible of such a division, the rock itself and all the other draughts declare. In the Doctor's second line we are not able to discover a single figure resembling those on the rock, or the smallest trace of the style of the inscription. Now it were easy to say, that his second line, on whatever part of the rock he saw it, has since decayed; but the truth is, that in his first line he has enabled us, by some faint resemblances in the first half of it, to discover where he is; and that in the second half he has introduced what is wholly dissimilar, though that part of the rock is at this day filled with figures the most distinct. If therefore the Doctor has not given us a faithful copy of that, which is known still to remain, why should we believe that there were in his time those other figures, which he draws, but which we can no where else discover? We might be led to fancy, that the inscription, when Dr. Mather saw it, was more obscure, than it is at present; but in reality it was only not more distinct; and Dr. Mather, like his successors, toiled in the maze of conjecture.

This maze of conjecture brings me to the last point, which I shall offer to your consideration; that of adopting the only effectual method, by which this remain of American antiquity can be fairly brought within the ken of the curious, and its preservation suitably assured.

The diversities of the copies, of which I have taken notice only with the view of fixing your first thoughts on the original, are not always, as I have argued, to be attributed to the fault of the copyists, but often to the obscurity of the sculpture, in which every man will see something different from every other. Under these circumstances no perfect copy can ever be made. The copy, which I have the honour to send you, pretends only to convey a general idea.* What I earnestly recommend is the removal of the rock, or at least of its sculptured face, from its present site, into the care of some public establishment in Boston. In Boston it will be accessible to every inquisitive spectator; every eye will make discoveries for itself, and combinations of its own.

I shall take the liberty of adding what occurs to me, as to the practicability of the removal. The extreme height, as I have already described it, is five feet one inch above the level of the soil; beneath, in some parts there may be an additional two feet, or more. The extreme breadth is eleven feet seven inches; the probable extreme thickness is six feet; and the weight, as I conjecture, is from five to six tons. Inquiry will ascertain, whether the face can be separated from the body of the rock by the saw, or by splitting, or whether the whole block must be taken together. It may also be a question, whether, if the separation be practicable, the entire removal were not more eligible. As to the method of transport, if any difficulty present itself, as to water carriage, it may be brought with facility during the winter on a sleigh. The expense may be readily known. The owner, as has been observed, is a Mr. Deane of Berkeley.

Of the value of this monument, and the degree, in which it is there-

* Fig. 13 is an engraving from Mr. Kendal's painting, or representation of the rock in oil colours.

fore worthy of preservation, and important to be procured, you are entirely sensible. Whatever be its origin or signification, it belongs to the history of America, and perhaps to that of the world. It may prove, as some have supposed it does, that Columbus was not the first navigator in this hemisphere ; it may prove, that the red inhabitants of this country were only the successors of a more cultivated people ; or it may prove, that those red inhabitants were more cultivated, than we have supposed them. It may help us to discover the origin of the population of America.

But it will appear to some, from the obscurity, in which I have described a great part of the inscription, as being involved, that its value, as a memorial of past times, is gone. The truth however is far otherwise.

I confess myself but little sanguine, as to the prospect of interpreting, in any minute manner, this inscription ; but, though such minute interpretation should not be accomplished, we may yet ascertain its general scope ; and, what is more, we may ascertain the name and country of the people, from whom it came down to us. Several figures, sufficient for exhibiting the character of the inscription, are still plain. The character is so peculiar, that its parentage need only present itself to be acknowledged.

Lastly, I shall anticipate an objection to the removal, founded on any doubt of its utility. Its removal will be useful, because it will thus be placed within the reach of frequent observation ; and error will be dissipated. It will be useful also, because, upon all calculations of probability, it will best secure its preservation. The rock and its inscription are but little valued in their own neighborhood. The attempts to find the money, of which it has been supposed to be designed to publish the concealment, have come to nothing, and the rock is out of repute. It is robbed even of the veneration entertained by all men for antiquity; for it is regarded as the work of a buccaneer, to mark the deposit of his ill-gained treasure. One experiment seems yet left to the searchers for gold; and it is a little singular, that it has not before this time been tried. The rock may be split, or blasted, to remove it, and dig beneath.

But what ignorant adventure has left undone, the regular march of industry may do. Next year, a wharf or a ship yard may be projected on the site of the writing-rock; and its consecrated stone, grown into value or into a nuisance, may be buried, as an abutment, or broken up, to build a wall, or clear the ground.

With sincere esteem,

I am, dear sir,

your faithful, humble servant,

E. A. KENDAL.

XXVIII. ACCOUNT

OF A STONE BUST, SUPPOSED TO HAVE BEEN AN INDIAN GOD.

Written A. D. 1790.

BY EZRA STILES, D. D. LL.D.

President of Yale college.

THIS bust was found in East Hartford (Connecticut) where it has been immemorially known; and was deposited in the museum of Yale College in 1788. The annexed drawing, Fig. 14, is a good resemblance of the original. It is thirty one inches and a half high, and seventeen inches wide. It is a hard, coarse grained stone, or white granite, not white indeed, like marble, but with a dark or greyish intermixture, leaving a whitish aspect predominant. The summit is the cap of a Powaw, used to this day by the Powaw priests of the Six Nations. The excavations are rough, and the whole a huge piece of sculpture; but it is a real work of art, and undoubtedly Indian. What was its use, and especially whether it be an Idol, is problematical. This must be left to every one's judgment or conjecture. I shall however mention a circumstance, which inclines me to believe it to have been an Indian god.

The site or position was six miles east of Hartford ferry, at the bottom of a declivity between two hills, and remained covered with forest trees till about the year 1740; when, upon clearing up the land, the stone image was removed one hundred rods, and cast out into the road. The constant tradition has been, that it was anciently worshipped by the Indians, who powawed before it. Powaws were still in full use in New England the beginning of the present century; they were certainly in existence here in 1725; and, I believe, did not go into entire desuetude until 1730 or 1740. While they were still retained in full use, there was an example of a funeral Powaw at this Stone Image; which inclines me to think it an Idol. Not to rely on the uniform tradition, which however is not without its weight, I confide in a fact, narrated to me by the reverend *Eliphalet Williams*, D.D. who was ordained pastor of the church in East Hartford in 1747, who well remembers, that soon after his ordination this Bust was shown to him, as an Indian god, by the owner, Mr. Spencer, who was then a very aged man; and who gave him the following account of it. He well remembered that, when he was a youth, a Sachem or Chief of the Farmington Tribe, fifteen miles off, having died, the Indians brought his corpse over from Farmington to be buried at East Hartford after the Indian manner; that they first brought the corpse, and laid it down before this Idol, and made a great India Powaw before it; then they carried away the corpse and buried it; and afterwards returned and powawed again before the Idol, and then dispersed. This he declared to Dr. Williams to have been a fact, to which he was knowing. The same aged person was also acquainted with other facts, concurring to convince him, that the Indians were worshippers of Idols, and actually worshipped at this Stone, as an Idol.

I have only to add, that the venerable ministers, our Fathers, always said, that the Indians were idolaters. The Rev. Mr. Eliot, the Indian apostle, Rev. Messrs. Mayhew of the Vineyard, Danforth of Taunton, Noyes of Stonington, and others, were perfectly acquainted with the Indian tongues, and studied and investigated their mythology. So numerous were the conversions to Christianity, that in 1690 there were above thirty Indian churches in New England; among which it cannot but be supposed there were some Indians, who perfectly understood their own Powaws and Religion. These all concur in asserting, that the Indians were once idolaters. Their worship, though sometimes paid to the Good Being, yet by their own confession was chiefly rendered to Chepi, or the evil Manitoo, or Evil Spirits. Whether the Stone Image, or dressed pieces of wood, which they also used, denoted a deceased person, or departed human spirit, like Baal of old, or the Devil, must remain uncertain, until our future travellers shall have learned the true mythology, now remaining in full vigour among the Chippewas, and the other western tribes of Indians, who still glory in their ancestorial Religion.

XXIX. ACCOUNT

OF COPPER COINS, FOUND IN MEDFORD, MASSACHUSETTS;

In a letter to Hon. John Quincy Adams, Esq. Corresponding Secretary of the American Academy of Arts and Sciences.

By Rev. THADDEUS MASON HARRIS, F. A. A.

Dorchester, Nov. 5, 1808.

DEAR SIR,

PERMIT me through you to make the following communication to the American Academy of Arts and Sciences.

In the spring of the year 1787, as going from Cambridge to Malden, I passed some people at work on the highway in Medford, who, in widening the road, had removed a large flat stone, under which they found a number of square copper coins, to the quantity I should judge of about two quarts. I took several of them myself; and on my return mentioned the discovery to several of my friends, who procured more.

I had hoped that a circumstance so curious would have attracted more attention, and that some learned antiquarian would have communicated to the public his observations upon the coin. As this has not been done, and lest the fact itself should be quite forgotten, I make this statement.

The coins were mostly square; but some of them of the shape and size of Fig. 15. The others are represented in Fig. 16. Fig. 17 is the same magnified, with the exergue and the characters completed by a comparison of several of the coins, on which the stamp was more regular and central.

They all bear the same stamp, on thin copper plate, cut, or rather broken into square pieces, with rough edges; and are considerably corroded by rust.

I have searched all the books of coins and medals in the College Library, but can find none, which contain any in the least resembling these. There is however in the "Histori-Geographical description of Russia, Siberia, and Great Tartary, by Philip John von Strahlenburg," page 406, Tab. xxi, letter A, the figure of a coin, which I have copied, Fig. 18, in size, shape, and impression so similar, as to demand some attention. He says, that "it was found in Great Tartary," that "the characters were presented to the public as a great rarity by M. Bandelot," and that the print and description of it was first published in the German tongue in a book, entitled "Das eroeffnete Ritter Platz, (im andern Theil des geoeffneten Antiquitäten Zimmers,") page 76.

If America was first peopled by emigrations from Siberia and Tartary, as may be inferred from the *square and circular ramparts and conical sepulchral mounds*, scattered through the whole Western Territory down to Mexico and Peru, *exactly similar in form, dimensions, and contents* to those described by M. Pallas and other travellers into the northern parts of the Russian empire, raised by nations no longer known there, and evidences of their having inhabited and traversed regions now become immense forests; and from *inscriptions on rocks* on the banks of the Ohio and at Taunton, very like to those on the Jenesei, delineated by Strahlenburg;—may we not trace *this ancient coin* to the same source? But this I leave to further investigation, and subscribe myself with much respect,

your friend and humble servant,

THADDEUS MASON HARRIS.

XXX.

AN ATTEMPT TO EXPLAIN THE INSCRIPTION ON THE DIGHTON ROCK;

In a letter to the Rev. Samuel Webber, D. D.

By Hon. JOHN DAVIS, Esq. LL. D. F. A. A.

DEAR SIR,

THE copies, which we now have, of the inscription on the *Dighton rock*, are probably as correct, as can be obtained; and whatever doubt there may be as to some of the figures or characters, from the variation in the copies, there are others, which, from the uniform correspondence of the copies, we may conclude to be exact. Of this description are the large triangular figures, which appear on every copy of the inscription. Some of the explanations, which have been suggested of this inscription, are evidently founded, in a considerable degree, on characters, which appear in different forms in different copies. And when the interpretation has reference to a supposed resemblance in the characters to letters in some of the ancient alphabets, a slight variation will materially affect the sense, and different copies, though bearing a general resemblance to *the eye*, will exhibit great diversity of *meaning*. If it could be determined, what was intended by those *conspicuous and strongly marked figures*, in which all the copies agree, we should be in a more likely way to ascertain the object of the entire inscription, and to form satisfactory conclusions as to its origin. Several *human figures*, and one representation of a *quadruped*, evidently appear on *all the modern copies*. They cannot be distinguished on that sent by Cotton Mather to the Royal Society early in the last century; but that copy, as it appears in the Transactions of the Society, is so imperfect, that it can be of little or no use in any inquiries on the subject. From the figures above mentioned, no precise inference can be drawn, as to the intent and object of the inscription. From the rudest people and from children among ourselves, nothing is more common than to see sketches of the human form and of animals, frequently without any particular plan, but from the wayward suggestions of an idle moment. Often indeed there is a plan and purpose in such delineations ; but from those figures alone, I apprehend, we can form no certain conclusion of the general scheme, which the delineators had in view. Some further definite elements are necessary to give meaning and consistency to the performance. A casual perusal of Charlevoix' voyage to North America has afforded me a pretty satisfactory elucidation of another of the figures on this rock, respecting which I wish to submit my impressions to your consideration.

In his seventh letter, speaking of the modes of hunting among the Canadian Indians, he refers to Champlain for a peculiar method of hunting the moose, the deer, and the caribou, which he thus describes. " They inclose a part of a forest with stakes, interwoven " with branches of trees, and leave but one narrow opening, where " they lay snares, made of raw skins. This space is *triangular*, and " from the angle of the entrance they draw *another triangle, much larger ;* so these two enclosures communicate together by the *two angles.* The two sides of the second triangle are also shut up with " stakes, and the hunters range upon a line from the base. Then they " advance, without breaking the line ; and drawing nearer and nearer to each other, they make a great shouting, and strike upon " something that makes a great noise. The beasts being driven forward, and not able to escape, either to right or left, and being affrighted with the noise, know not where to fly, but into the other " inclosure ; and many, as they enter it, are caught by the horns or

" the neck. They struggle greatly to get loose, and sometimes they " carry with them or break the snares. Sometimes also they stran- " gle themselves, or at least give the hunters time to shoot them at " their ease. Those, which escape this, fare no better; they are in- " closed in too small a space to shun the arrows, which the hunters " let fly at them from all sides." I had frequently read the interesting letters of Charlevoix, without being particularly attracted by this passage; but at the time of the perusal abovementioned, having been called to pay some attention to the inscription on the Dighton rock, it immediately occurred to me, that the *triangular inclosures*, thus described by the writer, much resemble some very prominent figures in that inscription. I soon after procured Champlain's Voyages from the College Library, and found that Charlevoix had given a just summary of what is recorded by that faithful and intelligent traveller; excepting that I do not find in Champlain any mention of the *snares of raw skins*, at the entrance of the smaller triangle, specified by Charlevoix. I was gratified to find in Champlain's book an engraved representation of this *gigantic trap*; of which I have taken a rude copy. (See Fig. 19). By comparing this representation and the description with two of the *uppermost figures* in Mr. Winthrop's copy of the inscription on the Dighton rock the resemblance will, I think, be apparent to every observer. In Mr. Kendal's drawing is an additional representation of this figure near the bottom of the rock, under the figure of the quadruped. Whatever may have been intended by the exhibition, it was evidently a favorite figure with those, who framed the inscription, as we may infer from its being thus repeated. I am induced to believe, that the very apparatus, described and sketched by Champlain, was designed to be expressed by those resembling figures on the rock.

This mode of hunting was not confined to the *Canadian Indians.* Roger Williams, writing of the Indians of New England, observes, " When they pursue their game, especially deer, which is the general " and wonderful plenteous hunting in the country, they pursue in " twenty, forty, fifty, yea two or three hundred in a company, as I " have seen; when they drive the woods before them." (Hist. Coll. iii. 233). Hutchinson is more particular. " Besides their bows," says he, " they had other devices to take their game; sometimes by " double hedges a mile or two in length, and a mile wide at one end, " and made narrow by degrees, until they came to a gap of about " six feet, against which thay lay hid to shoot the deer, as they came " through, in the day time; and at night they set deer traps, being " springs, made of young trees." (Hist. of Mass. vol. i.) This writer, as well as Charlevoix, speaks of the traps, as well as of the large inclosures. Perhaps these *traps* are meant to be delineated in the large figure on the left of Mr. Winthrop's copy, which contains some interior appendages, not found in the other resembling figures.

I am further induced to consider this application of those figures to have been intended, from a consideration of the situation, compared with the places, in which it appears from Champlain, but more particularly from La Hontan, that such erections were made. The last mentioned writer, describing a similar mode of hunting, which he witnessed, mentions, that the inclosures were made on an *isthmus,* between two lakes. He gives a drawing, from which I have hastily copied the inclosed sketch. (See Fig. 20). Its resemblance to Champlain's figure, and to those on the rock, will be perceived. The lines of the fence without the triangle extend to the lakes. The advantage of this arrangement, to prevent the escape of the deer, is manifest. In the vicinity of the Dighton rock a similar situation is to be found. The rock is near the entrance of a neck of land, called *Asonet-Neck.*

formed by Asonet and Taunton rivers, which unite about four miles below the rock. (See a sketch, Fig. 21). Across this neck a trap of this sort might be framed with the same advantages, as in that, delineated by La Hontan ; and no portion of our country perhaps was more favorable for the amusement and exploits of the hunter. The territory east of Taunton river, and between that river and Plymouth and Sandwich, is so congenial to *deer* particularly, that they are still found in considerable plenty in the forests in that region. The river, neighbouring ponds, and forests abounding in game, would render this vicinity a desirable and favorite residence for the Indians. To such places, it appears from Roger Williams, they were in the habit of resorting in large companies for hunting, fishing, and fowling, at particular seasons of the year. During the intervals of leisure, incident to such occupations, as the art of designing was not unknown and not unfrequent among the Indians of this country, it seems altogether natural and probable, that some one or more among the companies, successively resorting to this spot, should be disposed to make a delineation, commemorative or indicative of their favorite employment. If the mode of hunting on the *grand scale*, above mentioned, were in use among the Indians of New England, of which I believe there is no doubt, the apparatus, employed in it, would take a strong hold of the imagination ; and, as with all its grandeur it happens to be extremely simple in its construction, there would be nothing difficult in the representation. This I believe to be the true explanation of the several resembling triangular figures on the *Dighton rock.* If this be admitted, it gives a key to the whole. The quadruped (probably representing a deer), the bird, which many observers find there, and the arrow heads, all become consistent appendages. The human figures represent the hunters : and, without any extravagance of imagination, I think we may trace a river, with wears across it, for the taking of fish. The whole indicating a grand hunting scene in all its interesting varieties. A scene, which, next to war, most powerfully interested the savage inhabitants of the country. On this idea, we may find a probable explanation of several other figures. I think, I can see the sort of *noose*, described with so much naiveté in the "Journal of a plantation settled at Plymouth," and in which governor Bradford was *caught by the leg, while he came to look upon it*; and we can also make out the *log-trap*, of which we have an account in Belknap and other approved writers on Indian habits and customs. I have mentioned, that the art of designing was not unknown and not unfrequent among the Indians of this country. To this purpose there are many unquestionable authorities. Charlevoix, speaking of their wars, observes, that the chief of the victorious party leaves on the field of battle his fighting club, on which he takes care to trace the mark of his nation, that of his family, and his portrait, i. e. an oval with all the figures he had on his face. Others paint all these marks on the trunk of a tree, or on a piece of bark, with charcoal, pounded and rubbed, mixed with some colours. To come nearer home, Morell, in his interesting Latin poem on New England, thus speaks of their skill in embroidery;

"Inducto tergore corpus
"Villoso, leviter miris se singula formis
"Texta ligant."—

And their baskets and other furniture he thus describes;

"Corbes
"Contextos formis, varioque colore tapetum,
"Stramine compositum tenui, mirisque figuris."

This is no poetic fiction. Honest Gookin says the same in plain prose; and expressly mentions these portraitures of birds, beasts, fishes, and flowers. In the museum of the academy we have a specimen of their sculpture, an imitation of a serpent's head on the end of a stone pestle ; and Dr. Belknap mentions a bone, on which was engraven by Indians the bust of a man, apparently in the agonies of death. "I have heard," says the same estimable writer, "of two specimens of an Indian gazette found in New Hampshire. One was a pine tree, on which was depicted a canoe with two men in it. This is supposed to have been a mark of direction to those, who might come after. The other a tree in Moultonborough standing by a carrying place between two ponds, on which was carved the history of one of their expeditions. The number of killed and prisoners was represented by so many human figures, the former marked with the stroke of a knife across their throats." (Hist. of N. Hampshire, Vol. III.) Of this general character I conceive the inscription on Dighton rock to be, though not representing such cruel and disastrous transactions. The peaceful but energetic exploits of the hunter, I suppose, were only intended to be delineated, and the human figures may be in honor of some of the *Nimrods* of the day.

In governor Winslow's account of the natives of New England we find this observation. "Instead of records and chronicles they take this course ; where any remarkable act is done, in memory of it, either in the place, or by some pathway over adjoining, they make a *round hole* in the ground about a foot deep, and as much over, which when others passing by behold, they inquire the cause and occasion of the same, which being once known, they are careful to acquaint all men, as occasion serveth, herewith. And lest such holes should be filled or grown up by any accident, as men pass by, they will oft renew the same. By which means many things of great antiquity are fresh in memory." Will not this practice account for the many *small circles*, which we find in our inscription, and which we may suppose intended to give more permanency to the chronicle, than could be given by *holes in the ground.* Other marks of more irregular form I conceive to be merely the marks or signatures, appertaining to particular tribes, families, or distinguished individuals. Professor Pallas, in his travels into the north eastern provinces of Russia, mentions a monument not dissimilar, which he noticed on the bank of a river, emptying into the *Jenesei.* He conceives it to be a sepulchral monument, and mentions the bones found in the vicinity. The inscription he supposes to represent the signatures of the persons buried near the spot. In the collections of the Historical Society we find copies of engagements made by Awasuncks and her Indians with the governor of Plymouth in 1671, and another from the Dartmouth Indians. The originals were once in my hands, and I well recollect, that many of the signatures exhibited rude resemblances of birds, beasts, fishes, and other objects. One delineated a *tortoise* with considerable exactness. After the arrival of our ancestors and an intercourse with them, many of the Indians were fond of taking English names. Masassoit named his two sons Alexander and Philip. Those, who were able, would be proud to employ their English name, or at least the *initial,* when called upon to affix their signature. I have a deed given by *Wanasittas,* alias Alexander, in which he signs by affixing the letter *A* to the seal. This may help us to account for the Roman capitals, that appear on the rock, particularly in Mr. Kendal's copy. On the whole, I cannot but think it highly probable that general Washington's opinion of this inscription, given when he saw a copy of it in the college museum, is correct, and that it was the work of the native Indians of our country. It appears to me to have been designed to represent and commemorate exploits of hunting; and that the characteristic signatures of some of the principal actors were added. Its application to hunting is inferred principally from what

I suppose to be the meaning of the triangular figures. Of the justness of that opinion and of all the remarks suggested there cannot be a better and safer judge than yourself; for none, I am sure, is more habitually disposed to weigh with due deliberation every circumstance, which ought to enter into estimation in forming a correct decision. But that it may receive the scrutiny of many minds, you are at liberty, if you please, to communicate this letter to the Academy. In the leading idea I have some confidence. A more careful and thorough view of Indian habits, manners, and customs, than I have been able to take since I thought of making this communication, will either confirm the suggestion, or evince that it ought to be abandoned.

I am, sir, very respectfully,
and with great regard,
your ob't servant,
JOHN DAVIS.

P. S. General Washington's idea of this inscription was communicated to me by our friend, the reverend Dr. Lathrop, who was with him in visiting the college. He remarked as Dr. L. recollects, that he had repeatedly noticed similar inscriptions in the Indian country, in early life, which were unquestionably executed by the natives.

XXXI.

ANIMADVERSIONS ON THE DANGEROUS PRACTICE OF SLEEPING ON THE DAMP GROUND AND OF EXPOSURE TO THE NIGHT AIR, PARTICULARLY WHERE THE ANIMAL POWERS ARE DIMINISHED; ILLUSTRATED ON PHILOSOPHICAL PRINCIPLES;

Inclosed with a letter to Aaron Dexter, M.D. F.A.A. *and William Spooner,* M.D. F.A.A.

By A. FOTHERGILL, M. D. F. R. S.

Of the Royal College of physicians, London, honorary member of the Medical Societies of London, Edinburg, and Paris—of the Philosophical Societies of Bath, Manchester, Philadelphia, and of several Agricultural Societies.

NOCTES ATQUE DIES PATET ATRI JANUA DITIS. VIRG. ÆN. LIB. VI.

IT is the office of the physician to endeavour not only to cure, but to prevent diseases; and though the latter may sometimes seem to clash with his immediate interest, yet duty and humanity nevertheless demand it. Among the lower orders of people, ignorance is the frequent source of many of their calamities. Though few can be so ignorant, as not to know that dangerous and fatal maladies have been contracted from damp rooms, damp linen, or damp clothes, yet many may still be unaware, that the earth's surface, however dry it may appear, is constantly exhaling moisture; that the human body after being heated (or, to use a modern term, preternaturally excited) by a hot sun, hard labour, or intemperate drinking, is rendered much more susceptible of injury, from cold thus partially applied; and finally, that the danger is materially increased by inactivity, and the relaxing influence of sleep. For preternatural excitement, from whatever cause, constantly produces a proportionate collapse, or diminution of the animal powers. Certain late writers indeed, fond of singularity, have unguardedly ventured to persuade the public, that the ill effects imputed to sleeping in damp linen are merely imaginary; nay further, that the sprinkling of the sheets with cold water on going to bed is wonderfully salutary and refreshing, particularly to the weary traveller, exhausted with fatigue. Should our travelling invalids be so silly as to be misled by such a doctrine, or so imprudent as to hazard the experiment, they would soon feel cause to be convinced of their folly, and to lament their credulity.

It is therefore not without compassion and regret, that one sees so many inconsiderate people, under the above circumstances, lying prostrate on the damp ground, often sleeping for hours; sometimes even after rain, and when innumerable dew drops are visible on the grass; a practice too common, but which can never be sufficiently reprobated.* It has been discovered by experiments, that even in the driest seasons, a square foot of earth exhales an almost incredible quantity of watery moisture; that the evaporation increases in proportion to the heat of the atmosphere, and that, in proportion to the rapidity of evaporation, cold is generated. This process may be easily increased to a degree sufficient to convert water into ice, as an article of luxury, even in the hottest climates, as is well known in the East and West Indies.

In the temperate climate of Great Britain in a dry season, Dr. Watson discovered by experiment, that an acre of grass plat, clean mowed, yielded by evaporation after the rate of 1600 gallons per day, and after rain considerably more. The quantity of aqueous evaporations, *cæteris paribus*, is in direct proportion to the surface exposed, the heat of the climate, and the dryness of the atmosphere. Hence

* For example, in the State House garden of Philadelphia, although numerous benches are always ready to accommodate company with seats.

the evaporation of the summer months, on a medium, probably equals that of the rest of the year, and its quantity, in this warm climate, must of course exceed that of Great Britain. Evaporation is greatly accelerated by a brisk wind ; and the more rapid the evaporation, the greater (as has been hinted) is the degree of cold it produces. Add to this, that a sudden depression of 12 or 14 degrees of temperature (as often suddenly happens in this variable climate) is sufficient to cause the dew to fall, increasing the coldness of the ground and superincumbent atmosphere. This alone, in persons already enfeebled by the causes abovementioned, greatly enhances the danger. The hardy sailor indeed, through habit can, during a long voyage, bear with impunity to lie down in his clothes, though dripping-wet with sea-spray, yet this does not render him proof against the heavy dews of a hot climate on shore, where, if he imprudently sleep in the open air, though but a single night, it is at the risque of his life, as too many able seamen have experienced.*

The human body, exposed to the damp ground when weakened by infirm health, fatigue, or intemperance, is predisposed to receive, in its full force, the injurious impression of cold and moisture. When a person, under such circumstances, awakes from his sleep in a half torpid state, he generally feels a sense of numbness, chilliness, and inactivity through all his limbs, which (to say nothing of the loss of time and the endangering of health) renders him listless and unfit to renew his daily task with his wonted vigour and alacrity. But this is not all. For those, who indulge this dangerous habit, may think themselves fortunate, if they are not speedily overtaken by some severe disease, which may not only deprive them of working for themselves and families, but render them burthensome to their friends and the public. Cer-

* See Lind, and other late authors on the diseases of hot climates.

tainly a more ready means of procuring some obstinate, acute, or chronic disease could scarcely be devised. As if the avenues to pain, misery, and death, were not already sufficiently numerous without wantonly increasing them by temerity or fool-hardiness.

Can we wonder then at the frequency of rheumatisms, palsies, fevers of different kinds, coughs, and consumptions, which prevail in the finest and serenest weather? Or that the weekly bills of mortality should so often increase at that season of the year, when this imprudent practice is most frequent? Of its pernicious effects our hospitals and dispensaries could doubtless afford too many sad examples. These are well known to medical practitioners, yet the cause appears hitherto to have escaped public notice; and while it remains unnoticed, unreproved, the abuse will, of course, be continued to the no small detriment of individuals and of the state.

Labouring people have indeed been repeatedly cautioned, by the Humane Society, and very properly, against drinking cold water, when the body is heated; the practice being considered in this climate, as the frequent cause of sudden death. In Great Britain however it rarely proves fatal, but often produces obstinate cutaneous eruptions. It may indeed be fairly presumed, that where certain individuals, from a peculiar debility, or idiosyncrasy, fall victims to the cause, a still greater number contract dangerous diseases by unguardedly sleeping on the damp ground, wet clothes, or damp beds. The ordinary temperature of the springs and pump-waters in this city has been stated at about 53°, and that of the hydrant, conveyed from the river Schuylkill, is allowed to be in summer several degrees warmer.*

* September 15, 1807. The water of two pumps, one in Walnut street, the other in Fifth street, fresh drawn, are found by experiment this day to be 58°. While that of a neighbouring hydrant of Schuylkill water marks 74,° the present heat of the atmosphere.

Now if sudden death be often occasioned by drinking either of these waters, when the body is heated, how much greater would seem the danger, if drank when cooled down about 26 degrees lower viz. to the freezing point? Yet how many, when heated by dancing, or other violent exercise, eagerly assuage their thirst by copious draughts of ice water, or lemonade, cooled by ice? Nay, by freely eating ice itself in the various forms of ice creams? Yet hazardous as this practice undoubtedly is, few authentic instances of sudden death from that cause, have come to our knowledge. Is that delicate organ, the stomach, then, able to bear the sudden and violent transitions of heat and cold, better than the outward surface of the body? Is not the skin the exquisite organ of feeling, and is it not more tremblingly alive to various impressions, than the stomach itself? Otherwise whence is it, that a person can drink tea and coffee extremely hot without emotion, yet, if let fall on his skin, complains bitterly of being scalded? Admitting this, it tends to corroborate our present doctrine. For of all the remote causes of human maladies, the sudden or partial application of cold and moisture to a body predisposed is evidently one of the most frequent and most injurious. Were it not for this, and the periodical returns of the malignant and remittent fever (of which, during an epidemic constitution, exposure to cold is known to be a powerful exciting cause), the summer would, in all probability, prove the most healthy season.

It may not be improper in this place just to hint a necessary caution respecting another custom, fashionable among all ranks of society, as it doubtless endangers health. It is the habit of sitting, long after sunset, on summer evenings in the open air, exposed to the descending dews; often on cold marble steps before the doors; or in passages in the full current of the night air. But however pleasing and refreshing the cool air of the evening may appear, after the intense heat of the day, yet, for reasons assigned, much caution is required. The example of the healthy and robust ought by no means to encourage the delicate and valetudinary to indulge indolence at the expense of their welfare, in sitting till a late hour. Have not such persons too often cause to regret the effects of their temerity ? The evening air till about sun set, or an hour after, might surely be enjoyed with equal advantage, and more safety, were walking, riding, or other gentle exercise adopted instead of the present inactive, sedentary habit.

From a series of observations in this variable climate, I find by the thermometer that, during the summer months, the temperature of the external atmosphere from four o'clock in the afternoon till ten in the evening commonly undergoes a diminution from twelve to sixteen degrees. But on a sudden storm from the north east, accompanied with heavy rain, the mercury in the course of a few hours sometimes undergoes a still more surprising depression, of twenty five to thirty five degrees. Yet regardless of these sudden transitions, fashionable young people disdain to appear in warmer clothing. Ladies though valetudinary resolve to continue their elegant summer dress, or rather *undress* to the verge of winter. How many blooming females thus sacrifice health, beauty, and life itself, at the shrine of fashion !

Can we wonder at the frequency and fatality of pulmonic diseases, or that consumption alone, should constitute more than one fifth of the deaths, which appear in the annual bills of mortality ?

It is very observable among young persons, especially those of a delicate constitution and sprightly disposition, that when they are conscious of having thus contracted an obstinate complaint through their own indiscretion, they studiously ascribe it to any other cause, rather than the right one ; particularly if the latter be of the fashionable, or pleasurable kind. A species of deception, which may often impose on parents and guardians, but cannot easily elude the penetration of a sagacious physician.

Perhaps it will be objected, if sleeping on the ground, or exposure to the night air at a late hour be so very injurious, whence is it, that any of those, who indulge these habits, escape with impunity? The same question may be urged, when a malignant fever rages with epidemic violence, whence is it, that some persons in the infected neighbourhood escape, and continue to enjoy their usual health? A few such escapes thus betray many into a fatal security. But is it not more prudent to take warning from the calamities of others, than to run headlong into dangers, that might easily be avoided?

"Felix quem faciunt aliena pericula cautum."

CORRIGENDA ET ADDENDA.

Page.	*Line.*
1	1 prefix I.
18	— — II.
23	— — III.
33	— — IV.
38	— — V.
40	— — VI.
—	12 for 1 read 6.
55	16 for 962,6 read 966,66.
—	28 — 291,7 — 291,66.
—	30 — 666,66 — 669,44.
—	31 — 904,54 — 905,55.
—	32 — 962,6 — 966,66.
84	2 for dawn read down.
—	14 — concession — concussion.
112	4 b. — 1786 — 1759.
133	19 — Crystal and — Crystals of.
150	13 b. — Crousted — Cronstedt.
175	13 — ufr — fur.

Note. Mr. Barrell's measures of rain, page 104, are expressed in inches and decimals of an inch, the first three places on the right being decimals.

Note 2. The top of the funnel of the rain-guage, used by the Rev Mr. Newell, was about 15 inches above the surface of the ground. See page 122.

XXXII. AN ESTIMATE

OF THE HEIGHT, DIRECTION, VELOCITY AND MAGNITUDE OF THE METEOR, THAT EXPLODED OVER WESTON IN CONNECTICUT, DECEMBER 14, 1807.

With methods of calculating observations made on such bodies.

BY NATHANIEL BOWDITCH A. M. A. A. S.

and member of the Philosophical Society held at Philadelphia.

THE extraordinary meteor which appeared at Weston in Connecticut on the fourteenth of December 1807, and exploded with several discharges of stones, having excited great attention throughout the United States, and being one of those phenomena of which few exact observations are to be found in the history of physical science, I have thought that a collection of the best observations of its appearance at different places, with the necessary deductions for determining as accurately as possible, the height, direction, velocity, and magnitude of the body, would not be unacceptable to the Academy, since facts of this kind, besides being objects of great curiosity, may be useful in the investigation of the origin and nature of these meteors; and as the methods of making these calculations are not fully explained in any treatise of trigonometry, common in this country, I have given the solutions of two of the most necessary problems, with examples calculated at full length. The second problem is not (to my knowledge) given in any treatise of spherics. The observations of the meteor, which after many inquiries, were found to have been made with sufficient accuracy to be introduced in the present investigation, were those made at Wenham about seven miles north-easterly of Salem, by Mrs. Gardner, a very intelligent lady, who had an opportunity of observing it with great attention; those at Weston by Judge Wheeler and Mr. Staples; and those at Rutland in Vermont by William Page Esq. In collecting and combining these observations I have received great assistance from my friend, John Pickering jun. Esq. A. A. S. particularly in the observations at Wenham. These observations are given after the problems, and the results from combining them in various manners are stated at the end of this memoir.

PROBLEM I. FIG. 1.

Suppose that in two places in given latitudes and longitudes the azimuths of a meteor were observed at the same moment of time, and its angular elevation above the horizon of one of those places. It is required to determine the situation of the meteor.

SOLUTION.

Let C be the centre of the earth, PWSM a portion of its surface reduced to the level of the sea supposed to be spherical, P the pole of the earth. w, s, the places of observation, m the place of the meteor. Draw Cw, Cs, Cm, cutting the spherical surface in the points W, S, M. Then Ww, Ss, will represent the vertical heights of the places of observation, and Mm the vertical height of the meteor above the level of the sea; PWM the azimuth of the meteor observed at w, and PSM its azimuth observed at s. Then in the spherical triangle PWS are given PW, PS, the co-latitudes of the places of observation, and the angle WPS equal to their difference of longitude, to find by spherics the angles PWS, PSW, and the side SW. The sum or difference of PWS, PWM, will give the angle SWM; and the sum or difference of PSM, PSW, will give the angle WSM.

Then in the spheric triangle WSM will be given the angles SWM, WSM and the side SW, to find the sides WM, SM, which are respectively equal to the angles mCw, sCm. The altitude of the meteor observed at w, added to 90°, and $\frac{1}{14}$th. part of the arch WM subtracted from the sum for terrestrial refraction, will leave the correct value of the angle Cwm: this added to mCw and the sum subtracted from 180° will leave the angle Cmw. Then in the plane triangle Cwm, will be given the angles and the side Cw (which may in general, when Ww is small, be taken equal to the semidiameter of the earth, 3982 miles*) to find wm the distance of the meteor from the observer at w, and Cm its distance from the centre of the earth, from which subtracting CM equal to 3982 miles, there will remain the vertical altitude of the meteor above the level of the sea. In the plane triangle sCm are given Cs, Cm, and the included angle sCm (= arch SM) to find sm the distance of the meteor from the observer at s, and the angle Csm equal to the supplement of the zenith distance of the meteor at s. The co-latitude of the meteor is equal to the arch PM, and the angle SPM is equal to the difference of meridians between the meteor and the observer at s. These quantities may be easily found, by means of the spheric triangle PSM, in which PS, SM and the angle PSM are given. They may also be found in a more simple manner, and to a sufficient degree of accuracy, by the usual rules of navigation, supposing the angle PSM to be the course and SM the distance, whence may be found the difference of latitude, departure, and difference of longitude between the points S, M.

* The mile made use of in this memoir is the statute mile of 5280 feet. In the following calculations on the Weston meteor, it will be supposed that Cw= Cs=3982 miles; the part Ww or Ss being but a small fraction of a mile.

EXAMPLE.

Suppose the azimuth of the meteor at Wenham PWM=117° 35′ 54″, azimuth at Weston PSM=3°, altitude at Wenham 5° 50′ 40″, co-latitude of Wenham PW=47° 19′ 45″, co-latitude of Weston PS 48° 45′, difference of meridians WPS=2° 36′ 45″. It is required to find the latitude and longitude of the meteor, its distance from Wenham and Weston, and its vertical height above the level of the sea.

This corresponds to Example 10 in Table 1.

In the triangle PSW.

$\frac{1}{2}$P S = 24°22′ 30″
$\frac{1}{2}$PW=23 39 52

Sum	48 2 22	Cos.AC	0·1748214	- - - - Sine AC	0·1286575	PSW 52°56′34″	SineAC	[illegible]
Diff.	0 42 38	Cos.	9·9999666	- - - - Sine	8·0934643	PW 47 19 45	Sine	[illegible]
$\frac{1}{2}$WPS	1 18 22	Cotan.	11·6420673	- - - - Cot.	11·6420673	WPS 2 36 45	Sine	[illegible]
$\frac{1}{2}$Sum	89 7 36	Tang.	11·8168553	$\frac{1}{2}$dif. 36°11′2″ Tan.	9·8641891	SW 2 24 25	Sine	[illegible]

$\frac{1}{2}$Diff. 36 11 2	PWS 125 18 38	PSW 52 56 34
	PWM 117 35 54	Azim. PSM 3
Sum 125 18 38=PWS		
Diff. 52 56 34=PSW	SWM 7 42 44	WSM 55 56 34

In the triangle WSM.

$\frac{1}{2}$WSM 27 58 17
$\frac{1}{2}$SWM 3 51 22

Sum	31 49 39	Cos. AC	0·0707652		Sine AC	0·2778898
Diff.	24 6 55	Cos.	9·9603401		Sine	9·6112706
$\frac{1}{2}$SW	1 12 12$\frac{1}{2}$	Tang.	8·3223773		Tang.	8·3223773
$\frac{1}{2}$Sum	1 17 34	Tang.	8·3534826	$\frac{1}{2}$dif. 0° 55′ 57″	Tang.	8·2115377
$\frac{1}{2}$Diff.	0 55 57					

C$w$$m$=95° 41′ 50″=Alt. 5° 50′ 40″+90°−$\frac{1}{14}$WM*

Sum	2 13 31=WM=mCw - - - - - -	2 13 31
Diff.	0 21 37=SM=sCm	Cmw=82 4 39
		Sum 180 0 0

* The correction $\frac{1}{14}$WM, by the above calculation is 9′ 32″. The value made use of in finding Cwm is 8′ 50″, estimated by a rough calculation, and it was thought unnecessary to repeat the operation on account of this small difference.

In the triangle C*wm*.

C*mw*	82° 4′ 39″	Sine AC	0·0041651	- - - - - - - - - - -			0·00417
C*w*	3982	log.	3·6001013	- - - - - - - - - - -			3·60010
C*wm*	95 41 50	Sine	9·9978494	WM	2° 13′ 31″	Sine	8 58915
C*m*	4000·51	log.	3·6021158	*wm*	156·1 miles	log.	2 19342

In the triangle C*sm*.

C*m*+C*s*	7982·51	log. AC	6·0978605	C*ms*	53°24′36″	Sine AC	0·09533
C*m*∽C*s*	18 51	log	1·2674064	C*s*	3982	log.	3·60010
½sum ang.	89 49 11½	Tang.	12·5025138	*s*C*m*	0 21 37	Sine	7·79851
½diff. ang.	36 24 35½	Tang.	9·8677807	*sm*	31·2 miles	log.	1·49394

Sum 126 13 47=C*sm* ∴ Alt. at Weston 36° 13′ 47″.
Diff. 53 24 36=C*ms*

The course from S to M is nearly N 3° W, the distance SM 21′ 37″, or 21′·62 ; hence the difference of latitude is 21′·59 = 21′ 35″, the departure 1′·13, and the difference of longitude 1′·51 = 1′ 31″.

Latitude of Weston	41° 15′ 0″	Longitude of Weston	73° 27′ 0″
Diff. of latitude	21 35	Diff. of longitude	1 31
Latitude of Meteor	41 36 35 N	Long. of Meteor	73 28 31 W

PROBLEM II. FIG. 2.

Suppose that in two places *s*, *w*, in given latitudes and longitudes, the angular elevations of a meteor C*sm*, C*wm*, were observed, and the azimuth PSM at one of the places. It is required to find the situation of the meteor.

SOLUTION.

This figure is to be marked like the first, then on SM (continued if necessary) let fall the perpendicular AW. Suppose a plane drawn through w, perpendicular to Cw, to cut the line sm in b. Join Cb cutting SM in B, and let CA continued cut sm in a. Find in the triangle PSW, the angles PWS, PSW, WSM (or ASW), and the side SW as in the last problem. Then in the right-angled spheric triangle SAW are given SW and the angle ASW, to find by spherics SA, AW, and the angle SWA. The angle Csm, or its supplement, is equal to the angle Csa, the angle sCa = arch SA, and the angle Cas= $180°—Csa—sCa$.

$$\text{Sine } Cas : \text{Sine } Csa :: Cs : Ca$$

$$\text{Tang. AWB} = \frac{\text{Tang. } Cas}{\text{Sine AW}} \left(1 - \frac{Ca}{Cw} \cdot \text{Cosine AW}\right)$$

The affection of the angle AWB may be determined by the figure and the data of the problem.*

$$\text{Sine MWB} = \frac{Ca}{Cw} \times \text{Cotang. } Cwm \times \text{Tang. } Cas \times \text{Cos. AWB.}$$

$$\text{MWA} = \text{AWB} \underset{\backsim}{+} \text{MWB.}$$

The sign to be made use of is easily discovered by the figure, observing that the point B falls between M and S.

$$\text{Cotang. } mCw \text{ (=Cotang. MW)} = \text{Cosine MWA} \times \text{Cotang. AW.}$$

* This angle may also be found in the following manner. Having in the plane triangle aCw, the sides Ca, Cw, and the angle aCw (=arch AW) the angles Caw, Cwa, may be found by plane trigonometry, and AWB by this formula.

$$\text{Tang.AWB} = \frac{\text{Cos. } Cwa \times \text{tang. } Cas}{\text{Sine } Caw}.$$

The sum of the angles C*wm*, *m*C*w*, subtracted from 180° leaves C*mw*. Then

Sine C*mw* : Sine C*wm* :: C*w* : C*m*.

The distances *wm*, *sm*, and the latitude and longitude of the meteor may be found as in Problem 1.

When the distance of the meteor is great, the angles C*sm*, C*wm*, must be corrected for terrestrial refraction, by subtracting one fourteenth part of the intercepted arches SM, WM respectively ; but as these arches are generally unknown, it will be necessary (when great accuracy is required) to make the calculation with the altitudes uncorrected, and thus find the approximate values of the corrections of the altitudes for refraction, and, by repeating the operation, the required quantities will be obtained. In this way the refraction in the Wenham observations was found to be about 9 or 10 minutes.

EXAMPLE.

Suppose the altitude of the meteor at the time of its disappearance at Weston was 75°, its azimuth at that place N 15° W, and the corresponding altitude of the meteor at Wenham 5° 30′ corrected for refraction. It is required to find the latitude and longitude of the meteor, its distance from Wenham and Weston, and its vertical altitude above the level of the sea.

Here are given the angle C*wm* = 90° + alt. at Wenham = 95° 30′, C*sm*=90° + alt. at Weston = 165°. The arch SW = 2° 24′ 25″, the angle PWS = 125° 18′ 38″, and the angle PSW = 52° 56′ 34″, are found as in the last example. The angles PSW, PSM added together give WSM or ASW = 67° 56′ 34″.

This corresponds to Example 14, Table 1.

SW 2°24′25″ Tang. 8·6235990	- - - - - - Sine 8·6232157	- - - Cos. 9·9996167
ASW 67 56 34 Cos. 9·5746474	- - - - - - Sine 9·9669904	- - - Tan. 0·3923430
SA 0 54 16 Tang. 8·1982464	AW 2°13′50″ Sine 8·5902061	SWA 22°4′29″ cot. 0·3919597
Csa 165 0 0 Sine 9.4129962	AW 2 13 50 Cot. 11·4094901	
Cas 14 5 44 Sin. AC 0·6134301	MWA 20 24 42 Cos. 9·9718374	
Cs 3982 log.*	MW 2 22 47 Cot. 11·3813275	- - - Sine 8·61823
Cw 3982 log. AC*	*Cwm* 95 30 0 Sine 9·9979960	
Ca÷*Cw* log. 0·0264263	*Cmw* 82 7 13 sin. AC ·0041201	- - - - - 0·00412
AW 2 13 50 Cos. 9·9996708	Sum 180 0 0	
1·061933 log. 0·0260971	*Cw* 3982 log. 3·6001013	- - - - - 3·60010
Sub. 1 ·061933 log. 8·7919221	*Cm* 4001·5 log. 3·6022174	*wm* 166·9 log. 2·22250
Cas 14 5 44 Tang. 9·3998470	M*m* 19·5	
AW 2 13 50 sin. AC 1·4097939	MW 2°22′47″ Sine 8·6182788	
AWB 21 46 44 Tang. 9·6015630	MWA 20 24 42 Sine 9·5425303	
AWB 21 46 44 Cos. 9 9678392	AM 0 49 47 Sine 8·1608091	
Ca÷*Cw* log. 0·0264263	SA 0 54 16	
Cwm 95 30 Cot. 8·9835769	SM 0 4 29 Sine 7·11533	
Cas 14 5 44 Tang. 9 3998470	*Csm* 165 0 0	
MWB 1 22 2 Sine 8·3776894	*Cms* 14 55 31 Sine AC 0·58912	
AWB 21 46 44	*sum* 180 0 0	
MWA 20 24 42	*Cs* 3982 log. 3·60010	
SWA 22 4 29	*sm* 20·2 log. 1·30455	
SWM 1 39 47		
PWS 125 18 38		

PWM 123 38 51 = calculated azimuth.

* These logarithms are neglected, because one is the arithmetical complement of the other, and their sum (rejecting 10 in the index) is 0.

The course from S to M is nearly N 15° W, the distance S M 4′ 29″ ; hence the difference of latitude of the points S, M is 4′ 20″, departure 69″·6, difference of longitude 93″. Hence the latitude of the point M is nearly 41° 19′ 20″ N, and its longitude 73° 28′ 33″ W.

If it be required to find the change in the above elements arising from an error in the altitude at Wenham, it would only be necessary to repeat the latter part of the calculation, since the values of SA, SWA, AWB, would remain the same in both cases.

Remark 1. When the distances of the observers from each other and from the meteor are small, the correction arising from the spherical form of the earth may be neglected, supposing the triangle SWM to be rectilinear and drawn on a horizontal plane. In this case the calculations will be rendered more simple if the heights are estimated from a plane drawn through w parallel to the horizon, supposing the points w, W, to coincide. Then if the points s, w, are at the same height, the points s, S, will also coincide as in Fig. 3. If the points s, w, are not at the same level, as in Fig. 4, the lines ms, MS (continued if necessary) will meet in S′, in the plane MWS, making SS′=Ss× Cotang. alt. meteor at s. In either case there will be given in Problem I. the angles SWM, WSM, SMW (=180°—SWM—WSM) and SW to find by plane trigonometry WM, SM. Then the altitude of the meteor above the level of the point w will be represented by

WM×Tang. elevation of the meteor at w.

In Problem 2, when the points s, w, are at the same level, as in Fig. 3, there will be given the angles Mwm, Msm, WSM, and the side SW, to find the angle SWM by the following formula.

Sine SWM=Tang. alt. meteor at w × Cotang. alt. meteor at s × Sine WSM,

which being found the rest of the calculation may be made as above. When the points s, w, are not on the same level, as in Fig 4, the line SS′ being found as above, and the angle WSS′ equal to WSM or its supplement, SW being also given, the side S′W and the angles WS′S, S′WS, may be found by plane trigonometry. Then as before we shall have

Sine S′WM = Tang. alt. meteor at w × Cotang. alt. meteor at s × Sine WS′M,

which gives the bearing of the meteor from W, whence the distance WM, and the height of the meteor as in Problem I.

Remark 2. When either of the azimuths or altitudes is not accurately known, but the limits between which the real value is contained are given; the situation of the meteor may be calculated for each of these limits, and by this means the limiting values of the required elements of the motion of the body may in general be obtained. This method is frequently made use of in this memoir.

Remark 3. In order to judge of the accuracy of the results obtained by the preceding problems, it will be useful to repeat the operation, making successively a small change in each of the given quantities. For if any one of the required quantities be not materially affected by these changes, the calculated value will in general be nearly correct. On the other hand if a small error in the observed angles produces a great error in the result, it will be proper to reject it. Thus, in Problem I. if the given angles WSM, SWM, are both very small, the least change in either of those angles will in general produce a great change in the situation of the point M, as is well known; and if the two places of observation s, m, are thus situated with respect to the meteor, the observations made at those places must not be combined together. This is the case with the observations of the Weston meteor made at Rutland and Weston, and for that reason the observations made at those places are not combined together, in the calculations made for determining the place of the meteor.

Observations at Wenham, Weston, and Rutland.

Sometime after the appearance of the meteor, I went with Mr. Pickering to Mrs. Gardner's house in Wenham, where she had observed the phenomenon. She informed us that on the morning of the fourteenth of December 1807, when she rose, she went towards the window of her chamber, which looks to the westward, for the purpose of observing the weather, according to her invariable practice for many years past. The sky was clear except a few thin clouds in the west. It was past day-break, and by estimation about half an hour before sun-rise, or seven o'clock. The meteor was immediately observed just over the southern part of the barn in her farm yard, nearly in front of the window; its disc was well defined, and it resembled the moon so much, that unprepared as Mrs. Gardner's mind was for a phenomenon of that nature, she was not at first aware that it was not the moon, till she perceived it in motion, when her first reflection (to use her own words) was—where is the moon going to? The reflection however was hardly made, when she corrected herself, and with her eye followed the body with the closest attention througout its whole course. It moved in a direction nearly parallel to the horizon and disappeared behind a cloud to the northward of the house of Samuel Blanchard Esq. The true azimuth of the south part of the barn from the place of observation is N 107° 59′ W, its altitude 3° 25′. The top part of the building is horizontal. The azimuth of Mr. Blanchard's house is N. 148° 22′ W. These buildings were useful in determining nearly the limits of the azimuths of the meteor. The azimuths were obtained by observing with an excellent theodolite, the difference of the azimuths of the sun and object, and finding the sun's azimuth by his observed altitude. The same method was made use of in obtaining the azimuths of the meteor. The angular elevation of the meteor above the horizon appeared always greater than that of the barn 3° 25′, and less than that of a tree in front of the window, along the branches of which the meteor ranged; the altitude of the top of this tree was 7° 10′. These fixed objects served to determine the altitude of the meteor, which is the most important element in the calculation, to a considerable degree of accuracy. After the theodolite was carefully adjusted, Mrs. Gardner directed the telescope attached to the instrument towards that part of the heavens where she first saw the meteor, the true azimuth was N 106° 54′ 54″ W. Altitude 5° 50′ 40″. The azimuth of a second place where it was seen was N 117° 35′ 54″ W. Altitude as before. The azimuth of a third place was N, 132° 15′ 54″ west. Altitude 5° 29′ 40″. The azimuth of the place of disappearance was N 144° 33′ 54″ W. Altitude 4° 1′ 40″.* All these azimuths fall within the limits mentioned above, but the two last are undoubtedly too great. For a great circle passing through Wenham and Weston is inclined to the meridian of Wenham by an angle equal to 125° 18′ 38″, and as the two last azimuths exceed that quantity, they fall to the southward of Weston, which cannot be correct, because the meteor disappeared before it arrived at the zenith of Weston, as was observed by Judge Wheeler. It happens fortunately in the present instance that the other places of observation at Weston and Rutland are so situated with respect to Wenham, that a considerable error in the azimuths at Wenham, would not materially affect the result of the calculation made for determining the height or direction of the meteor, as will appear in the following calculations. Mrs. Gardner supposed the meteor to have been

* In the following calculations the allowances made for refraction in the above observations, were 8′ 50″, 8′ 50″, 9′ and 10′ 10″ making the altitudes respectively 5° 41′ 50″, 5° 41′ 50″, 5° 20′ 40″, and 3° 51′ 30″.

visible about half a minute. In its progress it was occasionally obscured by thin broken clouds, which intercepted the view of it several times. No train of light was observed to accompany it. Its velocity did not appear to be so great as that of shooting stars. Its colour was more vivid than that of the moon. The place of observation at Wenham, is in the latitude of 42° 40′ 15″ N and in the longitude of 70° 50′ 15″ W from Greenwich.

By the observations of Judge Wheeler at Weston, published in the interesting memoir of Professors Silliman and Kingsley, in the sixth volume of the Transactions of the American Philosophical Society held at Philadelphia, it appears, that on the fourteenth of December 1807, at about 6h. 30′, A. M. " numerous spots of uncloud-" ed sky were visible, and along the northern part of the horizon a " space of ten or fifteen degrees was perfectly clear. The attention " of Judge Wheeler was first drawn by a sudden flash of light, which " illuminated every object. Looking up he discovered in the north a " globe of fire, just then passing behind the cloud, which obscured " though it did not entirely hide the meteor. In this situation its ap-" pearance was distinct, and well defined, like that of the sun seen " through a mist. It rose from the north, and proceeded in a direc-" tion nearly perpendicular to the horizon, but inclining, by a very " small angle, to the west, and deviating a little from the plane of a " great circle, but in pretty large curves, sometimes on one side of the " plane, and sometimes on the other, but never making an angle with " it of more than four or five degrees. Its apparent diameter was " about one half or two thirds the apparent diameter of the full moon. " Its progress was not so rapid as that of common meteors and shoot-" ing stars. When it passed behind the thinner clouds, it appeared " brighter than before; and when it passed the spots of clear sky, it " flashed with a vivid light, yet not so intense as the lightning of a

" thunder-storm. Where it was not too much obscured by thick " clouds, a waving conical train of paler light was seen to attend " it, in length about 10 or 12 diameters of the body. In the clear sky " a brisk scintillation was observed about the body of the meteor, like " that of a burning fire-brand carried against the wind. It disappear- " ed about 15 degrees short of the zenith, and about the same num- " ber of degrees west of the meridian. It did not vanish instantane- " ously, but grew, pretty rapidly, fainter and fainter, as a red hot can- " non ball would do, if cooling in the dark, only with much more ra- " pidity.—The whole period between its first appearance and total ex- " tinction, was estimated at about 30 seconds. About 30 or 40 sec- " onds after this, three loud and distinct reports, like those of a four- " pounder, near at hand were heard.—Then followed a rapid succes- " sion of reports less loud—so as to produce a continued rumbling— " This noise continued about as long as the body was in rising, and " died away apparently in the direction from which the meteor came." Mr. Staples observed, " that when the meteor disappeared, there were " apparently three successive efforts or leaps of the fire ball, which " grew more dim at every throe, and disappeared with the last.—From " the various accounts which we have received of the appearance of " the body at different places, we are inclined to believe, that the time " between the disappearance and report, as estimated by Judge Whee- " ler, is too little, and that a minute is the least time that could have " intervened." The latitude of Weston is about 41° 15′ N, longitude 73° 27′ W from Greenwich, but there is a little uncertainty in both these quantities, though not enough to affect materially the result of the calculation.

The observations made at Rutland were procured by the kind offices of Professor Hall, of Middlebury College, Vermont, to whom Mr. Page communicated his valuable observations in a paper, expressed in the following terms. "I was at the west door of my "house on Monday morning, the fourteenth of December 1807, about "day light, and perceiving the sky suddenly illuminated, I raised my "eyes and beheld a meteor of a circular form, in the southwesterly "part of the heavens, rapidly descending to the south, leaving behind "it a vivid sparkling train of light. The atmosphere near the south "part of the horizon was very hazy, but the passage of the meteor "behind the clouds was visible, until it descended below the moun-"tains, about twenty miles south of this place. There were white "fleecy clouds scattered about the sky, but none so dense as to ob-"scure the tract of the meteor. I now lament that I did not make "more particular observations at the time, and I should probably un-"til this day have considered it to be what is commonly called a '*fall-"ing star*,' had I not read in the New York papers an account of the "explosion of a meteor, and the falling of some meteoric stones near "New Haven, Connecticut, which, by recurring to circumstances, "then fresh in my recollection, I found to be on the same morning "that I observed the meteor at Rutland. I am indebted to my learn-"ed friend, Dr. Samuel Williams, for his aid and directions in ascer-"taining the situation of the meteor, when I first observed it, and its "course, and also for the order of my observations. *Form*, circular. "*Magnitude*, less than a quarter of the diameter of the moon. *Col-"our*, red vivid light. *Tail*, or *train of light*, about eight times the "length of its diameter at the least, projected opposite to its course. "*Azimuth*, when first observed about 9° 30′ west of the meridian. "*Altitude* when first observed, about 18° 30′.* Descent to the south "part of the horizon, west of the meridian, by estimation 7 or 8 de-

* In making use of this altitude, 3′ for refraction was subtracted, making it 18° 27′.

" grees. *Motion*, very rapid, probably thirty seconds in sight. " *Place of observation*, Rutland, county of Rutland, and state of Ver- " mont, latitude 43° 36′ N, as ascertained by Dr. Williams ; longi- " tude west from Greenwich [72° 58′ 15″] as ascertained by Mr. Bow- " ditch, by calculations made upon observation of the solar eclipse of " June 16, 1806." In a letter, which accompanied the preceding paper, Mr. Page observed that his recollection of the meteor was pretty distinct, and that he was enabled to determine its situation by the position of certain known objects.

Deductions from the preceding observations.

The observations made at Wenham, combined in various ways with those at Rutland and Weston, by the methods given in the preceding problems, furnish the results contained in Table 1, in which the given quantities are marked with an asterisk. These quantities are varied a few degrees in the different examples, for the purpose of forming an estimate of the change in the calculated place of the meteor, from any supposed error in the observations. In the two first examples are combined (by Problem 2) the azimuth and altitude observed at the first appearance of the meteor at Rutland, with various supposed altitudes at Wenham. The 3d. and 4th. examples are like the first and second, except in a small change in the altitude and azimuth at Rutland. In the 5th. and 6th. examples, the first azimuth and altitude observed at Wenham are combined (by Problem 1) with the azimuth at Weston, supposing it in the 5th. example to be north; and in the 6th. N 3°W. The 7th. and 8th. examples contain the results from combining the same Wenham observation with the azimuth at Rutland, supposing it in the 7th. example to be N 170° 30′ W, and in the 8th. N 173° W. From the 9th to the 12th. examples, the same calculations are repeated with the second Wenham azimuth and altitude. In the 13th. example, the azimuth and altitude at Weston at the time of the disappearance of the meteor, are combined with the altitude at Wenham, supposing it 5° : in the three following examples the calculation is repeated with small variations in the values of the given quantities. The azimuths at Wenham, calculated in the 13th. and 14th. examples, are made use of in the 17th. 18th. and 19th. with the corresponding assumed altitudes at Wenham, and the azimuth at Rutland at the time of the disappearance of the meteor, supposing it to be N 172° W in the 17th. and 18th. examples, and N 170° 30′ W in the 19th.

It appears by this table, that in the 5th. and 6th. examples the altitude of the meteor at Weston was about 16° 30′, and in the 9th. and 10th. about 36°. Now if the meteor appeared at Weston to describe a great circle, beginning at the north part of the horizon and terminating at a point having the azimuth N 15° W and altitude 75° (which was nearly the case by the observations of Judge Wheeler) the azimuth corresponding to the altitudes 16°30′ and 36°, would be respectively 1° 11′ and 2° 53′, as is easily found by spherics. The places of the meteor corresponding nearly to the azimuths 1° 11′ and 2° 53′, are given in the three right hand columns of the table opposite to those examples; these quantities being found by proportion. Thus by the 5th. and 6th. examples, the latitudes corresponding to the azimuths 0° and 3° are 42° 3′ 6″ and 42° 2′ 15″, varying 51″ by a change of 3° of azimuth; hence the latitude corresponding to the azimuth 1° 11′ is 42° 2′ 46″ or 42° 2′ 45″, as in the table. The other quantities were calculated in the same manner. The azimuth of the meteor at Wenham at the time of disappearing was not far from 123°30′ or 124°, as is evident from examples 13, 14, 15 and 16. Mrs. Gardner supposed the meteor to have been visible considerably south of this

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point, which could not be correct for the reasons stated in the former part of this paper. By taking the second and third azimuths and altitudes of the meteor, as estimated by Mrs. Gardner, and finding by proportion the altitude corresponding to the azimuth $123° 30'$ or $124°$, and allowing $9'$ or $10'$ for refraction, the altitude will be found to differ but few minutes from $5° 30'$, which is made use of in the 14th. example. The estimated altitude would have been found nearly the same, if the four observations at Wenham had been taken into the calculation, by the usual method of interpolation, explained by Sir I. Newton in the Princip. Lib. 3. Lem. 5.* The results of the 14th. example are assumed in the right-hand columns of Table I, and in Table II, as the true values at that time, and it is evident that the latitudes and longitudes thus found must be nearly correct, since the meteor disappeared almost in the zenith of Weston, and a considerable error in any of the observations would not materially affect the result, as appears by comparing examples 13, 14, 15, and 16. This latitude and longitude agrees nearly with that obtained in the 19th. example, by combining the azimuth and altitude at Wenham, with the azimuth $170° 30'$ at Rutland, from which it appears probable that the azimuth of the meteor at Rutland, at the time of its disappearance, must have been about $170° 30'$, and the corresponding *calculated* altitude at that place $5° 45'$;† but, by Mr. Page's observations, the azi-

* In putting A for the azimuth at Wenham and a for the corresponding altitude corrected for refraction, expressed in degrees and decimals, the formula of Newton gives $a = 5°{\cdot}6972 - 0°\,0009488\,(A - 106°{\cdot}91)\,(A - 117°{\cdot}60) - 0°{\cdot}00007012\,(A - 106°{\cdot}91)\,(A - 117°{\cdot}60)\,(A - 132°{\cdot}26)$.

† Mr. Page states that he saw the meteor till it descended below the mountains, but as it was hazy in the direction of the meteor and the time early in the morning, it must have been difficult to determine by *observation* the precise point of its disappearance. The above method of *calculating* the altitude must give it very nearly correct.

muth of the meteor at the time of its disappearance was 172° or 173°, being about 2° greater than by the preceding calculations; and it seems reasonable to make the same allowance on the first azimuth, observed at Rutland. This correction being made, the azimuths become 168° 30′ and 170° 30′ and the altitudes 18° 27′ and 5° 45′, corresponding respectively to the first and last observations at Rutland. The azimuth corresponding to any intermediate altitude may be found sufficiently near by supposing the variations of altitude and azimuth to be proportional to each other. In this way the azimuths corresponding to the altitudes 6°30′ and 7° 30′* would be respectively 170°23′ and 170°14′; which are rather less than the azimuths made use of in examples 11 and 7. The changes to be made in the results of these examples, for this small difference of azimuth, may be easily estimated by comparing those examples with the 12th. and 8th. In this way were found the assumed values, corresponding to those examples, given in the right hand columns of Table I. By taking the mean of the assumed values in Table I, corresponding to the examples 5, 6; and 7, 8; also the mean of those deduced from examples 9, 10; and 11, 12; there will be obtained the altitudes, latitudes and longitudes of the meteor, marked in Table II, as the most probable values corresponding to the times of the first and second observations made at Wenham.

At the first Rutland observation the meteor was not seen at Wenham, since the azimuth at Wenham at that time was probably less than 84° (as appears by the four first examples of Table I) and the first observed azimuth exceeded 106°; so that there can be no very accurate estimate of the situation of the meteor at that time. However, as the

* These are nearly the altitudes at Rutland at the time of the two first observations at Wenham, as appears by Examples 7, 8; 11, 12. An error of several minutes in these altitudes would hardly cause any sensible change in the calculated azimuths at Rutland.

altitude of the meteor observed at Wenham, and its calculated altitude above the level of the sea (found in Table II) did not vary much during the time of its appearance at Wenham, it is highly probable that no great change was experienced from the time of the first Rutland, to the first Wenham, observation. The preceding method of interpolation gives for the azimuth 83° 14′ 59″ at Wenham, a corresponding altitude at that place of 7° 43′.* This altitude with the azimuth at Rutland 168° 30′, and the corresponding altitude 18° 27′, give the results in Example 2, Table I, which, with an increase of 3′12″ in the longitude, are assumed in the right hand columns of that table and in Table II, as the place of the meteor at the first Rutland observation. This addition is made to the longitude because the mean longitudes assumed in Table II exceed a few miles the results from the corresponding Rutland observations in Table I.

A mistake of 1° in the observed altitudes at Wenham would produce an error of about 2½ miles in the calculated height of the meteor, but the effect of this source of error cannot be great, since the observed altitude must have fallen between the limits 3° 25′ and 7° 10′, corresponding to the heights of the barn and meteor; as was observed above.

With the altitudes, latitudes and longitudes of the meteor given in Table II, and the latitudes and longitudes of the places of observations, were calculated the distances of the meteor inserted in Table II, to give at one view the results of all the observations.

* This azimuth and altitude were found in the following manner. With the azimuth at Wenham estimated in Example 1, 79° 33′ 46″, was calculated, by the preceding formula of interpolation, the corresponding altitude at Wenham. The difference between this and the supposed altitude 6° 30′ was called the error of this supposition. The operation was repeated with another assumed altitude, as 8°, and the error of this supposition found. By these errors a corrected altitude was calculated by the Rule of False; and by repeating the operation a few times, the above azimuth and altitude were obtained.

TABLE I.

PLACES OF THE METEOR CACULATED WITH VARIOUS CHANGES IN THE VALUES OF THE OBSERVED ANGLES FOR THE PURPOSE OF ESTIMATING THE EFFECT OF SUPPOSED ERRORS IN THOSE ANGLES.

Exam.		Azimuths of the meteor at			Altitudes of the meteor at			Distances of the meteor from			Calculated places of the meteor.			Assumed places of the meteor.		
		Wenham	West.	Rutl.	Wenh.	West.	Rutl.	Wenh.	West.	Rutl.	Alt.	Lat.	Long.	Alt.	Lat.	Long.
		° ′ ″		°	° ′		° ′	miles.	miles	miles	miles	° ′ ″	° ′ ″	miles	° ′	° ′
1st Rutland Obs.	1	79 33 46		168½*	6 30 *		18 27*	120·7		48·1	15·5	42 57 35	73 8 59			
	2	83 14 59		168½*	7 43 *		18 27*	121·8		56·3	18·2	42 51 2	73 10 48	18·2	42 51	73 14
	3	79 38 1		168 *	6 30 *		18 27*	121·2		48·2	15·5	42 57 31	73 9 29			
	4	77 46 52		168½*	6 30 *		20 0*	120·6		44·5	15·4	43 0 43	73 8 7			
1st Wenham Obs.	5	106 54 54*	0°		5 41 50*	16° 11′		142·2	58·3		16·6	42 3 6	73 27 0	16·7	42 2¾	73 28¼
	6	106 54 54*	3		5 41 50*	16 50		145·2	57·6		17·0	42 2 15	73 30 19			
	7	106 54 54*		170½*	5 41 50*		7 32	134·6		108·0	15·6	42 5 11	73 18 59	15·7	42 5	73 19½
	8	106 54 54*		173 *	5 41 50*		7 22	129·3		105·6	14·9	42 6 35	73 13 13			
2d. Wenham Obs.	9	117 35 54*	0		5 41 50*	35 9		154·6	31·6		18·3	41 37 14	73 27 0	18·5	41 37	73 28½
	10	117 35 54*	3 *		5 41 50*	36 14		156·1	31·2		18·5	41 36 35	73 28 31			
	11	117 35 54*		170½*	5 41 50*		6 24	152·2		139·7	18·0	41 38 16	73 25 1	18·1	41 38	73 25½
	12	117 35 54*		173 *	5 41 50*		6 14	144·6		135·1	16·9	41 41 23	73 17 23			
Disappearance at Weston	13	123 49 42	15 *		5 *	75 *		166·9	18·0		18·0	41 18 52	73 28 23			
	14	123 38 51	15 *		5 30 *	75 *		166·9	20·2		19·5	41 19 20	73 28 33	19·5	41 19 ⅓	73 28½
	15	123 17 46	10 *		5 *	75 *		165·7	24·6		17·9	41 20 30	73 28 16			
	16	124 17 56	15 *		5 *	80 *		167·4	18·4		18·1	41 17 39	73 27 57			
	17	123 49 42*		172 *	5 *		5 08	161·6		158·5	17·3	41 21 34	73 23 52			
	18	123 38 51*		172 *	5 30 *		5 40	161·3		158·0	18·7	41 22 9	73 23 46	19·5	41 19 ¼	73 29¼
	19	123 38 51*		170½*	5 30 *		5 45	167·1		162·1	19·5	41 19 17	73 29 16			

TABLE II.

PLACES AND DISTANCES OF THE METEOR AT THE TIMES OF THE DIFFERENT OBSERVATIONS, AS DETERMINED BY THE MEAN OF ALL THE CALCULATIONS.

Times of Observation.	Distances of the meteor from			Places of the meteor.		
	Wenham	Weston	Rutland	Altitude	Latitude	Longitude
	miles.	miles.	miles.	miles.	North	West
At the first Rutland observation	124	113	57	18·2	42°51′	73 14′
At the first Wenham observation	139	59	110	16·2	42 04	73 24
At the second Wenham observation	154	32	141	18·3	41 37½	73 27
At the time of disappearing.	167	20	162	19·5	41 19⅓	73 28½

From the places of the meteor given in the preceding table it is easy to find, by the common rules of trigonometry, that *its course was about* S 7° W, *in a direction nearly parallel to the surface of the earth,* *and at the height of about eighteen miles.* These points appear to be ascertained to a considerable degree of accuracy. The time elapsed between the disappearance of the meteor and hearing the three loud reports at Weston, which, according to the estimates of different observers, was *at least* sixty seconds, serves in a degree to confirm the accuracy of the estimated altitude of the meteor. For the velocity of sound being 1142 feet per second, the distance corresponding to 60 seconds is $60 \times 1142 = 68520$ feet, or 13 miles nearly: consequently the height must have exceeded 13 miles.

At the first appearance of the meteor at Rutland, it was elevated at least 8° above the horizon of Weston; and at its disappearance at Weston, was above 5° above the horizon of Rutland; as may be easily proved from the places of the meteor given in Table II. Now as it was seen by Judge Wheeler and Mr. Page quite near the horizon, it must have been observed at both places from the time of the first Rutland observation till its disappearance at Weston. The distance of the points where the meteor was then situated is easily found from the data in Table II to be 107 miles in a straight line, and *the distance really passed over by the body while visible must have exceeded that quantity.* The whole duration of the appearance of the meteor, as estimated by Mr. Page and Judge Wheeler, was about 30 seconds, which would make its velocity about $3\frac{1}{2}$ miles per second, by both observations. In a similar manner the distance passed over, while visible at Wenham, was about $52\frac{1}{2}$ miles, and if the duration of its appearance was 30 seconds, as Mrs. Gardner estimated it, the velocity corresponding would be $1\frac{3}{4}$ miles per second; this would have been more than doubled if the extreme azimuths at Wenham had been made use of without correction. From these results it appears probable that *the velocity of the meteor exceeded* 3 *miles per second.* We may form an idea of the greatness of this velocity, by observing that it is fourteen times as swift as the motion of sound, and nearly as great as that of a satellite revolving about the earth at the same distance, and if a body were projected in a vertical direction with about double the velocity (the air being supposed not to resist) it would proceed beyond the sphere of the earth's attraction.

In estimating the magnitude of the body from the present observations, no very accurate result is to be expected, since the apparent diameter was not exactly measured by any of the observers. The observations that were made, serve however to prove that the body was much larger than the whole mass of stones that fell near Weston, as will be evident from the following calculations. Mr. Page supposed the apparent diameter of the body to be about one quarter part of that of the moon, or about 8′. The greatest observed distance of the meteor from Rutland was 162 miles, the least 57 miles. The diameter of the meteor corresponding to those distances and the angle 8′ are nearly $\frac{1}{7}$th. and $\frac{1}{3}$d. of a mile, and, by this observation, the real diameter of the meteor must fall between those limits. Judge Wheeler supposed the apparent diameter to be half or two thirds of that of the moon, or between 16′ and 24′. The least distance of the meteor from Weston was 20 miles, the greatest 113 miles. The least diameter corresponding to the distance 20 miles and angle 16′ is $\frac{1}{11}$ of a mile, or rather 491 feet; the greatest diameter, corresponding to the distance 113 miles, and angle 24′ is nearly $\frac{3}{4}$ of a mile, so that the limits furnished by this observation are nearly $\frac{1}{11}$ and $\frac{3}{4}$ of a mile. Mrs. Gardner supposed the diameter to be equal to that of the moon, or 32′; this, with the extreme distances at Wenham, 124 and 167 miles, furnish the limits $1\frac{1}{4}$ and $1\frac{1}{2}$ miles. This last estimate exceeds the others considerably; this may be owing in part to the smallness of the altitude of the object, which probably made it appear larger than it would otherwise have done, from the same cause which makes the moon appear largest when near the horizon. *The least of all the limits of the diameter of the meteor is* 491 *feet.* A body of this magnitude and of the same specific gravity as the stone that fell at Weston (which weighed about 225 pounds to a cubic foot) would contain a quantity of matter exceeding in weight *six millions of tons.* If the specific gravity were the same as that of the air at the surface of the earth, the quantity of matter would exceed *two thousand tons*, and if the specific gravity were the same as that of the air at the height of the meteor (which by the usual rule for Barometrical admeasurements is about $\frac{1}{38}$th. part of that at the surface of the earth) the quantity of matter would exceed *fifty tons.* Either of these estimates exceeds by far the weight of the whole mass that fell near Weston, which by the accounts published does not appear to have been greater than half a ton, and would not form a sphere of two feet diameter of the same specific gravity as the stone, as was observed by Professor Day, in his valuable paper on the origin of meteoric stones. A sphere of this diameter, seen at the distance of the meteor from Wenham, would hardly be visible without the assistance of a telescope, since its apparent diameter would not exceed two thirds of a second. These reasons seem strongly to favour the opinion, that by far the greater part of the mass continued on its course without falling to the earth, and the gradual disappearance of the meteor, as observed by Judge Wheeler, is agreeable to this hypothesis.

As it is but within a few years that observations of these meteors have been carefully made, we have not yet sufficient data for a well grounded theory of their nature and origin; none that has yet been proposed is free from difficulties. The greatness of the mass of the Weston meteor does not accord either with the supposition of its having been formed in our atmosphere, or projected from a volcano of the earth or moon; and the striking uniformity of all the masses that have fallen at different places and times (which indicates a common origin) does not, if we reason from the analogy of the planetary system, altogether agree with the supposition that such bodies are satellites of the earth.

XXXIII. ANALYSIS

OF SULPHATE OF BARYTES, FROM HATFIELD, MASSACHUSETTS.

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HAVING lately read in the New York Mineralogical Journal, an account of the chemical examination of heavy spar from New Jersey, by Mr. George Chilton, I could not avoid remarking the great resemblance in external characters between the substance above mentioned and the Sulphate of Barytes of Massachusetts. In order to ascertain whether they equally agree in chemical composition, the latter has been subjected to analysis, an abstract of which I have the honour of presenting to the Academy, together with specimens, from a portion of which this analysis was made.

This mineral is found in great abundance in Hatfield in this state, also less pure and in smaller quantities at the lead mine near North Hampton. I have been informed by Gen. Maltby, to whose politeness I am indebted for these specimens, that it is found in veins running through beds of gneiss or granite, and forming with the horizon an angle of 40° or 50°. These veins make their appearance at the surface of the ground, but are there very narrow ; but they rapidly increase in width as they descend, and at a short distance from the surface their diameter is from 3 to 4 feet. Large quantities of it have been thrown up from a vein, opened for the purpose of obtaining lead and copper, of which there are some indications. When pure it is of a pure white, translucent and of a pearly or porcelain lustre. Some specimens are tinged with a reddish yellow colour, arising from the presence of oxide of iron.

Its fracture is laminated, and the lamina are frequently divided by thin layers of transparent amorphous quartz. When crystallized it is in the form, to use the language of Mr. Chilton, of "rectangular bev-"elled tables, united into radial groups, which cross each other at "various angles of obliquity," and about one sixteenth part of an inch in thickness.

Before the blow-pipe it can hardly be fused without addition. In small fragments in decrepitates.

Small portions of galena and sulphuret of copper are frequently disseminated through this substance.

The specific gravity of this spar is 4·280, but it is difficult to obtain portions of any size unmixed with quartz, by which its relative weight is more or less influenced.

1. One hundred grains of this mineral exposed in a crucible of platina to a red heat for one hour lost 3 grains in weight.

2. One hundred grains reduced to an impalpable powder were mixed with 300 of sub-carbonate of potass and 1000 of water and boiled to dryness in a silver bason. Water was again added and the boiling to dryness repeated. Fluid was again poured into the vessel, and the whole thrown on a filter. The insoluble portion, when collected and dried, weighed 84 grains.

3. On these 84 grains was poured muriatic acid, and when the effervescence had ceased the whole was passed through a filter, and the weight of the residue, perfectly dried, amounted to 34·2.

4. These were mixed with 100 grains of carbonate of potass and a sufficient quantity of water and boiled to dryness. Water was again added, and the insoluble portion after filtration and drying weighed 23·5 grains.

5. These were treated as the above and 15 grains remained undissolved.

6. The 15 grains were lastly mixed with 40 of sub-carbonate of potass and water and repeatedly boiled to dryness. After filtration the residuum was thrown into muriatic acid and there remained undissolved 4 grains, which exhibited all the characters of silex.

7. By accident a small portion of a solution of carbonate of potass was added to the muriatic solution and a partial precipitation took place. I therefore added the former to the latter, till no more precipitate would form ; the whole was then poured on a filter and the precipitate, collected and dried, weighed 77 grains.

8. A solution, accompanied with effervescence, was made of these 77 grains in muriatic acid, and the solution, spontaneously evaporated, produced only crystals of muriate of Barytes. Previous however to the evaporation, liquid ammonia was poured into the solution, a precipitate formed, which, when collected and dried, weighed 2 grains, and consisted of alumina. Barytic water produced no effect.

9. These were redissolved in water and sulphuric acid added to the solution, a copious precipitation took place, which weighed on drying 81 grains.

10. The alkaline solution, which had been boiled on the powder, was saturated with sulphuric acid and evaporated. A small quantity of silex and a dark coloured substance was separated. The latter gave a white curdy precipitate with muriatic, and appeared to be oxide of silver, doubtless derived from the vessel.

I endeavoured in experiment 9, to obtain in a direct way the quantity of real sulphate in this mineral, but in the process of evaporating and redissolving the muriate, a portion of it was accidentally lost, and it was necessary therefore to arrive at the proportion by an indirect method.

The substance precipitated in experiment 7, may be considered as carbonate of Barytes, containing 78 parts of the pure earth. The weight of this precipitate was 75 grains, exclusive of the 2 grains of alumina, which, if the analysis of Klaproth be taken as a datum, must of course contain 58·50 parts of Barytes.

Now according to the experiments of the same chemist and of Fourcroy, 100 parts of sulphate of Barytes are composed of 66 of the earth and 34 of the acid, and consequently the above 58·50 parts must have been combined, in the mineral we have attempted to examine, with 29·83 parts of sulphuric acid.

Following the above calculation the proportions of the component parts of our native mineral are

Barytes - - - - - - - - - - - - - - - -	58·50
Sulphuric acid - - - - - - - - - - - - -	29·83
Silex - - - - - - - - - - - - - - - - -	4
Alumina - - - - - - - - - - - - - - - -	2
Water - - - - - - - - - - - - - - - - -	3
	97·33
Loss - - - - - - - - - - - - - - - - - -	2·67
	100·00

The uses to which the sulphate of Barytes may be applied are rather limited. In chemistry it is employed for the purpose of obtaining the pure earth, and for the preparation of its nitrate, muriate and hydro-sulphuret. It has been said by men of practical information in Boston to afford a good base for water colours.

Boston, *August*, 1810.

XXXIV. INVESTIGATION

OF THE APPARENT MOTION OF THE EARTH VIEWED FROM THE MOON, ARISING FROM THE MOON'S LIBRATIONS,

By JAMES DEAN, A. M.

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IF the moon moved uniformly about the earth in the ecliptic, with an angular motion exactly equal to that of the moon's diurnal rotation and in the same direction, and the lunar equator coincided with the ecliptic, the earth viewed from any part of the moon's surface would always appear in the same situation above the horizon of the spectator, or with the same azimuth and altitude. To a spectator placed on the centre of the moon's disc the earth would appear constantly in the zenith, to one situated on the borders of the disc it would appear in a particular point of the horizon, and in other points of the disc it would appear at a fixed altitude and azimuth, corresponding to the place of the observer. The inequality of the moon's motion about the earth, combined with the effect of the inclination of the lunar orbit and equator (which cause the moon's librations) produce to a spectator placed on the surface of the moon, an apparent motion of the earth about its mean place, supposed at rest; to investigate which is the object of the present memoir.

In Fig. 5, 7, 9, 11, or 13, let Z represent the mean place of the earth's centre, as seen by a spectator placed on the surface of the moon, and referred to the concave surface of the visible hemisphere of the spectator, this point being supposed, as above, to be at rest on that surface. Through Z draw EZW, representing a portion of the lunar celestial equator, or a parallel to it, and SZN perpendicular to it, representing an arch of a circle of declination. Make ZS = ZN = 6° 39′ the angle of inclination of the lunar orbit and equator, and ZE = ZW = 6° 18′ the greatest equation of the moon's centre. Draw also the circles of declination DEA, CWB, and the parallels of declination DNC, ASB.

Preliminary Propositions.

1. When the moon is in the ascending node both its poles are in the circle of the disc, and the centre of the earth viewed by the spectator at the moon's surface appears on the line EW, but declining south, as the south pole is entering the disc.

2. When the moon has arrived at its greatest north latitude the centre of the earth, viewed as above, has arrived at its greatest south declination, and will be found in the line AB, 6° 39′ south of its mean place, and, like the sun in the tropics, will continue its declination some time nearly the same.

3. When the moon is in the descending node, the earth again appears on the line EW, but declining north as the north pole is entering the disc.

4. When the moon is at its greatest south latitude, the earth is at its greatest north declination or parallel CD, 6° 39′ north of its mean place, where it will continue some time nearly unaltered.

5. When the moon is in its upper apsis, its true place coincides with its mean, and the earth, viewed as above, appears on the circle of declination SN, but its angular motion towards the east being slower than the moon's motion on its axis, its apparent diurnal motion is towards the west.

6. When the moon has arrived at its mean distance, the earth, observed as above, is 6° 18′ behind or west of its mean place, and as the moon revolves on its axis with the mean uniform motion, the earth will appear just as far west of the circle of declination SN, in the line

BC, and nearly stationary as to that direction, as the earth has acquired its mean motion.

7. When the moon has arrived at its lower apsis, the earth again appears on the circle of declination SN, but its angular motion toward the east being greater than that of the moon on its axis, its apparent diurnal motion is toward the east.

8. When the moon has again arrived at its mean distance, the earth seen from it is 6° 18′ before or east of its mean place, and will appear just as far east of the circle of declination in the line AD, and as it has acquired its mean motion that distance will remain some time with little variation.

Now to ascertain the combined effect of these two causes in producing an apparent vibratory motion of the earth as observed from the moon—

First, let the moon's apogee and ascending node be in conjunction as in Fig. 6, and the moon in the same point. By Prop. 1 and 5, the centre of the earth, observed from the moon, will appear at its mean place Z Fig. 7, moving towards the south and west. After one quarter of a revolution, by Prop. 2 and 6, it will be found in B. After half a revolution, by Prop. 3 and 7, it will be again in Z, but moving north and east. After three quarters, by Prop. 4 and 8, it will be nearly at rest in D, and the completion of the revolution carries it back to the point Z. Thus in the present position of the nodes and apsides, in each revolution of the moon, the earth will appear to move twice through a line more than 18° long, passing the mean point Z and lying N E and S W.

Next, let the moon's apogee be 90° forward of the ascending node as in Fig. 8, and the moon again in the apogee, the centre of the earth, by Prop. 2 and 5, will appear in S moving towards B, Fig. 9. After one quarter of a revolution it will appear by Prop. 3 and 6 in W, moving toward C. After half a revolution it will appear, by Prop. 4 and 7, in N moving towards D. After three quarters of a revolution it will, by Prop. 1 and 8, be in E moving towards A. Therefore when the moon's apogee is in the greatest north latitude, the earth observed from the moon seems at each revolution to describe an oval 12° 36′ broad from east to west, and 13° 18′ long from north to south, passing the north towards the east.

Next, let the moon's apogee be 180° from the ascending node, and the moon still in the apogee as in Fig. 10, the centre of the earth, by Prop. 3 and 5, will be in the mean place Z Fig. 11, moving north and west. After one quarter of a revolution, by Prop. 4 and 6, it must be nearly stationary at C. After half a revolution, it must by Prop. 1 and 7 be again at Z, moving south and east. After three quarters of a revolution, it appears, by Prop. 2 and 8, to be nearly stationary in A. Thus when the apogee is in the descending node, during each revolution of the moon, the earth seems, as before, twice to describe a line more than 18° in length and passing through the point Z, but lying N W and S E.

Lastly, let the moon's apogee be 270° before the ascending node, as in Fig. 12, and the moon in the same place, the centre of the earth by Prop. 4 and 5 will be found in N, moving towards C, Fig. 13. Having performed one quarter of a revolution by Prop. 1 and 6, it will be in W, moving towards B. After half a revolution by Prop. 2 and 7, it will be in S, moving towards A. After three fourths of a revolution, it will be by Prop. 3 and 8 in E, moving towards D. Therefore when the moon's apogee is in the greatest south latitude, the earth observed from the moon seems at each revolution to describe an oval, similar and equal to the former, but in the contrary direction, passing the south towards the east.

When the line of apsides is oblique to the line of nodes, the path described will be an oval, whose transverse axis lies S W and N E, when the apogee is nearest the ascending node, and NW and SE when it is nearest the descending node, and more or less eccentric as the apogee is nearer to, or farther from either node ; and the direction when the apogee is in north latitude is by the north to the east, and when in south latitude by the south to the east.

The numerous irregularities of the moon's motion will produce various waving deviations of 1° or 2° from the path above described, which is the one that would result from the two causes contemplated, and the mean of all the others.

The time from the parting of the apogee and ascending node to their meeting again is at a mean one or two days less than six years. In this time there are $79\frac{1}{2}$ librations in longitude and $80\frac{1}{2}$ in latitude.

Mr. Ferguson supposes the lunarians may measure time by the motion of the earth on its axis, and the libration of its poles, but would either of them be as much noticed there, as the motion just now examined, of which the period is 73 or 74 lunar days ? As the sun crosses this parallelogram every lunation, the path may be investigated by them for the purpose of computing eclipses.

This cycle of motions, various as they are, may be easily imitated by a pendulum, formed by a heavy ball C, Fig. 14, and the flexible thread BC suspended on two branches of the same thread DB, BE, of such lengths, that by continuing CB to meet DE in A the line AB may be $\frac{1}{40}$ of AC ; these branches being in the plane of the meridian. If this pendulum be impelled SW, in about twenty vibrations they will gradually expand into a circle in the direction of the sun's diurnal motion. In twenty more they will shrink into a right line lying SE and NW. In twenty more they will expand into a circle in a direction contrary to the former, and after the remaining twenty it will resume the motion first communicated.

XXXV.

OBSERVATIONS OF THE ECLIPSE OF THE SUN OF SEPT. 17, 1811, MADE AT PORTLAND.

BY REV. ICHABOD NICHOLS.

Extracted from a letter to Nathaniel Bowditch.

FOR the purpose of observing this eclipse, I spoke to some gentlemen to take a station on Observatory Hill, and procure time-keepers, glasses, &c. I stationed myself on a hill one mile west. I used a new watch, made by Roskill. They had one of the same construction, and another independently regulated. I had an achromatic telescope of about 50, and an excellent day and night glass. They had an admirable achromatic of about 100, and two day and night glasses. Mr. L. Babbit assisted me in the observations, and we used the same time-keeper. The following are the results.

Beginning.

	App. time.	h. ′ ″
By the telescope on Observatory Hill	0 57 30	
First day and night glass - -	0 57 35	Mean 0 57 32
Second Do. - - - -	0 57 31	
My observation with the telescope	0 57 34	Mean 0 57 34
Mr. Babbit's - - - -	0 57 34	

End.

By the telescope on Observatory Hill	3 58 46	
First day and night glass - -	3 58 54	Mean 3 58 48·7
Second Do. - - -	3 58 46	
My observation with the telescope	3 59 02	Mean 3 59 00
Mr. Babbit's - - -	3 58 58	

By an altitude of the sun, taken at the moment of immersion, the time was found to be 0h. 57′ 30″ apparent.

The watches were regulated by single and likewise by double altitudes of the sun. I began on the 10th and ended the 20th Sept.

The latitude of Portland is estimated at 43° 39′ N.

XXXVI.

OBSERVATIONS OF THE ECLIPSE OF THE SUN OF SEPT. 17, 1811, MADE AT BOWDOIN COLLEGE, BRUNSWICK.

BY PROFESSOR CLEAVELAND.

Communicated in a letter to Nathaniel Bowditch.

THE chronometer, which I employed, was the College clock. By a sufficient number of observations of equal altitudes of the sun, I ascertained its daily loss to be 6″·9, and, on the noon of the 17th, the clock was 2′ 14″·2 slow of mean time.

The observations were made within a few feet of Massachusetts Hall, one of the College buildings. On the morning of Tuesday the atmosphere was somewhat loaded with smoke; but, when the sun came to the meridian, it was sufficiently clear. A little inconvenience arose from the wind, which was blowing considerably. On the whole however the observations were satisfactory; particularly of the termination of the eclipse, on which I always place more reliance, than on those of the beginning.

The Rev. Dr. Appleton very kindly assisted me in all the observations. He observed with a Gregorian reflector, whose magnifying power is about 120.

I employed the refracting telescope, belonging to an Equatorial. Its magnifying power is less than that of the Reflector abovementioned; but it exhibits the sun's limb exceedingly well defined. Our observations with the two telescopes did not differ 1″ from each other.

The following is the result.

	h.	′	″	
Beginning of the eclipse - -	12	53	52·2	mean time
End of the eclipse - - -	3	55	20·2	
Duration - - - - -	3	1	28	

I had no micrometer for ascertaining the quantity of the eclipse. The moon's limb exhibited very little of that rough or serrated appearance, which was so noticeable in 1806.

The latitude of Bowdoin College is 43° 53′. Doctor McKeen, from a lunar eclipse in January 1805, made the longitude 69° 50′ W from Greenwich. Mr. Ferrer, in the sixth volume of the Transactions of the American Philosophical Society, made it 4*h.* 49′ 16″ W from Paris, by the observations of the total eclipse of the sun of June 1806.

XXXVII.

OBSERVATIONS ON THE ECLIPSE OF SEPT. 17, 1811, MADE AT BURLINGTON IN THE UNIVERSITY OF VERMONT.

BY JAMES DEAN, A. A. S.

Professor of Mathematics at that University.

Extracted from letters to Nathaniel Bowditch.

A COMMON brass eight day clock, made at Burlington, was used in these observations. It was regulated in the ordinary method, by taking equal altitudes of the sun by reflection from a vessel of tar, by a Hadley's octant. Sept. 10th at noon, by the mean of 19 pairs of altitudes (corrected for the change of declination) the clock was too slow for apparent time 1′ 28″. Sept. 11th at noon, by the mean of 13 pairs, it was too slow 2′ 9″. Sept. 12th, at noon, by the mean of 9 pairs of observations, it was too slow 2′ 53″. Sept. 13th and 14th it was cloudy. On the 15th, though the weather was very bad, cloudy and hazy, I thought it absolutely necessary to examine the motion of the clock. In 24 pairs of observations 17 were within 10″; the mean of these made the clock too slow for apparent time at noon, Sept. 15th, 5′ 9″. Having computed, by counting the threads in an inch on the rod of the pendulum, that $1\frac{1}{4}$ turn of the nut would about correct the loss of 44″ in a day, I determined to regulate and adjust the clock to apparent time, to avoid the perplexity of odd minutes and seconds.

Clock too slow at noon - - -	5′ 9″
Loss in winding - - - -	13
Additional loss till 4 o'clock - -	7
Stopt to regulate it and bring it to an even minute	31
Set forward - -	6′ 0″

On Sept. 16th it was examined by 12 pairs of equal altitudes, and found to be one second too fast for apparent time. From this mean neither of the pairs deviated more than four seconds. On the day of the eclipse by the mean of 20 pairs, corrected as before, the clock was exactly as on the preceding day, one second too fast for apparent time. These observations were not quite so close as the former ones on account of the wind, but no pair deviated more than ten seconds, 20 pairs were within five, and 15 within three seconds of the mean.

I observed the eclipse through a spy-glass, having an achromatic object-glass, and magnifying 11 times. It was fitted up so as to have a horizontal and vertical motion, and was prepared with a piece of common window-glass, smoked to a proper degree of darkness. John Johnson, Esq. observed through a spy-glass, magnifying 13 times, fixed in the same manner. We placed the glasses in a south window close to the clock, and agreed that each should determine for himself the second when he first perceived the impression. At 33 minutes after noon I directed our assistant to begin and count the seconds audibly and distinctly from minute to minute, till we had both determined the eclipse to have begun. Mr. Johnson spoke about fifteen seconds after I had discovered it. At the end we placed our glasses in a couple of the west windows, in a room adjoining the clock, and proceeded in the same manner. Deducting one second for the error of the clock, the apparent times were as follows ;

		h. ′ ″
Beginning of the eclipse	J. Dean -	0 38 51
	J. Johnson	0 38 39
End of the eclipse ·	J. Dean -	3 43 11
	J. Johnson -	3 43 25

By subtracting 5′ 26″ from the beginning, or 5′ 28″ from the end of the eclipse, the *mean* times corresponding will be obtained.

Not having a micrometer, between 15 and 20 minutes after 2, I took the greater breadth of the visible part in the octant, and found it 5′ on the extra arch, and 7′ on the direct. This I repeated twice with the same result.

At 0*h.* 15′ I hung out a thermometer, which then stood at 74° on the south side of the house. At 12*h.* 30′ it rose to 83°. At 1*h.* 15′, sometime before any perceptible diminution of light, it fell to 80°, and the diminution of heat was very obvious to the senses. At 2*h.* 15′ it had fallen to 72°, and at the end of the eclipse it rose to 81°.

Those outlines of bodies, which were parallel to a line joining the horns, cast a shadow strongly defined, while lines perpendicular to that exhibited a strong penumbra. The intersection of these lines exhibited a singular appearance. On the whole, the diminution of light was much greater than I expected. Making a random conjecture, I should represent it as dark as when the sun has descended 6° or 8° below the horizon.

The latitude of the University, as near as I have been able to ascertain it from observation, is 44° 28′, and its longitude by estimation 73° 12′ W from Greenwich.

XXXVIII.

OBSERVATIONS OF THE SOLAR ECLIPSE OF SEPT. 17, 1811, MADE AT NANTUCKET.

BY HON. WALTER FOLGER, JUN.

Communicated in a letter to Nathaniel Bowditch.

THE telescope used in this observation is a three feet achromatic, to which I have fixed a micrometer, composed of two screws that pass through the eye-tube, so that their points meet in the centre of the focus of the eye-glass. On the end of the screw without the tube is a circular plate, divided into 10 equal parts by diameters drawn on the plate, and is so fixed, that the first division of each screw-head shall correspond with a line drawn on the outside of the tube, when the points meet in the centre of the focus. The divisions, being made to coincide with the lines drawn on the tube, will show the tenth parts of a turn of the screw, which is of a very fine thread, such for example as are made use of for a watch; and it is not difficult to estimate a tenth part of one of these divisions, which will show $\frac{1}{100}$ of a turn of the screw. By the mean of a number of measurements of the sun's diameter, I found 0·9294 turns of the screw would answer to one minute.

September 13*d.* 10*h.* 34′ 54″·5 A. M. mean time, by the mean of four altitudes taken by reflection from a surface of molasses, I found the clock to be 2′ 11″·25 too slow for mean time. In the afternoon the wind blew from the westward so strong that I could not make any observations. On the 17th at 8*h.* 50′ 23″·1 A. M. mean time, by the mean of ten altitudes of the sun I found the clock too slow for mean time 5′ 21″·725. In the afternoon the wind prevented me from observing. On the 18th at 8*h.* 16′ 42″·43 A. M. mean time, by the mean of eight altitudes, the clock was too slow for mean time 6′ 9″·18.

The morning of Sept. 17 was clear, with a small air from the S E: In the afternoon it shifted to W S W, and blew fresher. With the abovementioned telescope and a power of 26, I noted the beginning of the eclipse at 0*h.* 51′ 9″ per clock: Capt. Latham Gardner with a small spy-glass, with a power of 8 or 10, noted the beginning at 0*h.* 51′ 24″; which, reduced to mean time, give

By my observation	0*h.*	56′	38″	·8
Capt. Gardner's obs.	0	56	53	·8

I noticed a tremulous motion of the sun's limb, which rendered the observation of the beginning not so certain as I could have wished. This was not observed by Capt. Gardner; perhaps it was owing to the small power of his glass. At the end, the sun's limb appeared perfectly distinct and steady. I noted the end at 3*h*, 54′ 16″, Capt. Gardner at 3*h.* 54′ 7″, and Capt. Joseph Allen, with the inverting telescope belonging to a sextant, at 3*h.* 54′ 16″; which, reduced to mean time, are

By my observation	3*h.*	59′	52″
Capt. Gardner's	3	59	43
Capt. Allen's	3	59	52

Near the end of the eclipse I observed the light of the sun to follow the moon as at A and B, Plate II, Fig. 1, so that the limbs of the sun and moon did not make an acute angle at A and B. The two projections of light, which in the figure are black at A and B, drew nearer and nearer, until they entirely coincided, and then they seemed to spring together in an instant, and the sun's limb appeared perfectly well defined, which was the time I noted for the end. When I mentioned this appearance to Captains Gardner and Allen, after the eclipse had ended, they both said they did not observe it. I doubt whether they could have seen it with glasses of such small power as they used.

After the eclipse had begun, I measured the chord CD with the micrometer twice, and then the line EF (or greatest breadth) until near the end of the eclipse. I found it extremely difficult to measure the spaces accurately, especially the larger ones, as the telescope was not mounted on a stand.—The times and measurements follow.

Mean time.		Turns.	
1*h.* 17′ 17″·5	Chord CD	17 36	18′ 40″·7
28 10 ·9	Chord CD	21·90	23 33 ·8
34 55 ·1	Space EF	19·30	20 45 ·9
39 55 ·3	- -	17·91	19 16 ·2
2 04 02 ·0	- -	11·11	11 57 ·2
11 27 ·3	- -	8·97	9 39 ·1
15 38 ·5	- -	7·44	8 00 ·3
27 24 ·9	- -	5·14	5 31 ·8
30 50 ·0	- -	4·63	4 58 ·9
35 01 ·0	- -	4·58	4 56 ·6
42 55 ·4	- -	6·04	6 29 ·9
46 52 ·6	- -	6·85	7 29 ·2
51 37 ·7	- -	7·75	8 20 ·3
55 56 ·9	- -	9·16	9 51 ·4
3 07 55 ·3	- -	12·77	13 44 ·4
12 17 ·4	- -	14·99	16 07 ·6
17 14 ·6	- -	15·48	16 39 ·4
38 03 ·2	- -	22·05	23 43 ·5
49 47 ·6	- -	26·39	28 23 ·7

The place where the eclipse was observed is about S E, distant nearly 200 feet, from the S W meeting house, noted on the map of Massachusetts, in the latitude of 41° 15′ 32″.

XXXIX.

On the Eclipse of the Sun of Sept. 17, 1811, *with the longitudes of several places in this country, deduced from all the observations of the Eclipses of the Sun and Transits of Mercury and Venus, that have been published in the Transactions of the Royal Societies of Paris and London, the Philosophical Society held at Philadelphia, and the American Academy of Arts and Sciences.*

BY NATHANIEL BOWDITCH, A. A. S.

And member of the Amer. Philosophical Society held at Philadelphia.

I OBSERVED the eclipse of Sept. 17, 1811, in the garden adjoining my house in Salem, about 300 feet S S W from the meeting house where the Rev. Doctor Barnard officiates. An excellent chronometer, made by Grimalde, was used in this observation. The regulation was made by equal altitudes of the sun, observed in the morning and evening, for several days before and after the eclipse, by an accurate sextant made by Ramsden, and a level surface formed by a bowl of Barbadoes tar. The observation of Sept. 16, 17, and 18, gave the following result.

	App. noon by chronometer.	Too slow for app. time.	Diff.
Sept. 16, by 28 observations	10*h*. 47′ 52″·0	1*h*. 12′ 08″·0	
17, " 48 "	10 47 22 ·9	1 12 37 ·1	29″·1
18, " 36 "	10 46 52 ·5	1 13 07 ·5	30 4

During the whole eclipse the weather was very clear, not a cloud was to be seen, and there was but little wind. The telescope used was a four feet achromatic, with a power of about 30. An assistant seated near the telescope counted the seconds from the chronometer, at the times of the beginning and end of the eclipse. About two minutes before the commencement of the eclipse, the part of the sun's limb where the first contact took place was brought in the centre of the field of view, and kept there till the first impression on the limb was observed at 11*h.* 42′ 36″ per chronometer. The end of the eclipse was at 2*h.* 46′ 18″ per chronometer. The first contact appeared to be instantaneous; it seemed as if there could not have been an error of 1″ in this time. The end was not quite so well defined; the moon appeared to remain 2″ or 3″ on the sun's limb. Fahrenheit's thermometer in the shade stood at 71° at 1*h.* P. M; at 2*h.* 43′ the mercury had fallen four degrees, and at 4*h.* had again risen to 71°.

The chronometer at noon Sept. 17 was too slow for apparent time 1*h.* 12′ 37″·1, and the daily variation was 30″·4. A proportional part corresponding to the beginning of the eclipse is 1″·2, and at the end 5″; making the chronometer too slow at those times 1*h.* 12′ 38″·3 and 1*h.* 12′ 42″·1; which, added to the observed times, give

Beginning of the eclipse	0*h.* 55′ 14″·3	apparent time.
End of the eclipse	3 59 00 ·1	

The latitude of the place of observation is 42° 33′ 30″ N. The longitude 53 seconds in time East from Harvard Hall in Cambridge, as found by a trigonometrical survey, made by Professor Farrar from Cambridge to Boston Light-House, and by myself from the Light-House to Salem. This agrees with the calculation of Seth Pease, Esq. from his survey of the Post Roads, and accords very nearly with Holland's map.

The eclipse was also carefully observed at Salem, by Mr. Samuel Lambert, at a place, which by measurement was found to be 6″ N and 2″·7 in time E from the place where my observations were made. Hence the place of this observation is in the latitude of 42° 33′ 36″ N, and in the longitude of 55″·7 E from Cambridge. The chronometer used by Mr. Lambert was an excellent one, made by

Barraud, carefully regulated for several days before and after the eclipse, by equal altitudes of the sun, by a sextant and a surface of molasses. To verify the regulations of the time-keepers used in our observations, we compared them together for several days before the eclipse, and ascertained their relative rate of going. They were also compared a few hours before the eclipse and immediately after it, and we found, that at the beginning and end of the eclipse, the regulation deduced from his observations agreed exactly with mine. The telescope used by Mr. Lambert was a Gregorian Reflector, 18 inches in length, and his manner of observing and counting time was similar to that in my observations. The result of his observation is,

Beginning of the eclipse	$0h.\ 55'\ 24''\cdot3$	apparent time
End of the eclipse	3 59 01 ·1	

From these observations Mr. Lambert calculated the ecliptic conjunction to be at $2h.\ 13'\ 31''\cdot6$ apparent time, using the elements as given in the Nautical Almanac, without correcting for the errors in the moon's longitude and latitude. This differs but one second from the result found by using Burg's and Delambre's Tables, corrected for the errors in longitude and latitude, as will be shown hereafter.

The observations made at Salem are useful in finding the error of the lunar tables in longitude, and the apparent time of the conjunction under the meridian of Greenwich. To do this, it will be necessary to ascertain the longitude of the places of observation from Greenwich, to as great a degree of accuracy as possible; and as these longitudes are made to depend on that of Harvard Hall in Cambridge by means of the above survey, it will be necessary in the first place to calculate the longitude of that University, from the observations made at Cambridge, Chelsea, Salem, and Newbury.

On the longitude of Cambridge University.

The late Rev. President Willard, in volume i. page 60 of the Memoirs of the American Academy of Arts and Sciences, made the difference of meridians between Greenwich and Cambridge $4h.\ 44' \ 30''\frac{2}{3}$, by the mean of the observations of the solar eclipses in 1766 and 1778, and the transit of Mercury in 1743. In these calculations he supposed the difference of meridians between Greenwich and Paris to be $9'\ 16''$ in time instead of $9'\ 21''$, which is now used by astronomers.* This causes a difference of $5''$ in the longitude of Cambridge, deduced from the transit of 1743. The ratio of the polar to the equatorial diameter of the earth was assumed to be $\frac{229}{230}$, whereas the latest calculations of Burg and La Place, from the lunar equations arising from the oblate figure of the earth, make it $\frac{304}{305}$, or nearly $\frac{299}{300}$, as supposed by La Lande. For these reasons I concluded to recalculate these and other late observations, with the new tables of Burg, Delambre, and La Lande, as published in the third volume of Vince's Astronomy, always using the ratio of the diameters of the earth as assumed by La Lande, $\frac{299}{300}$.

The first observation calculated by President Willard is an eclipse of the sun of Aug. 5, 1766, at Greenwich, in the latitude of $51^\circ\ 28'\ 40''$, observed by Dr. Maskelyne and his assistant. The mean of

* La Lande, in the third edition of his Astronomy, supposed the difference of meridians of Greenwich and Paris to be $9'\ 18''\cdot8$, in conformity to the calculation of General Roy, from the survey made some years ago for connecting the two observatories. (Vide Phil. Trans. 1790, page 223.) A more accurate estimate from the same data by Mr. Dalby, made it $9'\ 20''\cdot4$. (Phil. Trans. 1791, Part 2, p. 245.) Delambre, in his Solar Tables, published in 1806, supposes the difference of meridians to be $9'\ 21''$.

their observations made the beginning at Greenwich 5*h.* 29′ 57″, and the end at 7*h.* 11′ 33″·5 apparent time. The beginning at Cambridge, in the latitude of 42° 23′ 28″, observed by Dr. Winthrop, was 11*h.* 39′ 23″, end 2*h.* 45′ 09″ apparent time. These make the conjunction at Greenwich at 5*h.* 43′ 57″·6, and at Cambridge at 0*h.* 59′ 27″·0 apparent time; whence the difference of meridians is 4*h.* 44′ 30″·6.

The second observation is an eclipse of the sun of June 24, 1778. The beginning at Greenwich, observed by Dr. Maskelyne, was 3*h.* 40′ 11″, and the end at 5*h.* 25′ 12″ apparent time. This was compared with the Rev. Mr. Paysons's observations at Chelsea, in the latitude of 42° 25′ 11″ N, and 26 seconds in time east from Cambridge: The beginning was at 9*h.* 6′ 42″, the end at 11*h.* 38′ 23″ apparent time. President Willard used only the time of the end of the eclipse at Chelsea, but upon examination it was found that the beginning gave very nearly the same result as the end, and it was thought proper to use both observations. The conjunction at Greenwich deduced from these observations is at 3*h.* 35′ 52″·9, and that at Chelsea at 10*h.* 51′ 50″·9 apparent time. Whence, by allowing 26″ for the difference of meridians of Cambridge and Chelsea, the difference of meridians of Greenwich and Cambridge by this eclipse will be obtained, 4*h.* 44′ 28″·0.

The third observation used by President Willard is the transit of Mercury of Nov. 5, 1743, observed at Cambridge by Professor Winthrop: second internal contact at 8*h.* 17′ 5″ A. M. second external contact at 8*h.* 18′ 58″ A. M. apparent time. The same was observed at Paris, in the latitude of 48° 50′ 14″ nearly, by Messrs. Maraldi, Cassini senior and junior, La Caille and Le Monnier, as in the Memoirs of the Royal Academy of Arts and Sciences of Paris for 1743, The mean of all these observations, reduced to the meridian of the Observatory of Paris, give for the first internal contact 8*h.* 40′ 40″·2 A. M. second internal contact 1*h.* 10′ 15″·7, second external contract 1*h.* 12′ 10″·5 apparent time. These times differ a little from those given in volume 1, page 53 of the Memoirs of the American Academy of Arts and Sciences, owing to a difference in the reduction of the observations of the internal contacts, observed by Cassini senior, and the external contact by Le Monnier. From these observations, computing the parallaxes for each of the contacts, the difference of meridians between Paris and Cambridge is 4*h.* 53′ 53″·3,* and by subtracting the difference of meridians of Paris and Greenwich, 9′ 21″, there remains the difference of meridians of Greenwich and Cambridge, 4*h.* 44′ 32″·3.

The fourth observation is the solar eclipse of April 3, 1791. This was observed at Cambridge by Professor Webber. The beginning at 6*h.* 1′ 27″, formation of the annulus 7*h.* 8′ 7″, breaking of the annulus 7*h.* 12′ 56″, end of the eclipse 8*h.* 28′ 26″ A. M. apparent time. The observations at Greenwich were, the beginning 0*h.* 18′ 40″·0, the end 3*h.* 6′ 47″ apparent time. At the Royal Observatory at Paris, beginning 0*h.* 33′ 37″·4, end 3*h.* 17′ 36″·0 apparent time. The observations at Greenwich, make the conjunction at 0*h.* 42′ 1″·3 apparent time. Those at Paris 0*h.* 51′ 20″·1 apparent time, from which subtracting 9′ 21″, leaves the apparent time of the conjunction at Greenwich 0*h.* 41′ 59″·1. The mean of this and the former estimate is 0*h.* 42′ 00″·2, the difference between this and the time of the conjunction at Cambridge 19*h.* 57″ 29″·1, leaves the difference of Meridians of Cambridge and Greenwich 4*h.* 44′ 31″·1.

* In the computation in vol. i. page 55 of the Memoirs of the Academy, the longitude of the nonagesimal is too great by 30°, which renders the parallaxes there calculated incorrect. There is a similar mistake in vol. ii, p. 28.

The fifth observation is the total eclipse of the sun of June 16, 1806. The time of conjunction deduced from my observations at Salem, compared with the time of conjunction at Paris, computed by La Lande, gives, by allowing 53 seconds for the difference of meridians of Salem and Cambridge, the longitude of Cambridge 4*h.* 44′ 24″·9 W from Greenwich, as is shown in the additional observations on that eclipse given in this memoir.

The sixth observation is the transit of Venus of June 3, 1769. The observations at Newbury and Cambridge make the conjunction at Cambridge at 5*h.* 20′ 18″·6, and those at Greenwich and Paris make the conjunction at Greenwich at 10*h.* 4′ 49″·7 apparent time. The difference is the longitude of Cambridge by this observation 4*h.* 44′ 31″·1, as will be shewn hereafter.

Upon examination of the transactions of the Royal Societies of London and Paris, those of the Society held at Philadelphia and the Memoirs of the American Academy of Arts and Sciences, two more corresponding observations were found. The first was that of the transit of Mercury of Nov. 12, 1782, but this was very poorly adapted to determine with accuracy the difference of meridians. For the planet entered but 31 seconds on the sun's disc, and the situation was such that a small error in the latitude of the planet would cause a great error in the difference of meridians, and it entered so obliquely on the sun's limb that it was difficult to determine the precise moment of the contacts. This was particularly the case at Paris where the sun was low: the observers there differed above 4 minutes in the time of the first internal contact and above 2 minutes in the second external contact. In the transit of 1789, the planet was more favourably situated, as it respects its latitude, but the sun set before the end of the transit at Paris, and the weather prevented making an observation of the beginning of the transit; the first internal contact was however observed there by astronomers in an interval of clear weather. This observation being made under such unfavourable circumstances, and making the longitudes nearly 20 seconds less than the other observations, it was thought proper not to take it into the computation, and as no other observations were known, that could be used in this calculation, the mean of the preceding values was taken as the true longitude of Cambridge.

Solar Eclipse—Aug. 5, 1766. (2 Obs. Green. 2 Obs. Camb.)	$4h. 44' 30'' 6$
June 24, 1778. (2 Obs. Green. 2 Obs. Chelsea.)	28 0
April 3, 1791. (2 Obs. Paris, 2 Obs. Green. 4 Obs. Camb.)	31 1
June 16, 1806. (Several in Europe, 4 Obs. in Salem.)	24 9
Transit of Mercury—Nov. 5, 1743. (4 Obs. Paris, 2 Obs. Camb.)	32 3
Transit of Venus–June 3, 1769. (2 Green. 1 Paris, 1 Camb. 1 Newbury.)	31 1
Mean of above thirty observations	4 44 29 7

As the difference of latitude of Cambridge and Salem was found by a trigonometrical survey to be less than by astronomical observations, it was thought proper to estimate the effect of a supposed error in the latitude of Salem, Cambridge or Chelsea. To do this the preceding calculations were repeated with latitudes increased by one minute, and it was found that the longitudes, deduced from the observations of 1806, 1743 and 1769, were not varied a tenth of a second by this change, and the corrections of the observations of 1766, 1778, and 1791, were respectively $- 1''{\cdot}5 + 1''{\cdot}2 + 1''{\cdot}8$, therefore the mean longitude just found would be increased $\frac{1}{4}$ of a second by an increase of 1 minute in the latitude of Cambridge, consequently the error in the longitude, arising from this source, must be wholly insensible, since there cannot be an error of a minute in the latitude of that place.

Hence the difference of meridians between Harvard Hall in Cambridge and the Royal Observatory of Greenwich may be assumed as equal to $4h.\ 44'\ 29''{\cdot}7$, and from the near agreement of these observations I am inclined to believe that *this longitude is more accurately ascertained than that of any other place in the United States.* The calculation of President Willard differs about a second from the above estimate. Mr. Ferrer in vol. vi. page 359 of the Transactions of the American Philosophical Society, computed the longitude by combining the observations of the solar eclipse of 1791, the transit of Venus of 1769, and the transits of Mercury of 1782 and 1789, making the longitude greater by 2″·3, but this difference is less than was to be expected in using an observation so liable to error as that of the transit of Mercury of 1782.

As several emersions of the first and second satellites of Jupiter have been observed at Cambridge by Professors Winthrop and Williams, and published in the Philosophical Transactions and in the Memoirs of the American Academy, my curiosity was excited to know how near the longitude could be ascertained by comparing those observations with the times computed from Delambre's tables of the satellites, published in the third edition of La Lande's Astronomy. The result of this calculation is in the following table:—

	App. time.				Longitude.		
	d.	*h.*	′	″	*h.*	′	″
Emersion 1st satellite, by Dr. Winthrop, 1768 April	25	9	13	52	4	43	33·4
May	18	9	27	27	4	44	25·3
June	10	9	37	25	4	45	02·8
July	3	9	45	54	4	44	41·4
1769 May	14	10	19	07	4	43	09·7
Aug.	23	7	31	50	4	43	58·1
Dr. Williams, 1782 July	3	12	09	53	4	44	21·0
Aug.	27	9	6	25	4	44	38·4
Sept.	12	7	31	29	4	46	43·0
Emersion 2d Satellite, by Dr. Winthrop, 1769 June	7	9	01	15	4	44	40·1
Dr. Williams, 1782 June	25	9	48	30	4	44	26·6
July	2	12	21	54	4	44	11·2
Aug.	28	9	03	49	4	44	27·9
				Mean	4	44	29·1

The mean of these thirteen observations makes the difference of meridians of Greenwich and Cambridge 4*h*. 44′ 29″·1, varying but $\frac{3}{5}$ of a second from the preceding calculation. The near agreement of these results may however be considered as wholly accidental, since the number of observations is small, and the differences from each other above three minutes. Indeed no great accuracy is to be expected by this method, unless the number of observations be very great, and the number of emersions and immersions nearly equal. In proof of this, I shall give the longitudes deduced from the emersions of the first, second, and third satellites, observed at Chelsea by the Rev. Mr. Payson, and publised in the first volume of the Memoirs of the American Academy of Arts and Sciences. These observations being reduced to the meridian of Cambridge by allowing 26 seconds for the difference of meridians, give the longitude of Cambridge as in the following table.

		App. time.	Longitude.
		d. h. ′ ″	
1st Satellite	1779, April	22 10 36 37	4 46 07·8
	1779, May	8 8 56 53	4 45 40·1
	1779, May	15 10 51 41	4 43 39·6
	1779, June	23 9 16 14	4 43 40·9
2d Satellite	1779, May	29 8 57 34	4 43 54·6
	1779, June	30 8 38 49	4 42 50·2
3d Satellite	1779, May	16 8 53 54	4 41 42·1
	1779, May	23 12 52 14	4 41 57·4
	1779, June	28 8 35 35	4 42 44·8
		Mean	4 43 35·3

The mean of these nine observations differs nearly 54 seconds from that of the former set. Hence we perceive the uncertainty of this kind of observations. These calculations were not examined with much care, as it was found that the results were not sufficiently exact to be used in the present computation.

The longitude of Harvard Hall in Cambridge being 4*h*. 44′ 29″·7

West from Greenwich, that part of Salem where my observations of the eclipse of Sept. 17, 1811, were made is in the longitude of *4h.* 43′ 36″·7, and where Mr. Lambert observed must be in the longitude of *4h.* 43′ 34″·0. These longitudes are used in reducing the Salem observations.

Observations at Salem, Sept. 17, 1811.

The following elements of the eclipse of Sept. 17, 1811, corresponding to the beginning and end of the eclipse as observed by me in Salem, were calculated from the tables of Burg and Delambre, published in Vince's Astronomy.

	Beginning.	End.
	h. ′ ″	h. ′ ″
Apparent times of observation - -	0 55 14·4	3 59 00·1
Mean times of observation - -	0 49 48·4	3 53 31·5
Longitude west from Greenwich - -	4 43 36·7	4 43 36·7
Mean times of observation reduced to Greenwich	5 33 25·1	8 37 08·2
☉'s longitude from the apparent equinox -	173°53′21″·4	174°00 50·4
☉'s horizontal parallax - - -	8·77	8·77
☉'s semidiameter — Irradiation 3″·5 -	15 53·75	15 53·78
☉'s horary motion - - -	2 26·55	2 26·56
Apparent obliquity of the ecliptic - -	23 47 41·9	
☽'s longitude from the apparent equinox -	173 18 13·1	174 48 41·5
☽'s latitude north increasing - -	33 18·0	41 37·5
☽'s horizontal parallax — 4″·92 reduction for Salem	53 54·98	53 55·88
☽'s Semidiam. — inflex. 2″+aug. [10″·53 & 5″·70]	14 52·80	14 48·22
☽'s horary motion in longitude* - - -	29 32·41	29 33·43
☽'s horary motion in latitude - -	2 43·33	2 42·91
☽'s horary motion from the sun in longitude	27 05·86	27 06·87
☽'s parallax — ☉'s parallax - - -	h. 53 46·21	h. 53 47·11
☉'s right ascension - - -	11 37 33·9	11 38 01·3
Horary increment of ☉'s right ascension in time	8·95	
Horary increment of ☽'s horary motion in long.	0·32	0·36
Horary decrement of ☽'s horary motion in lat.	0·14	0·18
Horary increment of ☽'s horizontal parallax -	0·29	0·29
Horary increment of ☽'s semidiameter -	0·08	0 08
(☽—☉) parallax in longitude - -	4 37·9	17 18·3
(☽—☉) parallax in latitude - -	35 31·4	46 07·1

* These horary motions are for one hour *mean* time, all the calculations in this paper being made for mean time, the computed conjunction being reduced to apparent time at the end of the computation.

In calculating the time of conjunction in this and in the following observations, the moon's tabular longitude and latitude were first used without correction, and the time was found by calculation both for the beginning and end, the mean being taken for the time of conjunction. By repeating the process with those observations best adapted to the purpose it was found, that if the sun's longitude as given by Delambre's tables was correct, it would be necessary to decrease the moon's longitude as given by Burg 12″·0, and to decrease the tabular latitude by 10″·6. The error in longitude was deduced from the observations at Salem, and in latitude from those of Nantucket, Monticello and Washington. Two micrometrical observations made at Nantucket near the middle of the eclipse, gave for the correction of latitude— 9″·2 and — 12″·4, mean — 10″·8 ; the observations of the internal contacts of the eclipse at Monticello gave — 10″·4, and those at Washington — 10″·6. The mean of all these observations makes the error of latitude — 10″·6. It may be observed that this correction makes but very little change in the calculated longitudes of the places of observation, because the times of conjunction is affected in nearly the same way at most of the places. Thus, it was found that the correction of the time of conjunction at Salem, Brunswick, Portland, and Nantucket was 0″·8 ; at Burlington and Rutland+0″·9 ; at New Haven+1″·0 ; at New Brunswick + 1″·1 ; at New York + 1″·3 ; at Washington + 1″·4 ; at Monticello+1″·9, and at Williamsburg (where the first internal contact was not observed) + 0″·3. Hence the corrections of longitude arising from this source are respectively 0″·0, 0″·1, 0″·2, 0″·3, 0″·5, 0″·6, 1″·1, and — 0″·5 ; most of which are so small as to be hardly worthy of notice.

The error of the moon's longitude — 12″·0 has no sensible effect on the calculated longitudes from Greenwich, the time of conjunction being decreased about a quarter of a second at all the places of observation mentioned in this memoir.

The moon's longitude and latitude being corrected, the conjunction at Salem from my observations was found to be at 2*h*. 13′ 28″·9* apparent time; this, added to the longitude from Greenwich, 4*h*. 43′ 36″·7, gives the conjunction at that place 6*h*. 57′ 05″·6. By Mr. Lambert's observation calculated in the same way the conjunction was at 2*h*. 13′ 32″·7, which added to the longitude 4*h*. 43′ 34″·0 gives the conjunction at Greenwich 6*h*. 57′ 6″·7. The mean of the two observations is 6*h*. 57′ 06″·1,* which is used in the rest of this memoir as the apparent time of the conjunction at Greenwich, not having any European observations by which that time could be obtained.

At the time of the conjunction at Greenwich 6*h*. 47′ 06″·1, the sun's longitude by the above elements from Delambre's tables was 173° 56′ 32″·4, the moon's longitude from Burg 173° 56′ 44″·4, which differ 12″·0, agreeing with what was assumed above. At the same time the moon's latitude by Burg was 36′ 50″·8, which decreased by 10″·6 gives the moon's true latitude at the time of conjunction 36′ 40″·2 N. These corrected values were used in calculating the following observations.

Observations at Nantucket by Walter Folger jun. Esquire, Sept. 17, 1811.

The place of observation was a little to the westward of the centre of the town of Nantucket in the latitude of 41° 15′ 32″ reduced 41° 04′ 10″ N.

	App. time.	(☽−☉)Par.in lon.	Par. in lat.	☽ S. D.Aug.
Beginning	1*h*. 02′ 04″·8	3′ 00″·5	35′ 12″·5	14′ 52″·92
End	4 05 20 ·6	−18 48 ·8	45 48 ·2	14 48 ·06

Hence the apparent time of conjunction at Nantucket was 2*h*. 16′ 34″·5, which subtracted from the time of conjunction at Greenwich

* A decrease of 1′ in the estimated latitude of Salem, would decrease this time 1″·4.

6*h.* 57′ 06″·1 leaves the longitude of Nantucket 4*h.* 40′ 31″·6 = 70° 7′ 54″ West from Greenwich.

Mr. Folger made several observations of the width of the lucid part of the sun during the eclipse. I selected two observations when the distance was the shortest, subject to the least change, most easy to measure and best adapted to ascertain the error of the moon's tabular latitude. These observations were at 2*h.* 30′ 50″ and 2*h.* 35′ 01″ mean time. The measured distances were 4′ 58″·9; 4′ 56″·6. The moon's augmented semidiameter 14′ 51″·03; 14′ 50″·92. The sun's semidiameter 15′ 53″·77. Hence the apparent distances of the centres of the sun and moon (= measured lucid part + ☽'s semidiameter—☉'s semidiameter) were 3′ 56″·16 and 3′ 53″·75. The parallaxes in longitude (☽—☉) were—10′ 00″·6 and—10′ 30″·7; in latitude 41′ 21″·9 and 41′ 36″·5. From these were deduced the apparent latitudes; and, by applying the parallaxes in latitude, the true latitudes 37′ 35″·2 and 37′ 43″·4 were obtained, which subtracted from the corresponding tabular latitudes 37′ 44″·4 and 37′ 55″·8 give the error of the tables in latitude, by the first observation —9″·2; by the second —12″·4; the mean of both is —10″·8.

At Monticello, Virginia, by the Hon. Thomas Jefferson, late President of the United States and President of the American Philosophical Society, Sept. 17, 1811.

The two internal contacts are useful in finding the error of the moon's latitude. These observations are as follow, the latitude being 38° 8′ N, reduced 37° 56′ 52″.

	App. time.	(☽−☉) Par. long.	Par. in lat.	☽ Aug. S. D.
Annulus formed	1*h.* 53′ 00″	—5′ 58″·2	36′ 51″·4	14′ 52″·55
Annulus broken	1 59 25	—6 53 ·5	37 17 ·6	14 52 ·40

The calculation was first made from these observations, without correcting the moon's tabular latitude, and the apparent times of the conjunction deduced differed nearly a quarter of a minute. By repeating the calculation it was found that they would both give the same result $1h.\ 41'\ 55''\cdot7$, by decreasing the latitude $10''\cdot4$. The error of Burg's tables in the latitude of the moon is therefore by this observation — $10''\cdot4$. By subtracting the time of conjunction $1h.\ 41'\ 55''\cdot7$ from $6h.\ 57'\ 06''\cdot1$, the longitude of Monticello is obtained $5h.\ 15'\ 10''\cdot4 = 78^\circ\ 47'\ 36''$ W from Greenwich.

At Washington, Columbia, by Seth Pease, Esq. Sept. 17, 1811.

These observations were made in the latitude $38^\circ\ 54'$ N, reduced $38^\circ\ 42'\ 47''$, and $1'\ 27''$ in space, or $5''\cdot8$ in time, W from the Capitol.

	App. times.	(☽ – ☉) Par. long.	Par. lat.	☽ Aug. S. D.
Beginning	0*h*. 22′ 08″·9	8′ 30″·7	30′ 48″·5	14′ 53″·62
Annulus formed	2 02 06 ·0	—6 51 ·9	37 55 ·3	14 52 ·25
Annulus broken	2 06 53 ·1	—7 31 ·8	38 14 ·3	14 52 ·13
End of the eclipse	3 36 52 ·8	–18 07 ·0	43 26 ·3	14 49 ·38

The apparent times of the conjunction deduced from the internal contacts, without correcting for the error of the moon's latitude, were $1h.\ 48'\ 55''\cdot1$ and $1h.\ 48'\ 19''\cdot8$, differing $35''\cdot3$. This difference is wholly corrected by decreasing the moon's tabular latitude $10''\cdot6$, which makes the time of conjunction by both observations $1h.\ 48'\ 39''\cdot6$. The external contacts give $1h.\ 48'\ 58''\cdot2$. Mean $1h.\ 48'\ 48''\cdot9$, which, subtracted from $6h.\ 57'\ 6''\cdot1$, gives the longitude of the place of observation $5h.\ 8'\ 17''\cdot2$, from which subtracting $5''\cdot8$ there remains the longitude of the Capitol $5h.\ 8'\ 11''\cdot4$, by this observation.

The eclipse of April 3, 1791, observed at Georgetown, by Mr. Ellicott, makes the longitude of the Capitol $5h.\ 8'\ 4''\cdot5$, as will be shewn hereafter. The mean of both may be assumed as the longitude of the Capitol $5h.\ 8'\ 8''\cdot0 = 77^\circ\ 2'\ 00''$ W from Greenwich.

An occultation of α Tauri, observed by Mr. Ellicott January 21, 1793, and one of *n* Pleiadum by Messrs. Bradley and Pease, October 20, 1804, might be used in calculating the longitude of this city, if corresponding observations under a known meridian could be obtained. To compare these times with those computed for Greenwich in the Nautical Almanac, would render the result liable to an error which might amount to nearly half a degree of longitude.

At William and Mary College, Williamsburg, by Professor Blackburn, Sept. 17, 1811.

Latitude of the place of observation 37° 15′ 20″ reduced 37° 4′ 17″ North.

	App. time.	(☽−☉)Par. long.	Par. lat.	☽ S. D. Aug.
Beginning	0*h*. 26′ 56″·20	7′ 06″·5	30′ 02″·4	14′ 53″·83
Annulus broken	2 13 12 ·29	—9 23 ·0	37 42 ·3	14 52 ·18
End of the eclipse	3 41 57 ·20	—19 48 ·4	42 51 ·1	14 49 ·32

Hence the apparent time of conjunction, by the mean of these three observations, was 1*h*. 50′ 17″·7, which subtracted from 6*h*. 57′ 6″·1 gives the longitude of William and Mary College 5*h*. 6′ 48″·4 = 76° 42′ 06″ W from Greenwich. The calculation of the longitude of this place from the transit of Mercury of Nov. 5, 1789, will be given in this memoir.

Near New Brunswick, New Jersey, by Mr. John Garnett, Sept. 17, 1811.

Mr. Garnett's account of the observation is as follows. " The " beginning was perceptible at 0*h*. 36′ 5″ apparent time, allowing 3″ " before it became sensible for the contact, it must have been at 0*h*. " 36′ 2″. The end at 3*h*. 45′ 58″ apparent time. Latitude of the " place of observation 40° 30′ 0″ N, being 26″ N and 2″·5 in time W " from Columbia College." As this allowance of 3″ was not made on the other observations of this eclipse, it was thought that the computed longitude would be more accurate if the uncorrected values were used, as in the following calculation.

	App. time.	(☽ – ☉) Par. long.	Par. lat.	☽ aug. S. D.
Beginning	$0h.\ 36'\ 05''$	$6'\ 48''\cdot 8$	$32'\ 53''\cdot 1$	$14'\ 53''\cdot 29$
End	3 45 58	—17 46 ·9	44 38 ·2	14 48 ·89

Hence the apparent time of conjunction was at $1h.\ 59'\ 09''\cdot 5$, which subtracted from $6h.\ 57'\ 6''\cdot 1$ leaves the longitude of the place of observation $4h.\ 57'\ 56''\cdot 6 = 74^\circ\ 29'\ 9''$ W. Hence Queen's College, which is $38''$ E from Mr. Garnett's, is in $74^\circ\ 28'\ 31''$ W from Greenwich. This will be combined hereafter with the observation at New York.

At Yale College, New Haven, by Professor Day, Sept. 17, 1811.

The latitude of the place of observation is $41^\circ\ 17'\ 58''$, reduced $41^\circ\ 06'\ 35''$ N.

	App. time.	(☽ – ☉) Par. long.	Par. lat.	☽ aug. S. D.
Beginning	$0h.\ 44'\ 12''\cdot 7$	$5'\ 50''\cdot 8$	$34'\ 04''\cdot 9$	$14'\ 53''\cdot 10$
End	3 51 56 ·7	—17 45 ·1	45 24 ·5	14 48 ·59

Hence the apparent time of conjunction was at $2h.\ 5'\ 15''\cdot 0$, and the longitude of Yale College $4h.\ 51'\ 51''\cdot 1 = 72^\circ\ 57'\ 46''$ W from Greenwich.

At Rutland, Vermont, by Doctor Williams, Sept. 17, 1811.

These observations were published in the Washingtonian, a paper printed at Windsor, Vermont. " The beginning of this eclipse was " at $12h.\ 41'\ 46''$, the end was at $3h.\ 46'\ 31''$. Little or no uncertainty " seemed to attend these observations. The clock was carefully reg-" ulated by corresponding attitudes of the sun, taken for several days " before, and on the day of the eclipse, corrected by the proper equation " of equal altitudes—The telescope a reflector with a magnifying pow-

" er of 53. The latitude of Rutland nearly 43° 36′ N." Reduced latitude 43° 24′ 32″.

	(☽—☉) Par. long.	Par. lat.	☽ aug. S. D.
Beginning	7′ 07″·6	35′ 13″·8	14′ 52″·75
End	—15 28 ·5	46 02 ·8	14 48 ·60

Hence the apparent time of the conjunction at Rutland was 2*h*. 5′ 18″·5, which subtracted from 6*h*. 57′ 06″·1 leaves the longitude of Rutland 4*h*. 51′ 47″·6 W from Greenwich.

In the remarks on the eclipse of June 16, 1806, in this paper, it is shewn that the longitude of Rutland, deduced from that eclipse, is 4*h*. 51′ 52″·0. The mean of the observations of 1806 and 1811 give for the longitude of Rutland 4*h*. 51′ 49″·8 = 72° 57′ 27″ W from Greenwich.

Observations at Burlington, Vermont, by Professor Dean and John Johnson, Esq. Sept. 17, 1811.

The place of observation was the University of Vermont, in the latitude of 44° 28′ N, reduced 44° 16′ 32″. The beginning of the eclipse by the observations of Professor Dean was at 0*h*. 38′ 51″, by Mr. Johnson 0*h*. 38′ 39″. The end by Professor Dean 3*h*. 43′ 11″, by Mr. Johnson 3*h*. 43′ 25″. The mean of these observations is 0*h*. 38′ 45″ and 3*h*. 43′ 18″ mean time, which were used in calculating the time of conjunction.

	(☽—☉) Par. long.	Par. lat.	☽ aug. S. D.
Beginning	7*h*. 55″·3	35′ 33″·0	14′ 52″·65
End	—14 32 ·1	46 16 ·4	14 48 ·63

Hence the apparent time of conjunction was 2*h*. 4′ 7″·8, which subtracted from 6*h*. 57′ 6″·1 leaves the longitude of the university of Vermont 4*h*. 52′ 58″·3=·73° 14′ 34″ W from Greenwich.

Observations at Portland, by the Rev. Mr. Nichols and others, Sept. 17, 1811.

The beginning of the eclipse at Observatory Hill was 0*h.* 57′ 32″ apparent time, and at Mr. Nichols' observatory one mile W from the former place 0*h.* 57′ 34″ mean 0*h.* 57′ 33″. The end at those places was at 3*h.* 58′ 48″·7 and 3*h.* 59′ 00″ mean 3*h.* 58′ 54″·3. The latitude of the place of observation nearly 43° 39′, reduced 43° 27′ 32″.

	App. time.	☽—☉ Par. long.	Par. lat.	☽ aug. S. D.
Beginning	0*h.* 57′ 33″·0	4′ 45″·1	36′ 20″·0	14′ 52″·59
End	3 58 54 ·3	—16 26 ·7	46 34 ·7	14 48 ·12

Hence the apparent time of conjunction was at 2*h.* 15′ 41″·5, which subtracted from 6*h.* 57′ 6″·1 leaves the longitude of Portland 4*h.* 41′ 24″·6, which makes Observatory Hill in the longitude of 4*h.* 41′ 22″ W from Greenwich.

Observations at Bowdoin College, Brunswick, Sept. 17, 1811, *by Professor Cleaveland.*

Latitude of the place of Observation 43° 53′ N, reduced 43° 41′ 32″.

	Mean time.	(☽—☉) Par. long.	Par. lat.	☽ aug. S. D.
Beginning	0*h.* 53′ 52″·2	4′ 35″·4	36′ 35″·3	14′ 52″·54
End	3 55 20 ·2	—16 24 ·4	46 45 ·0	14 48 ·04

Hence the apparent time of conjunction was at 2*h.* 17′ 23″·1, which subtracted from 6*h.* 57′ 6″·1 leaves the longitude of Bowdoin College 4*h.* 39′ 43″·0 W from Greenwich. It will be seen in the addition to this memoir, that the end of the eclipse of the sun of June 16, 1806, made the longitude of this college 4*h.* 39′ 37″·3. The mean of these observations makes the longitude of that place 4*h.* 39′ 40″·1=69° 55′ 1″ W from Greenwich.

At New York, Columbia College, by Dr. Kemp, Sept. 17, 1811.

The latitude of the place of observation 40° 42′ 45″ N, reduced 40° 31′ 24″.

	App. time.	(☽−☉) Par. long.	Par. lat.	☽ aug. S. D.
Beginning	0*h*. 38′ 53″	6′ 26″·7	33′ 13″·3	14′ 53″·23
End	3 47 49	—17 33 ·1	45 04 ·6	14 48 ·71

Hence the apparent time of conjunction was at 2*h*. 1′ 22″·9 apparent time, which subtracted from 6*h*. 57′ 6″·1 gives the longitude of Columbia College New York 4*h*. 55′ 43″·2 by this observation. Mr. Garnett's observation at New Brunswick made the longitude 4*h*. 57′ 56″·6, from which subtracting the difference of meridians between that place and Columbia College 1′ 51″·3 in time (as computed from the survey of the Post Roads by Seth Pease Esq. corrected at the extreme points by Mr. Garnett) gives the longitude of Columbia College by observation 4*h*. 56′ 5″·3.

Mr. Ferrer, by a chronometer, found the longitude of Kinderhook, where the solar eclipse of 1806 was observed, 51″·3 E from his house in Partition Street, New York, and Albany 58″ E from the same house. These correspond to 51″·0 and 57″·7 in time E from Columbia College, and by adding these respectively to the longitudes of Kinderhook and Albany computed in this paper from the eclipse of 1806, viz. 4*h*. 55′ 9″·6 and 4*h*. 54′ 59″·3, give the longitude of Columbia College by these observations 4*h*. 56′ 0″·6 and 4*h*. 55′ 57″·0.

By the solar eclipse of June 26, 1805, computed in this memoir, the longitude of Columbia College is 4*h*. 56′ 14″·8.

The mean of these five observations gives the longitude of Columbia College 4*h*. 56′ 00″·2 W from Greenwich, being 2″·8 less than the estimate of Mr. Ferrer in vol. vi. p. 360, of the Transactions of the American Philosophical Society of Philadelphia.

Additional observations on the total eclipse of June 16, 1806.

The mean times of this observation at Salem, given in the 20th page of the 3d volume of the Memoirs of the American Academy of Arts and Sciences, were estimated by using the equation of time given in the Nautical Almanac for 1806, which I have since found exceeds that in Delambre's new solar tables by 1″·2. The equation at the time of the conjunction by the Nautical Almanac is 6″·7 and by Delambre's tables 5″·5. The apparent times of these observations at Salem are, the beginning 10*h.* 6′ 18″·1, beginning of total darkness 11*h.* 25′ 19″·4, end of total darkness 11*h.* 30′ 7″·3, end of the eclipse 0*h.* 50′ 34″·6. The place of observation is 53 seconds in time east from Cambridge, as found by the survey made by Professor Farrar and myself. The elements at the beginning and end of the eclipse by the tables of Delambre and Burg are as follows.

	Beginning.	End.
	h. ′ ″	*h.* ′ ″
Apparent times of observation at Salem -	22 06 18·1	0 50 34·6
Mean times of observation - -	22 06 22·8	0 50 40·8
Longitude west from Greenwich - -	4 43 36·7	4 43 36·7
Mean times of observation reduced to Greenwich	2 49 59·5	5 34 17·5
☉'s right ascension - - -	5 36 49·8	5 37 18·3
☉'s longitude from the apparent equinox -	84°41 01·7	84 47 33·9
☉'s horizontal parallax - - -	8·66	8·66
☉'s semidiameter — Irradiation 3″·5 -	15 42·54	15 42·53
☉'s horary motion - - -	2 23·15	2 23·15
Apparent obliquity of the ecliptic - -		23 27 53·0
☽'s longitude from the apparent equinox -	83 49 33·2	83 30 02·2
☽'s latitude north decreasing - -	24 24·9	15 08·1
☽'s horizontal parallax — reduction for Salem 5″·49	60 08·71	60 11·81
☽'s Semidiam — inflex. 2″+aug. [15″·22 & 16″·37]	16 39·66	16 41·64
☽'s horary motion in longitude - - -	36 39·69	36 43·43
☽'s horary motion in latitude - -	3 22·24	3 22·98
☽'s horary motion from the sun in longitude	34 16·54	34 20·28
☽'s parallax — ☉'s parallax - - -	60 00·05	60 03·15

Hence the conjunction at Salem by the mean of the four observations made there was at 11*h.* 37′ 13″·1 A. M. apparent time, which differs but a fraction of a second from that found in page 28 of my former memoir; and as all the American observations would be affected in nearly the same way, it was thought unnecessary to recalculate them on account of the small variations arising from the use of these new tables. Subtracting 53″ from this time leaves the apparent time of the conjunction at Cambridge 11*h.* 36′ 20″·1. La Lande, by the mean of several observations made in Europe, found the conjunction at Paris to be at 4*h.* 30′ 6″ apparent time, as appears by the account of this eclipse published in his history of Astronomy for 1806, and in the Connoisance du Tems. The difference between these times of conjunction decreased by 9′ 21″ gives the difference of meridians of Greenwich and Cambridge 4*h.* 44′ 24″·9 used in the former part of this memoir.

The ecliptic conjunction at Paris 4*h.* 30′ 6″, corresponds to 4*h.* 20′ 50″·5 mean time at Greenwich. At this time, by the above elements, the sun's longitude was 84° 44′ 38″·4, the moon's longitude 84° 45′ 05″·5, the moon's latitude 19′ 17″·2 N. Hence if the sun's longitude be given correctly by Delambre's new tables, the error of Burg's tables in the longitude of the moon at that time was — 27″·1, and as the moon's true latitude was 19′ 19″·3, by page 28 of my former memoir, the error of Burg's tables in latitude was + 2″·1.

If from the times of conjunction calculated in pages 30, 31, and 32 of my former memoir, be subtracted the equation of time used there 6″·7, the remainder will be the apparent times of conjunction at those places, which subtracted from the apparent time of conjunction at Greenwich 4*h.* 20′ 45″, will give the corrected longitudes counted from the meridian of that Observatory. The effect of this operation is to decrease by one second of time the longitudes given in those pages. The longitudes counted from Salem must also be decreased by 4″·7 more, on account of the difference between the longitude of Salem calculated in this memoir 4*h*. 43′ 36″·7 and that formerly used 4*h*. 43′ 32″.

Hence the longitude of Rutland calculated in page 30 ought to be 4*h*. 51′ 52″ from Greenwich: that of Kinderhook, page 31, 4*h*. 55′ 9″·6, and that of Philadelphia, page 32, 5*h*. 0′ 34″·7. Another observation was made at Philadelphia, by Professor Hassler, in a place in the latitude of 39° 57′ 2″, and 7″ in time W from the State House.

	App. time.	Par. in long.	Par. in lat.	☽ Aug. S. D.
Beginning	9*h*. 39′ 48″·5	25′ 11″·4	21′ 15″·7	16′ 39″·11
End	0 25 48 ·9	—5 19 ·2	16 52 ·8	16 42 ·08

Hence the apparent time of conjunction was 11*h*. 20′ 00″·7, whence the longitude of the State House is 5*h*. 00′ 37″·3. The mean of this and the other observation is 5*h*. 0′ 36″. Other observations made at this place will be given hereafter.

The apparent times of the beginning and end of total darkness, as observed at Albany, are given by Mr. De Witt in page 302, vol. vi. of the Transactions of the American Philosophical Society, at 11*h*. 8′ 6″ and 11*h*. 12′ 57″. Mr. Ferrer in the same volume, page 294, states that the equation of equal altitudes had been neglected in regulating the time-keeper, and the corrected observations are 11*h*. 8′ 14″·6 and 11*h*. 13′ 05″·6 mean time, being 2″ more than in page 31 of my memoir. This decreases the parallax in longitude nearly 0″·4, increases the time of conjunction at Albany 1″·3, and decreases the longitude 1″·3. Hence the whole decrement of longitude from Greenwich is 2″·3, making the longitude of Albany 4*h*. 54′ 59″·3 W from Greenwich.

From Mr. Ellicott's memoir in vol. vi. page 255, of the Transactions of the American Philosophical Society, that the apparent times of the beginning and end of the eclipse at Lancaster were 9*h.* 53′ 8″ [erroneously printed 9*h.* 33′ 8″] and 0*h.* 18′ 56″. The mean times, used in page 32, are these quantities increased by 6″; whereas the former ought to have been increased 5″·8, the latter 7″·3. This increases the time of conjunction at Lancaster, given in page 32, nearly 0″·3. Hence the corrected longitude from Greenwich is 5*h.* 5′ 22″·2.

The observations at Natchez given by Mr. Dunbar in page 263, vol. vi. of the same Transactions, are, beginning 20*h.* 5′ 24″·6, end 22*h.* 38′ 54″·67 mean time, or 20*h.* 5′ 19″ and 22*h.* 38′ 47″·72 apparent time, which differ a few tenths of a second from those used in page 32 of my memoir. It is however to be observed, that Mr. Dunbar subtracted 5″ from the observed time of the beginning, supposing that time necessary to make the impression visible in the telescope; but as this correction is not applied to the other observations with which it is compared, it leads to an erroneous estimate of the longitude of the place. I assumed therefore 20*h.* 5′ 24″·1 and 22*h.* 38′ 47″·7 for the apparent times of observation, and using the elements in page 22, corrected for the errors of the longitude and latitude of the moon, found that the apparent time of conjunction became 10*h.* 15′ 15″·2 A. M. Hence the longitude of Mr. Dunbar's observatory is 6*h.* 5′ 29″·8, and the Castle of Natchez (supposed 9″ W) is 6*h.* 5′ 38″·8 W from Greenwich.

In page 276 of the sixth volume of the Transactions of the American Philosophical Society, are given the observations of this eclipse made at Bowdoin College, Brunswick, in latitude 43° 53′ N, reduced 43° 41′ 32″. The beginning was at 10*h.* 14′ 0″, the end at 12*h.* 55′ 20″ apparent time, and by using the elements of page 22, corrected as abovementioned, we have

	☽–☉ Par. long.	Par. lat.	☽ aug. sem.	App. time conjunction.	Longitude W Greenwich.
Beginning	17′ 57″·0	23′ 24″·8	16′ 39″·81	11*h*. 42′ 02″.3	4*h*. 38′ 42″·7
End	—10 42 ·3	21 02 ·4	16 41 ·49	11 41 07 ·7	4 39 37 ·3

The difference of nearly a minute, in the times of the conjunction deduced from the two contacts, arises probably from some mistake in noting the time of the beginning of the eclipse, since the end gives nearly the sāme result as the eclipse of the sun of Sept. 17, 1811, as was mentioned in the former part of this paper.

Mr. Ferrer in a letter to President Webber, mentions that the end of the eclipse at Williamsburg, (Virginia) was at 0*h*. 15′ 14″ mean time. This would make the longitude 5*h*. 7′ 46″, which being nearly a minute more than other observations make it, and no account having been given of the observation by which we might judge of its accuracy, I have concluded to reject it.

Transit of Mercury of Nov. 9, 1769.

This transit was observed in Philadelphia, Norriton, and Salem. It was invisible in Europe. The difference of meridians of Philadelphia and Norriton is known to be 52 seconds in time, by a trigonometrical survey, and the observations made there, compared with those at Salem, would have given the difference of meridians of Salem and Philadelphia, but on calculating the observation at Salem, (which was made at a place 1″·2 east from the place where my observations of the eclipse of Sept. 17, 1811 were made) I found the times were too great by above a minute, owing probably to the inaccurate method of regulating the watch by a common meridian line. This rendered the observation useless.

Deductions from the eclipse of the sun, of October 27, 1780.

The observations of this eclipse, made at Chelsea, Beverly, Newport, Providence, Long-island, and Charlotte-town, are given in the first volume of the Memoirs of the American Academy of Arts and Sciences. The elements of the eclipse for the times of observation at Chelsea, calculated by the Delambre and Burg are as follows.

	Beginning.	End.
	h. ′ ″	h. ′ ″
Apparent times of observation at Chelsea -	23 00 58	1 40 37
Mean times of observation at Chelsea -	22 44 56·8	1 24 35·3
Longitude west from Greenwich - -	4 44 03·7	4 44 03·7
Mean times of observation reduced to Greenwich	3 29 00·5	6 08 39·0
☉'s longitude counted from the apparent equinox	214° 50 43·5	214° 57 23·2
☉'s horizontal parallax - - -	8·87	8·87
☉'s semidiameter — Irradiation 3″·5 -	16 05·15	16 05·17
☉'s horary motion - - -	2 30·22	2 30·22
Apparent obliquity of the ecliptic - -	23 28 14	
☽'s longitude counted from the apparent equinox	213 53 44·0	215 30 33·7
☽'s latitude north decreasing - -	54 15·2	45 25·0
☽'s horizontal equatorial parallax - -	60 01·9	59 58·6
☽'s tabular semidiameter — inflexion 2″ -	16 21·07	16 20·17
☽'s horary motion in longitude - - -	36 25·61	36 21·46
☽'s horary motion in latitude - -	3 19·03	3 19·54
☽'s horary motion from the sun in longitude	h. 33 55·39	h. 33 51·24
☉'s right ascension - - -	14 10 14·9	14 10 40·7

None of the above places of observation were well situated to find with accuracy the error of the moon's latitude. However by various calculations, the result of which will be given hereafter, it was found that the correction to be applied to the moon's tabular latitude was — 10″·4, nearly ; and the error of the tabular longitude — 5″·7, supposing the sun's longitude to be correct. These corrections being made, the observations were re-calculated as follows.

Observations at Chelsea and Beverly, October 27, 1780.

The observations at Chelsea were made by the Rev. Mr. Payson. In the latitude of 42° 25′ 11″ N reduced 42°13′45″, and 26″ in time E from Cambridge, corresponding to 4*h.* 44′ 03″·7 W from Greenwich, the reduction of parallax being 5″·44.

	App. time.	(☽–☉) Par. lon.	(☽–☉) Par. lat.	☽ Aug. S. D.
Begin'g at Chelsea	23*h.* 00′ 58″	+26′ 44″·7	42′ 08″·3	16′ 30″·68
End	1 40 37	—1 16 ·1	51 47 ·7	16 28 ·89

Hence the apparent time of conjunction at Chelsea, was 0*h.* 41′ 55″·1, which added to 4*h.* 44′ 3″·7 gives the corresponding time at Greenwich 5*h.* 25′ 58″·8.

The observations at Beverly were made by the Rev. President Willard, Doctor Prince, and Doctor Cutler. The beginning was observed by them at 11*h.* 1′ 48″, 11*h.* 1′ 46″, and 11*h.* 1′ 42″. The end at 1*h.* 41′ 26″, 1*h.* 41′ 29″, and 1*h.* 41′ 23″ respectively. The mean of these times was used. The place of observation was found by trigonometrical survey to be 1′ 43″ N and 5″·6 in time E from the place in Salem, where I observed the eclipse of Sept. 17, 1811. Hence the latitude of the place is 42° 35′ 13″, reduced 42° 23′ 47″, longitude 58″·6 E from Cambridge, corresponding to 4*h.* 43′ 31″·1 W from Greenwich.

	(☽–☉) Par. long.	(☽–☉) Par. lat.	☽ S. D. Aug.
Beginning at Beverly	+26′ 36″·9	42′ 18″·2	16′ 30″·65
End	—1 19 ·7	51 54 ·5	16 28 ·84

Hence the apparent time of conjunction at Beverly was 0*h.* 42′ 38″·3, corresponding to 5*h.* 26′ 09″·4 at Greenwich. The mean of this and the observation at Chelsea gives the conjunction at Greenwich at 5*h.* 26′ 04″·1 apparent time, which is to be used in finding the longitudes of the other places of observation.

If the moon's corrected latitude used in this calculation was too small by *l* seconds, the time of conjunction at Greenwich would be decreased by 0·53 *l* seconds of time.

Observations at Long-Island, Penobscot, Oct. 27, 1780.

These observations were made by Doctor Williams and his assistants near the house of Mr. S. Williams, in a cove on the eastern part of Long Island in Penobscot River (which appears to be called Williams's carrying-place in Hollond's chart) in the latitude of 44° 17′ 07″·26, reduced 44° 05′ 39″, the reduction of the moon's equatorial parallax being 5″·83. Messrs. Williams, Winthrop, and Atkins observed both contacts with the largest telescopes. The beginning, as observed by them respectively, was at 11*h*. 11′ 8″, 11*h*. 11′ 38″, 11*h*. 11′ 13″; the end at 1*h*. 50′ 25″, 1*h*. 50′ 17″ or 19″, and 1*h*. 50′ 28″ apparent times. The mean of these times was used.

	App. time.	(☽ – ☉) Par. long.	(☽ – ☉) Par. lat.	☽ aug. S. D.
Beginning	11*h*. 11′ 19″·7	+25′ 02″·8	44′ 01″·6	16′ 30″·34
End	1 50 24 ·0	—1 59 ·7	53 01 ·4	16 28 ·21

Hence the apparent time of conjunction was at 0*h*. 50′ 44″·0, which, subtracted from the time of conjunction at Greenwich 5*h*. 26′ 04″·1, leaves the longitude of the place of observation on Long-Island 4*h*. 35′ 20″·1 W from Greenwich.

An increase of *l* seconds in the moon's latitude would decrease the time of conjunction at Long Island 0.52 *l* seconds, which subtracted from the corresponding correction at Beverly and Chelsea 0·53 *l* leaves the error of the longitude of Long-Island — 0·01 *l*, arising from an increase of *l* seconds in the moon's latitude. Hence it is evident that an error of 10 or 12 seconds in this element, will not sensibly affect the longitude of that place, calculated by the above observation.

At Charlotte Town, Island of St. John, Gulf of St. Lawrence, Oct. 27, 1780.

Observations were made at this place, by Messrs. Clarke and Wright in the latitude of 46° 13′ reduced 46° 1′ 32″, reduction of the equatorial parallax 6″·23.

	App. time.	(☽ – ☉) Par. long.	(☽ – ☉) Par. lat.	☽ aug. S.D.
Beginning	11*h*. 41′ 35″	+20′ 04″·6	47′ 09″·2	16′ 30″·02
End	2 17 41	—5 13 ·6	54 42 ·2	16 27 ·01

Hence the apparent time of conjunction was at 1*h.* 13′ 33″·0, which subtracted from the time of conjunction at Greenwich leaves the longitude of the place of observation 4*h.* 12′ 31″·1.

An increase of *l* seconds in the moon's latitude, would decrease the time of conjunction 0·46 *l* seconds of time, which subtracted from the corresponding correction at Beverly and Chelsea leaves ·07 *l*, which is the number of seconds of time to be subtracted from the longitude of Charlotte-town for an increase of *l* seconds in the moon's latitude, and as this correction is very small, there can be but little uncertainty in the longitude on this account.

Observations at Newport and Providence Oct. 27, 1780.

The beginning of the eclipse was not observed at these places. The end was observed at Newport, R. I. by Mr. Granchain, at 1*h.* 40′ 41″ apparent time. He states the latitude of the place to be 41° 30′ 30″. Hollond makes it 41° 28′ 28″. The mean is nearly 41° 29½′* which used as the true latitude makes the reduced latitude 41° 18′ 7″, the reduction of the moon's equatorial parallax 5″·24, the (☽—☉) par. in long.—1′ 43″·2, in latitude 51′ 21″·3, ☽'s augmented semidiameter 16′ 29″·09. Hence the conjunctions at Newport was at 0*h.* 40′ 58″·7 apparent time. The difference of meridians of Newport and Providence according to Hollond's survey is 18″·8, which would make the conjunction at Providence by this observation 0*h.* 40′ 39″ 9.

The end of the eclipse at Providence, by the observations of Messrs. Brown and West was at 1*h.* 39′ 08″·3 apparent time. The latitude of the place by Hollond is 41° 48′ 50″, reduced 41° 37′ 26″.

* This difference in the latitude is scarcely sensible in the computation of the longitude from this observation, since an increase of one minute in the latitude decreases the longitude but half a second of time. The same is to be observed of the observation at Providence.

The (☽—☉) par. in long.—1′ 18″·0, in latitude 51′ 26″·8, ☽'s augmented semidiameter 16′ 29″·06. Hence the conjunction at Providence by this observation was at 0*h.* 40′ 11″·2. The mean of this and the former result 0*h.* 40′ 39″·9 is 0*h.* 40′ 25″·5, which may be assumed as the apparent time of conjunction at Providence. This, subtracted from the time of conjunction at Greenwich, gives the longitude of Providence 4*h.* 45′ 38″·6, and by subtracting 18″·8, the longitude of Goat Island, Newport, is obtained 4*h.* 45′ 19″·8 W from Greenwich, which agrees nearly with the observations of the transit of Venus of June 3, 1769.

The longitudes of these two places are liable to a greater error from the uncertainty of the moon's latitude, than would have been the case if both contacts had been observed. For an increase of l seconds in the moon's latitude would decrease the times of conjunction at these places by 0·33 l seconds, which subtracted from the corresponding change in the time of conjunction at Greenwich 0″·53 l, leaves the variation of the longitudes just calculated 0″·2 l. Hence an increase of 5 seconds in the moon's latitude (corrected as above) would decrease the longitudes of Newport and Providence by one second of time, nearly, and the error from this source does not probably exceed that quantity.

At the apparent time of the conjunction at Greenwich 5*h.* 26′ 04″·1, the moon's tabular longitude was 214° 55′ 02″·1, the sun's longitude 214° 54′ 56″·4, the difference — 5″·7 is the correction to be applied to the longitude of the moon given by Burg, supposing the solar tables to be correct. This is the same as was assumed at the commencement of the calculation.

To find the error in the moon's latitude, the observations at Long Island, Beverly, and Providence were used as follows.

The greatest obscuration at Long Island was at 0*h.* 31′ 18″ apparent time, when an arch of 42° or 43° of the sun's disc was visible. Supposing this arch to be 42° 30′, the sun's semidiameter 16′ 05″·16, the moon's augmented semidiameter 16′ 29″·97, it is easy to find that the apparent distance of the centres of the sun and moon was 26·57, observing that the diameter, passing through those centres, bisects perpendicularly the chord connecting the extreme visible points of the sun's limb. At this time the (☽—☉) parallax in longitude was 11′ 20″·0, in latitude 49′ 13″·6, the apparent difference of longitudes of the centres of the sun and moon, found from the tables correcting the moon's longitude for the error — 5″·7 was 21″·52. From the apparent distance of the centres and their apparent difference of longitude, it is easy to find the apparent difference of latitude 15″·6, which added to the parallax in latitude, gives the latitude by this observation 42′ 29″·2; this subtracted from the tabular latitude 49′ 44″·3 gives the error in latitude by this observation — 15″·2.

At the same place at 0*h.* 28′ 48″ the lucid part of the sun when least, measured by a micrometer, was 24″.7. This added to the ☽'s augmented semidiameter 16′ 29″·99 and the ☉'s semidiameter subtracted from the sum, gives the apparent distance of the centres of the sun and moon 49″·53. The (☽—☉) par. in long. was 11′ 46″·0, and the apparent difference of longitude (found as above) was 37″·1, consequently the apparent difference of latitude 32″·8, which added to the parallax in latitude 49′ 04″·9, gives the latitude by observation 49′ 37″·7, which subtracted from the tabular latitude 49′ 52″·6 leaves the error of the tables in latitude by this observation — 14″·9.

At Beverly at 0*h.* 21′ apparent time the sun was eclipsed 11$^{d.}$ 24′, which makes the lucid part 96″·52. The sun's semidiameter was then 16′ 05″·16, the moon's augmented semidiameter 16′ 30″·47, the (☽—☉) paral. in longitude was 12′ 43″·5, paral. in latitude 47′ 44·″0, and, by a similar calculation to the preceding, the error of the moon's latitude by this observation is — $10''\cdot1$.

At Providence the greatest obscuration was nearly at $0h.\ 18'\ 55''$ apparent time, the lucid part measured by a micrometer was then $\frac{280}{3868}$, parts of the sun's semidiameter, equal to $139''\cdot73$. The sun's semidiameter $16'\ 05''\cdot16$, the moon's augmented semidiameter $16'\ 30''\cdot67$, the ($☽$ — $\odot$) parallax in longitude $12'\ 55''\cdot0$, in latitude $47'\ 11''\cdot0$. Hence the error in latitude by this observation is — $1''\cdot4$.

The mean of these four observations gives the error of latitude — $10''\cdot4$, the same as was assumed.

Eclipse of the sun of June 24, 1778.

The end of this eclipse was observed at Bradford, Massachusetts, by Doctor Williams at $11h.\ 38'\ 16''$ A. M. apparent time. The latitude of the place is nearly $42°\ 46'$ N, reduced $42°\ 34'\ 34''$. Using the same tables of Delambre and Burg, correcting the moon's longitude $+6''\cdot2$ and latitude $+1''\cdot1$, as deduced from the observations at Greenwich before given; supposing the irradiation $3''\cdot5$, inflection $2''$. It was found that the ($☽$ — $\odot$) parallax in longitude was $+5'\ 14''\cdot7$, in latitude $19'\ 52''\cdot1$, whence the apparent time of conjunction at Bradford was at $10h.\ 51'\ 46''\cdot2$ A. M. apparent time. The difference between this and the time of conjunction at Greenwich, calculated before, $3h.\ 35'\ 52''\cdot9$ gives the longitude of Bradford $4h.\ 44'\ 6''\cdot7$ W from Greenwich, or $30''\cdot0$ W from Salem, which agrees very nearly with the map of Massachusetts.

Annular eclipse of April 3, 1791.

This eclipse was observed at Georgetown, Columbia, by Mr. Ellicott, in the latitude of about $38°\ 55'$ N, reduced $38°\ 43'\ 47''$, as appears by vol. iv. page 48 of the Transactions of the American Philosophical Society, and the observations have been calculated by Mr.

Ferrer in the sixth volume of the same work. This gentleman supposes that the time of forming the annulus was marked too small by one minute, a mistake that might easily have been made, and of which several instances have occurred in the most important observations made by the best astronomers of Europe. This correction being applied, makes the times of conjunction, deduced from the three observations, agree much more nearly with each other than they otherwise would do. I have therefore adopted it in the following calculation. Using the tables of Delambre and Burg, correcting the moon's longitude by adding 20″, and the moon's latitude by adding 7″·6, which is necessary from the observation at Greenwich and Paris, mentioned in the former part of this memoir, the calculation becomes

	Mean time.	(☽–☉) Par. lon.	Par. lat.
Formation of Annulus	18*h*. 40′ 01″$\frac{1}{4}$	25′ 40″·7	46′ 54″·6
Breaking of Annulus	18 43 15 $\frac{1}{4}$	25 36 ·7	46 49 ·2
End of the eclipse	19 55 37 $\frac{3}{4}$	22 20 ·0	44 00 ·8

The conjunction by the mean of these three observations is at 19*h*. 37′ 00″·4 mean time, or 19*h*. 33′ 42″·6 apparent time. The difference between this and the conjunction at Greenwich, calculated before 0*h*. 42′ 00″·2, is 5*h*. 8′ 17″·6, the longitude of Georgetown, and as this place by the measurement of Seth Pease Esq. is 13·1 seconds, in time W from the Capitol in Washington, the longitude of the Capitol would be by this observation 5*h*. 8′ 4″·5. The observation of Mr. Pease on the eclipse of 1811, makes it in 5*h*. 8′ 11″·4. The mean of both gives the longitude of the Capitol in Washington 5*h*. 8′ 8″·0, whence the longitude of Georgetown is 5*h*. 8′ 21″·1 = 77° 5′ 16″ W from Greenwich.

The observations of this eclipse at Philadelphia, given by Mr. Rittenhouse in vol. iii. page 154 of the Transactions of the American Philosophical Society of that city, appear to be erroneous. For the conjunction deduced from the fourth contact agrees nearly with other observations, but the three first contacts make the conjunction too late by nearly a minute. Mr. Ferrer in his calculation in vol. vi. of the same Transactions, rejects the first contact, and subtracts one minute from the second and third; but this correction does not appear to be warranted by the observations. For if we suppose the regulation of the time-keeper to be correct, there must have been a mistake in reading off the *three* first observations, which is improbable; and if we suppose the regulation of the time-keeper to be erroneous by one minute, it will not make the observations accord without allowing also an error of one minute in the last contact. These reasons have induced me to reject the observations, as not having been made with sufficient accuracy to be used in calculating the longitude of Philadelphia.

Transit of Venus June 3, 1769.

The elements of this transit for June 3, 1769, at 10*h.* 2′ 34″·1 mean time at Greenwich, are as follows.

☉'s longitude by Delambre's tables of 1806 - -	73° 27′ 18″·9
♀'s longitude } deduced from the observations at Greenwich, Paris, and Prince of Wales' Fort.	73 27 18 ·9
♀'s latitude }	10 14 ·32 N.
☉'s horary motion - - - - -	143 ·46
♀'s horary motion in longitude - - - -	94 ·144
♀'s horary motion in latitude - - - -	—35 ·450
♀'s horizontal parallax - - - - -	30 ·45
☉'s horizontal parallax - - - - -	8 ·67
☉'s semidiameter by T. 2. P. 470 of La Lande's Astronomy	15 43 ·71
♀'s semidiameter - - - - - -	28 ·60
☉'s right ascension - - - - -	4*h.* 48 13 ·23
Horary increment of right ascension - - -	10 ·27

The mean of the observations of Messrs. Maskelyne, Dollond, Nairn, Hirst, Hitchins, Horsley, and Dunn, at the Royal Observatory at Greenwich, as given in the first volume of the Transactions of the Philosophical Society of Philadelphia, make the first external contact at 7*h.* 11′ 1″·9 and the first internal contact at 7*h.* 29′ 19″·1. The observation of the internal contact by Mr. Hirst is in one place printed 7*h*. 28′ 57″, in another 7*h*. 28′ 47″; that of Mr. Dunn 7*h*. 29′ 28″ and 7*h*. 29′ 48″. The values 7*h*. 28′ 57″, and 7*h*. 29′ 28″, were used as best agreeing with the other observations. The mean of the observations of the first internal contact at Paris, made by Messrs. Messier, Cassini, Sejour, Chaulnes, Maraldi, Fouchy, and Bery, as published in the Memoirs of the Royal Academy of Arts and Sciences of Paris, was 7*h*. 38′ 48″·7 apparent time. The parallaxes and times of conjunction are as follows.

	(♀−☉) Par. long.	Par. lat.	Conjunction.	Conj. Green.
I. contact Greenwich	—15″·000	+15″·551	10*h*. 4′ 49″·6	10*h*. 4′ 49″·6
II. contact Greenwich	—14 ·681	+15 ·988	10 4 44 ·3	10 4 44 ·3
II. contact Paris	—15 ·120	+15 ·658	10 14 16 ·2	10 4 55 ·2
The mean of these three observations gives the apparent time of the conjunction at Greenwich.				10 4 49 ·7

The mean of the observations of Messrs. Dymond and Wales, at Prince of Wales' Fort in Hudson's Bay, in latitude 58° 47′ 32″, were as below.

	App. time.	♀−☉ Par. lon.	Par. lat.	Conj. app. time.	Lon. W Green.
I. contact	0*h*. 57′ 04″·1	−4″·322	+12″·491	3*h*. 47′ 49″·6	6*h*. 17′ 00″·1
II. contact	1 15 23 ·3	−5 ·202	+12 ·483	54 ·8	6 16 54 ·9
III. contact	7 00 47 ·0	−13 ·110	+16 ·841	55 ·0	6 16 54 ·7
IV. contact	7 19 10 ·¾	−12 ·876	+17 ·206	49 ·9	6 16 59 ·8
				Mean	6 16 57 ·4

The internal contacts at this place were used in finding the latitude of Venus at the time of conjunction inserted in the above elements.

Professor Winthrop at Cambridge missed the first contact, but had a good observation of the second contact at 2*h*. 47′ 30″ apparent time. The parallax in longitude was then — 11″·743, in latitude +7″·484. Hence the apparent time of the conjunction by this observation was $5h.\ 20'\ 8''\cdot7$. Professor Williams observed the same contact at Newbury in latitude 42° 48′ N, and by Hollond's survey $6\frac{1}{2}$ seconds in time E from my house in Salem, or $59\frac{1}{2}$ seconds E from Cambridge, at $2h.\ 48'\ 44''$ apparent time. The parallax in longitude was then — $11''\cdot757$, in latitude + $7''\cdot643$, whence the conjunction at Newbury was at $5h.\ 21'\ 28''\cdot0$, corresponding to $5h.\ 20'\ 28''\cdot5$ apparent time at Cambridge. The mean of this and the former result is $5h.\ 20'\ 18''\cdot6$, which subtracted from the time of conjunction at Greenwich $10h.\ 4'\ 49''\cdot7$, gives the longitude of Cambridge by this observation $4h.\ 44'\ 31''\cdot1$.

At Providence in latitude 41° 50′ 41″, the transit was observed by Messrs. West and Brown. The first contact was not well observed, but the second contact was at $2h.\ 46'\ 35''$ apparent time. The parallax in longitude was — $11''\cdot762$, in latitude + $7''\cdot282$. Hence the conjunction was at $5h.\ 19'\ 12''\cdot7$ apparent time, which subtracted from the time of conjunction at Greenwich $10h.\ 4'\ 49''\cdot7$ gives the longitude of Providence by this observation $4h.\ 45'\ 37''\cdot0$. By the eclipse of Oct. 27, 1780 it was $4h.\ 45'\ 38''\cdot6$. The mean gives the longitude of Providence $4h.\ 45'\ 37''\cdot8$, and by subtracting $18''\cdot8$ we have the longitude of Goat Island, Newport, $4h.\ 45'\ 19''\cdot0$ W from Greenwich.

At the State House square in Philadelphia, in the latitude of 39° 57′ 10″, the transit was observed by Messrs. Shippen, Williamson, Prior, Ewing, Pearson, and Thompson. At Norriton in the latitude of 40° 9′ 56″, and by an accurate terrestrial measurement 52″ in time W from Philadelphia, the transit was observed by Messrs. Smith, Lukens, and Rittenhouse. At Lewistown in the latitude of 38° 46′ 38″ and $1''\cdot4$ in time E from Philadelphia, as determined by an accurate survey, the transit was observed by Messrs. Biddle and Bayley. The detail of these observations is given in the first volume of the Transactions of the Philosophical Society held at Philadelphia. The times of conjunction calculated at these places from the mean of the observations, and reduced to the meridian of the State House in Philadelphia, are as follows.

		App. time.	Par. long.	Par. lat.	Conj. Philadel. App. time.
Philadelphia	I. contact	2*h*. 13′ 46″·6	—10″·030	6″·287	5*h*. 4′ 23″·4
	II. contact	2 31 28 ·4	—11 ·115	6 ·447	3 40 ·7
Norriton	I. contact	2 12 57 ·8	— 9 ·960	6 ·357	4 27 ·2
	II. contact	2 30 07 ·0	—11 ·012	6 ·510	3 05 ·7
Lewistown	I. contact	2 14 19 ·0	—10 ·167	5 ·865	4 54 ·6
	II. contact	2 32 08 ·0	—11 ·277	6 ·030	4 20 ·6

The mean of these six observations gives the apparent time of conjunction at Philadelphia 5*h*. 4′ 8″·7, which subtracted from 10*h*. 4′ 49″·7 gives the longitude of Philadelphia by this observation 5*h*. 0′ 41″·0.

The transit was observed at Baskenridge, New Jersey, in the latitude of 40° 40′ N, by the Earl of Sterling, as follows.

	App. time.	Par. long.	Par. lat.	Conj. App. time.
I. contact	2*h*. 16′ 00″	—10″·102	6″·562	5*h*. 6′ 39″·9
II. contact	2 34 12	—11 ·199	6 ·729	5 6 33 ·3

The mean of these observations makes the conjunction at 5*h*. 6′ 36″·6 apparent time, which subtracted from 10*h*. 4′ 49″·7 gives the longitude of Baskenridge 4*h*. 58′ 13″·1 W from Greenwich.

At Quebec, in the latitude of 46° 47′ 17″ N, and 10″·4 in time W from the Castle of St. Lewis, the first contact was observed by Mr. Hollond at 2*h*. 30′ 8″$\frac{3}{4}$ apparent time. The parallax in longitude was — 10″·236, in latitude + 8″·837, whence the apparent time of conjunction was 5*h*. 21′ 17″·6, and the longitude of the Castle of St. Lewis 4*h*. 43′ 21″·7. At the Island of Coudre, in the latitude of 47° 16′ 30″ N, and 5′ 6″ in time E from Quebec, the second contact was observed by Mr. Wright, at 2*h*. 50′ 50″ apparent time. The parallax in longitude was — 11″·242, in latitude 9″·208. Whence the apparent time of conjunction was 5*h*. 23′ 45″·1, which subtracted from 10*h*. 4′ 49″·7, gives the longitude of that island 4*h*. 41′ 04″·6, whence that of Quebec is 4*h*. 44′ 10″·6. The mean of this and the former result is 4*h*. 43′ 46″·1 for the longitude of Quebec, and 4*h*. 40′ 40″·1 for that of I. Coudre.

Transit of Mercury of Nov. 12, 1782.

Observations of this transit were made at Paris, Cambridge, Philadelphia, New Haven, and Ipswich. Those made in this country were under more favourable circumstances than those at Paris, on account of the greater elevation of the sun above the horizon, but for the reasons before assigned, no great accuracy was to be expected in the longitudes found by comparing the American observations with each other; hence it was thought best not to use these observations.

Transit of Mercury of Nov. 5, 1789.

The observations at Cambridge are given in the second volume of the memoirs of the American Academy of Arts and Sciences, these at Philadelphia and Williamsburg in the second volume of the Transactions of the American Philosophical Society held at Philadelphia.

The elements of this transit for Nov. 5, 1789 at 3*h*. 7′ 50″·9 mean time at Greenwich, are as follows.

☉'s longitude by Delambre's tables of 1806 app. equinox	223° 40′ 45″·4
☿'s longitude by La Lande's tables corrected by the observations at Cambridge	223 40 45 ·4
☿'s latitude south decreasing,	7 15 ·1
☉'s horary motion	150 ·73
☿'s horary motion in longitude	199 ·03
☿'s horary motion in latitude	51 ·78
☿'s horizontal parallax	13 ·03
☉'s horizontal parallax	8 ·89
☿'s semidiameter	4 ·664
☉'s semidiameter — irradiation 3″·5	16 07 ·26
Horary variation of the hor. mot. of ☿ in longitude	— 0 ·061
- - - - in latitude	+ 0 .015
☉'s right ascension	14*h*. 44 52 ·07
Horary increment of right ascension in time	9 ·97

The observations at Cambridge give the following result.

	App. time.	☿ – ☉ Par. long.	Par. lat.	Conj. app. time.
I. contact	20*h*. 24′ 04″	3″·321	2″·282	22*h*. 39′ 30″·3
II. contact	20 25 52	3 ·309	2 ·292	31 ·9
III. contact	1 15 44	0 ·080	3 ·614	26 ·5
IV. contact	1 17 36	0 ·057	3 ·619	31 ·7

The mean of these four observations makes the conjunction at 22*h*. 39′ 30″·1, apparent time at Cambridge, corresponding to 3*h*. 23′ 59″·8 apparent time at Greenwich. I have preferred finding the conjunction at Greenwich from this observation rather than from that at Paris, on account of the failure in part of this observation, as mentioned in the preceding calculation of the longitude of Cambridge. The latitude of Mercury given in the above elements was decreased 0″·06, which appears to be necessary from the observations at Cambridge and Philadelphia.

The observations at Philadelphia were as follows.

	App. time.	(☿ – ☉) Par. long.	Par. lat.	Conj. app. time.
I. contact	20*h*. 7′ 59″·1	3″·481	2″·063	22*h*. 23′ 26″·1
II. contact	20 9 29 ·1	3 ·472	2 ·071	07 ·8
III. contact	0 59 32 ·6	0 ·225	3 ·485	13 ·2
IV. contact	1 01 12 ·6	0 ·203	3 ·490	7 ·0

The mean of these observations makes the apparent time of conjunction 22*h*. 23′ 13″·5. The difference between this and 3*h*. 23′ 59″·8 gives the longitude of Philadelphia by this observation 5*h*. 0′ 46″·3 W from Greenwich. The transit of Venus of June 3, 1769, made it 5*h*. 0′ 41″·0. The total eclipse of June 16, 1806 gave 5*h*. 0′ 36″. The mean of these three observations may be assumed as the longitude of Philadelphia 5*h*. 0′ 41″·1 W from Greenwich, which differs less than a second from the estimate of Mr. Ferrer in vol. vi. page 359 of the Transactions of the American Philosophical Society, which is *5h.* 10′ 1″·2 W from Paris, corresponding to *5h.* 0′ 40″·2 W from Greenwich. Mr. Ferrer's calculation is made by the three observations just named, and those of the transit of Mercury of 1782 and the annular eclipse of 1791. These last observations I have rejected for the reasons stated in the former part of this memoir. Subtracting 1″·4 from the longitude of Philadelphia, gives the longitude of Lewistown *5h.* 0′ 39″·7, and by adding 52″ the longitude of Norriton is obtained *5h.* 1′ 33″·1 W from Greenwich.

Messrs. Owen and Biddle found, by a trigonometrical survey, that the Light House on Cape Henlopen was 29″·8 N, and 13″·1 in time E from their observatory at Lewistown. Hence the Light House is in the latitude of 38° 47′ 8″ N, and in longitude *5h.* 0′ 26″·6 W from Greenwich.

The same transit of 1789 was observed at Williamsburg as follows.

	App. time.	(☿−☉) Par. long.	Par. lat.	App. time conj.
II. contact	*20h.* 3′ 10″	3″·570	1″·884	*22h.* 16′ 48″·0
III. contact	0 53 45	0 ·239	3 ·368	17 23 ·9
IV. contact	0 55 10·5	0 ·219	3 ·372	17 03 ·9

The mean of these three observations makes the conjunction at *22h.* 17′ 5″·3, which subtracted from *3h.* 23′ 59″·8, gives the longitude of Williamsburg by this observation *5h.* 6′ 54″·5. The solar eclipse of Sept. 17, 1811 makes it *5h.* 6′ 48″·4. The mean of both observations may be assumed as the longitude of William and Mary College *5h.* 6′ 51″·5 W from Greenwich, which is about 52″ less than the computation of Mr. Ferrer from the end of the solar eclipse of June 1806, an imperfect observation, which it was thought best to reject.

Eclipse of the sun of June 26, 1805.

The beginning of this eclipse was noted at Philadelphia, Lancaster, and New York. No observations were made to determine the error of the moon's tabular latitude, but it is probable from the following calculation, that this would not much affect the computed difference of meridians between those places, so that the longitude of New York may be obtained by these observations to a considerable degree of accuracy, by means of the longitudes of Philadelphia and Lancaster, computed in the former part of this memoir.

The observation at Philadelphia was made by Professor Patterson at $6h.\ 47'\ 40''\cdot5$ apparent time, in the latitude of $39°\ 57'\ 2''$, longitude $5h.\ 0'\ 41''\cdot1$ W from Greenwich. The corresponding apparent time at Greenwich was $11h.\ 48'\ 21''\cdot6$, when by the tables of Delambre and Burg, the elements were as follows.

	° ′ ″
☉'s longitude from apparent equinox - - -	94 48 30·5
☽'s longitude - - - - - -	95 08 27·0
☽'s latitude north decreasing - - - -	62 23·0
☉'s horary motion in longitude - - -	2 23·0
☽'s horary motion in longitude - - - - -	37 58·41
☽'s horary motion in latitude - - - -	3 26·66
Horary decrement ☽ hor. mot. long. - - - -	0·74
Horary increment ☽ hor. mot. lat. - - - - -	0·46
(☽—☉) horizontal parallax for Philadelphia - -	61 04·72
☽'s semidiameter — inflexion 2″ + aug. 2″ - - -	16 43·95
☉'s semidiameter — Irradiation 3″·5 - - -	15 42·05
☉'s right ascension - - - - -	6h. 20 57·5
(☽—☉) Par. in long. - - - - - -	—44 31·1
(☽—☉) Par. in lat. - - - - -	41 18·7

Hence the conjunction at Philadelphia was at $6h.\ 14'\ 11''\cdot6$, corresponding to $11h.\ 14'\ 52''\cdot7$ apparent time at Greenwich. An increase of $1''$ in the moon's latitude would decrease this $1''\cdot44$. Hence if the correction to be added to the moon's tabular latitude be l seconds, the apparent time at Greenwich will be at $11h.\ 14'\ 52''\cdot7 - 1''\cdot44\cdot l$, by this observation.

The observation at Lancaster, in the latitude of 40° 2′ 36″, longitude 5*h.* 5′ 22″·2 W from Greenwich, was made by Mr. Ellicott at 6*h.* 43′ 26″ apparent time. At that time by the above elements the moon's augmented semidiameter was 16′ 44″·18, (☽—☉) horizontal parallax 61′ 4″·70, par. in long. — 44′ 38″·5, par. in lat. 41′ 2″·2. Hence the apparent time of conjunction was 6*h.* 9′ 23″·3, corresponding to 11*h.* 14′ 45″·5 at Greenwich, and, by increasing the moon's latitude *l* seconds, this would become 11*h.* 14′ 45″·5 — 1″·46·*l*. The mean of this and the former value is 11*h.* 14′ 49″·1 — 1″·45·*l*.

The observation at New York was made by Mr. Ferrer in latitude of 40° 42′ 40″ N, at 6*h.* 50′ 10″ apparent time. The moon's augmented semidiameter was 16′ 43″·92, (☽—☉) horizontal parallax 61′ 4″·56, par. in long. — 43′ 52″·4, par. in lat. 42′ 0″·5. Hence the apparent time of conjunction was 6*h.* 18′ 34″, and by increasing the moon's latitude by *l* seconds, this becomes 6*h.* 18′ 34″ — 1″·38·*l*, which subtracted from the time of conjunction at Greenwich 11*h.* 14′ 49″·1 — 1·45 *l*, gives the longitude of the place of observation 4*h.* 16′ 15″·1 — 0″·07 *l*, and as this place is 0″·3 W of Columbia College, the longitude of that College would be 4*h.* 56′ 14″·8 — 0″·07 *l*, in which the coefficient of *l* is small, and we may without much error assume the longitude to be 4*h.* 56′ 14″·8 by this observation. This was combined with other observations in the former part of this memoir.

The longitudes here calculated, with the addition of a few places in the vicinity of Salem, marked with an asterisk, which I have found by a trigonometrical survey, are collected in the following table. The longitudes of Boston State-House and Light-House from Cambridge were found by Professor Farrar.

Most of the preceding calculations have been made in two different ways, to verify the accuracy of the results.

Table of Latitudes and Longitudes.

	Latitudes North.	Longitudes W from Greenwich.	
	° ′ ″	h. ′ ″	° ′ ″
Albany, New York - - - - -	42 38 39	4 54 59·3	73 44 49
* Baker's island light houses - - -	42 34 10	4 43 09·8	70 47 27
Baskenridge - - - - -	40 40	4 58 13·1	74 33 16
* Beverly, President Willard's house - -	42 35 13	4 43 31·1	70 52 46
Boston, State House - - - -	42 22 28	4 44 16·6	71 04 09
——— Light House - - - -	42 20 41	4 43 35·0	70 53 45
Bradford, Massachusetts - - -		4 44 06·7	71 01 40
Brunswick, Bowdoin College - - -	43 53	4 39 40·1	69 55 01
Burlington College, Vermont - -	44 28	4 52 58·3	73 14 34
Cambridge, Harvard Hall - - -	42 23 28	4 44 29·7	71 07 25
Cape Henlopen - - - -	38 47 08	5 00 26·6	75 06 39
Charlottetown, St. John's I. - - -		4 12 31·1	63 07 46
Chelsea - - - - -	42 25 11	4 44 03·7	71 00 55
Coudre Island - - - -	47 16 30	4 40 40·1	70 10 01
Georgetown - - - - -	38 55	5 08 21·1	77 05 16
Kinderhook - - - - -	42 23 08	4 55 09·6	73 47 24
Lancaster - - - - -	40 02 36	5 05 22·2	76 20 33
Lewistown - - - - -	38 46 38	5 00 39·7	75 09 55
Long Island, Penobscot - - -	44 17 07	4 35 20·1	68 50 01
* Lynn, Phillip's Point - - -	42 30 14	4 43 34·9	70 53 43
* Marblehead, West meeting house - -	42 32 30	4 43 25·8	70 51 27
* Manchester, Glass Head - - -	42 35 42	4 43 08·5	70 47 07
Monticello - - - - -	38 08	5 15 10·4	78 47 36
Nantucket, near middle of town - -	41 15 32	4 40 31·6	70 07 54
Natchez, Mr. Dunbar's observatory - -	31 27 48	6 05 29·8	91 22 27
——— Castle - - -		6 05 38·8	91 24 42
New Brunswick, New Jersey, Columbia College	40 29 34	4 57 54·1	74 28 31
New Haven, Yale College - - -	41 17 58	4 51 51·1	72 57 46
Newport, Goat Island - - - -		4 45 19·0	71 19 45
New York, Columbia College - - -	40 42 45	4 56 00·2	74 00 03
Norriton - - - - - -	40 09 56	5 01 33·1	75 23 16
Philadelphia - - - - -	39 57 02	5 00 41·1	75 10 16
Portland, Observatory Hill - - -	43 39	4 41 22	70 20 30
Prince of Wales' Fort, Hudson's Bay - -	58 47 32	6 16 57·4	94 14 21
Providence - - - - - -	41 50 41	4 45 37·8	71 24 27
Quebec - - - - - -		4 43 46·1	70 56 31
Rutland, Vermont - - - - -	43 36	4 51 49·8	72 57 27
Salem, place of observing the eclipses of 1806, & 1811	42 33 30	4 43 36·7	70 54 10
——— Mr. Lambert's place of observation -	42 33 36	4 43 34·0	70 53 30
Washington City, Capitol - - - -	38 53 37	5 08 08·0	77 02 00
Williamsburg College - - - -	37 15 20	5 06 51·5	76 42 52

On the Altitude and Longitude of the Nonagesimal degree of the ecliptic.

The altitude and longitude of the nonagesimal degree of the ecliptic, necessary in the calculation of the parallaxes in the preceding observations, were found by the method I published in the third edition of the Practical Navigator, and as this is shorter and not liable to so many cases as that given in the first volume of the Memoirs of the Academy, I have thought that an explanation and demonstration of the method would not be unacceptable.

The method is considerably abridged by means of a table containing the logarithms marked A, B, C, which occur twice in calculating a partial eclipse of the sun or occultation, and four times in a total or annular eclipse or transit. These logarithms are calculated for the obliquity of the ecliptic 23° 27′ 40″, by the following rule.

In north latitudes subtract the reduced latitude from 90°, in south latitudes add the reduced latitude to 90°, the sum or difference will be the polar distance; take half this and half of the obliquity of the ecliptic (11° 43′ 50″), and find the sum S and the difference D. Then

$$\text{Log. } A = \text{Log. Cos. } D + \text{Log. Sec. } S - 20.$$
$$\text{Log. } C = \text{Log. Tang. } S.$$
$$\text{Log. } B = \text{Log. Tang. } D - \text{Log. } C + 10.$$

Thus for Salem in the reduced latitude 42° 22′ 4″, the half polar distance is 23° 48′ 58″, the half obliquity 11° 43′ 50″, the difference D = 12° 5′ 8″, the sum S = 35° 32′ 48″.

Difference D	12° 5′ 8″	Cosine 9·9902660	Tang. + 10 =	19·3306527
Sum S	35 32 48	Secant 10·0895665	Tang. = C =	9·8540160
	Sum	A = 0·0798325	Diff. B =	9·4766367

In this way the logarithms may be found for places not included in the table. The changes for an increase of 100″ in the latitude or obliquity are found by repeating the operation with the increased values, and ascertaining the corresponding changes in the values of A, B, C. These logarithms are given to six places of figures, though in general five will be quite sufficient, since the latitude and longitude of the nonagesimal degree are rarely required to a greater degree of accuracy than 10″.

TABLE.

Places.	Reduced Latitude North.	Log. A	Var. A +100″ lat.	Var. A +100″ obl.	Log. B	Var. B +100″ lat.	Var. B +100″ obl.	Log. C	Var. C +100″ lat.	Var. C +100″ obl.
	° ′ ″		−	+		−	−		−	+
Albany	42 27 13	0 079670	53	97	9 475783	293	739	9 853328	223	223
Berlin	52 20 24	0 061608	49	75	9 324135	618	1099	9 771197	240	240
Beverly	42 23 47	0 079778	53	98	9 476336	292	737	9 853787	223	223
Boston	42 10 46	0 080190	53	98	9 478602	288	733	9 855524	222	222
Brunswick Coll.	43 41 32	0 077334	52	95	9 462117	218	767	9 843361	224	224
Burlington Coll.	44 16 32	0 076242	52	93	9 455341	330	781	9 838640	225	225
Cambridge (Eng.)	52 01 28	0 062166	49	76	9 331054	600	1080	9 773925	240	240
Cambridge (Amer.)	42 12 02	0 080150	52	97	9 478383	288	733	9 855355	222	222
Dublin obs.	53 12 07	0 060090	48	73	9 304166	670	1155	9 763705	242	242
Edinburg	55 46 02	0 055618	47	67	9 233401	878	1376	9 741011	249	249
Greenwich obs.	51 17 28	0 063466	49	77	9 346396	562	1038	9 780232	238	238
Havannah	23 03 34	0 120000	64	148	9 597658	95	516	10 006045	210	210
Kinderhook	42 11 37	0 080163	52	98	9 478455	289	733	9 855411	222	222
Lancaster	39 51 18	0 084648	54	104	9 501042	249	688	9 874005	219	219
Leon I. obs.	36 16 52	0 091680	55	112	9 529940	202	634	9 902005	216	216
London	51 19 29	0 063406	49	77	9 345714	564	1040	9 779944	238	288
Monticello	37 56 52	0 088372	55	108	9 517220	228	657	9 889004	217	217
Nantucket	41 04 10	0 082308	53	101	9 489723	269	710	9 864379	221	221
Natchez	31 17 36	0 101899	58	125	9 561510	152	577	9 940447	212	212
New Brunswick	40 18 40	0 083766	54	103	9 496889	256	696	9 870397	220	220
New Haven	41 06 35	0 082231	55	101	9 489333	269	711	9 864059	221	221
New York	40 31 19	0 083360	53	102	9 494930	260	700	9 868727	220	220
Newport	41 18 07	0 081863	53	100	9 487457	273	715	9 862529	221	221
Norriton	39 58 37	0 084412	54	103	9 499943	251	691	9 873042	220	220
Oxford obs.	51 34 28	0 062963	50	77	9 340586	576	1054	9 777800	239	239
Paris obs.	48 38 51	0 068207	50	83	9 394413	452	918	9 802627	233	233
Philadelphia	39 45 44	0 084828	53	104	9 501872	248	687	9 874738	219	219
Portland	43 27 32	0 077772	52	95	9 464767	313	761	9 845245	224	224
Richmond obs.	51 16 56	0 063482	49	78	9 346576	562	1038	9 780308	238	238
Rutland	43 24 32	0 077866	52	95	9 465330	312	760	9 845648	224	224
Salem	42 22 04	0 079832	52	98	9 476637	291	731	9 854016	222	222
Washington	38 42 47	0 086870	54	106	9 510949	233	669	9 883002	218	218
Williamsburg	37 04 47	0 090105	55	111	9 524062	211	645	9 895852	217	217

These logarithms are calculated for the obliquity 23° 27′ 40″. The columns marked *lat.* contain the variations of A, B, C, for an increase of 100″ in the reduced latitude. The column *obl.* contains the variations of A, B, C, for an increase of 100″ in the obliquity of the ecliptic. The signs must be changed, if the latitude or obliquity is less than that given in the table.

Example.

Required the values of A, B, C, for Salem, when the obliquity is 23° 27′ 41″·9.

Tabular numbers	0·079832	9·476637	9·854016
Var. for + 1″·9 obliquity	+ 2	— 14	+ 4
Required values	A = 0·079834	B = 9·476623	C = 9·854020

The following rule is adapted to the table of log. sines, &c. numbered xxvii in the third edition of the Practical Navigator, in the margin of which are placed two columns, one marked P. M. containing the double of the time corresponding to the degrees and minutes, allowing 15° for an hour; the other marked A. M. containing the difference between this and 12 hours. *In using tables not having these columns, it will be necessary to turn the time T, mentioned in the rule, into degrees and minutes, and take the log. cotangent of ½ T instead of that mentioned in the rule.*

RULE.

Add together the sun's right ascension, the apparent time (counted from noon to noon) and 6 hours, the sum rejecting 24 or 48 hours, if greater than those quantities, is to be called the time T; this is to be sought for in the column of hours of table xxvii, supposing the column A. M. to be increased 12 hours, as in astronomical computation.* The corresponding log. cotangent added to the log. A of

* Thus if the time T is 5 hours, it must be called 5H. R M. If T is 14

the table gives the log. tangent of the arch G. This log. added to the log. B of the table, rejecting 10 in the index, will be the log. tangent of the arch F ; these arches being less than 90° when T is found in the column A. M. otherwise greater. This rule is general except in places situated within the polar circles, which is a case that very rarely occurs. Within the *north polar circle* the supplement of F to 360° is to be taken instead of F ; within the *south polar circle*, the supplement of G to 180° is to be taken instead of G ; the other terms remaining unaltered. Then the longitude of the nonagesimal is equal to the sum of the arches F, G, and 90°, rejecting as usual 360° when the sum exceeds that quantity.

To the log. C add the log. cosine of the arch G, and the log. secant of the arch F, the sum, rejecting 20 in the index, will be the log. tangent of half the altitude of the nonagesimal.

Example.

Required the altitude and longitude of the Nonagesimal at Salem, September 17, 1811, at 0*h.* 55′ 14″·3, the observed apparent time of the beginning of the eclipse of the sun ; the obliquity of the ecliptic being 23° 27′ 41″·9, the reduced latitude 42° 22′ 04″ N, and the sun's right ascension 11*h.* 37′ 33″·9.

11*h.* 37′ 33″·9 ☉'s right ascension.		
0 55 14 ·3 App. time.		
6	A 0 079834	
T 18 32 48 ·2	Cotang 0 062375=log. cotang of ½T turned into deg.	
G 54 13 03	Tan. 0 142209	Cosine 9 766940
90	B 9 476623	C 9 854020
F 22 34 30	Tan. 9 618832	Secant 34621
Sum 166 47 33=Long. Nonages.		24 20 41½ Tan. 9 655581
		48 41 23 Altitude Nonages.

....

hours it must be called 2 H. A. M. the corresponding log. tangent is equal to the log. tangent of ½T turned into degrees and minutes in the usual way.

Demonstration.

Let EQ (Plat. 2, Fig. 2) be the equator, ♑ ♋ the ecliptic, ♈ the first point of Aries, p the north pole of the ecliptic, P the north pole of the equator, Z the zenith of the place of observation, P p the obliquity of the ecliptic, P Z the north polar distance of the point Z. Then as in President Willard's paper, in the first volume of the Memoirs of the Academy, p Z is the altitude of the nonagesimal = H; and the angle ♈ p Z its longitude = L. The angle ♈ P Z is equal to the right ascension of the meridian R, found by adding the apparent time to the sun's right ascension.

In the spherical triangle p P Z put $S = \frac{1}{2}(PZ + Pp)$, $D = \frac{1}{2}(PZ - Pp)$, the angle $pPZ = 90° + R = T$, $G = 180° - \frac{1}{2}(PpZ + pZP)$, $F = 180° - \frac{1}{2}(PpZ - pZP)$. Hence $PpZ = 360° - F - G$ and $90° - PpZ = ♈pZ$ = longitude of the nonagesimal L becomes $L = 90° + F + G$, rejecting as usual the 360°. Then, by the noted rules of Napier (marked (7) (8) in page 653 of the third edition of the Navigator) we have Cos. S : Cos. D : : Cot. $\frac{1}{2}$T : Tang. (180° — G) and Sine S : Sine D : : Cot. $\frac{1}{2}$T : Tang. (180° — F). Dividing the terms of the last analogy by the corresponding ones of the former, and putting $\frac{\text{Sin. S}}{\text{Cos. S}} = \text{Tang. S}$, $\frac{\text{Sine D}}{\text{Cos. D}} = \text{Tang. D}$, and noting the signs of the terms in the usual way, in order to ascertain the affection of F and G, by putting Tang. (180° — G) = — Tang. G, Tang. (180° — F) = — Tang. F, we have Cos. S : Cos. D : : Cot. $\frac{1}{2}$ T : — Tang. G; and Tang. S : Tang. D : : Tang. G : Tang. F. Or, in putting $\frac{\text{Cos. D}}{\text{Cos. S}} = A$, $\frac{\text{Tang. D}}{\text{Tang. S}} = B$, Tang. G = — A Cot. $\frac{1}{2}$ T, Tang. F = B Tang. G.

The quantities A, B, are evidently the natural numbers corresponding to the logarithms A, B, of the preceding table. The formulas for Tang. F and Tang. G, furnish in logarithms the rule above given for calculating F and G to be substituted in the value of $L = 90° + F + G$.

When R is in the ascending signs, as in Fig. 2, and Z is situated without the polar circles, D, S and $\frac{1}{2}$ T must be acute. In this case the formula for Tang. G and Tang. F become negative, consequently G, F will be obtuse. In Fig. 3, R is in the descending signs, and Z without the polar circles, D and S are acute, $\frac{1}{2}$ T obtuse, and its tangent becomes negative; hence, by the formula tang. G and tang. F are positive, and F, G acute. Consequently G and F are of a different affection from $\frac{1}{2}$ T agreeable to the rule.

If the polar distance P Z (Fig. 2, 3) decrease and become equal to Pp, D, B and F will be $= 0$. By decreasing farther the value of P Z, the point Z will fall within the north polar circle, P Z will be less than Pp, and D, B will become negative, and F change its sign. Hence to make use of the formula $L = 90 + F + G$, it will be necessary, in this case, to write $360° - F$ instead of F. On the contrary, if the polar distance P Z (Fig. 2, 3.) be supposed to increase, D and S will remain acute until $PZ = 180° - Pp$, then $S = 90°$ and its cosine $= 0$, consequently A and tang. G will become infinite and $G = 90°$. Beyond that point, within the south polar circle, S will exceed 90°, its cosine will be negative, A, B, will be negative, and tang. G will change sign, consequently the supplement of its former value must be taken. These agree with the rule and include all the cases.

Again (by § 10 page 653 of the Navigator) we have in the triangle PpZ, Cos. $\frac{1}{2}$ (PpZ — PZp) : Cos. $\frac{1}{2}$ (PpZ + PZp) : : tan. $\frac{1}{2}$ (Pp + PZ) : tang. $\frac{1}{2}$$p$Z, which in symbols is Cos. (180° — F) : Cos. (180° — G) : : tan. S : tang. $\frac{1}{2}$ H, or by reduction cos. F : cos. G : : tang. S : tang. $\frac{1}{2}$ H, whence the rule for finding the half altitude of the nonagesimal is easily deduced. It may be observed that this rule gives the distance from the north pole of the ecliptic to the zenith, which may sometimes be obtuse and equal to the supplement of the actual altitude.

Cor. From the above demonstration it is evident, that the difference of the arches F, G (or its supplement to 360°) is equal to the angle PZp. This angle is useful in finding the correction of the altitude and longitude of the nonagesimal, from an error in the latitude of the place. Thus if the latitude were increased by the quantity Za (in the case of Fig. 3) and the perpendicular ab were let fall on the arch pZ, the altitude of the nonagesimal would be decreased by $Zb = Za \times \cos. PZp$, and as $ab = Za \times \text{sine } PZp$, the longitude of the nonagesimal would be decreased by the angle $Zpa = Za \times \dfrac{\text{Sine } PZp}{\text{Sine } Zp}$.

Thus in the preceding example the difference of the arches G, F is $31° \, 38' \, 33'' = PZp$, its cosine is ·851, its sine ·525. Hence if the increment of latitude Za be $100''$, the decrement of the altitude of the nonagesimal Zb will be $85''·1$, and the arch $ab = 52''·5$, which divided by the sine of the altitude pZ ·7511 will give the decrement of the longitude of the nonagesimal $69''·9$.

XL.

ASTRONOMICAL OBSERVATIONS MADE NEAR THE CENTRE OF THE VILLAGE OF DEERFIELD, MASSACHUSETTS.

BY EPAPHRAS HOYT.

Communicated in a letter to Professor Farrar.

1. *On the eclipse of the Sun of Sept.* 17, 1811.

THE telescope used in observing this eclipse was a 2½ feet achromatic, magnifying about 75 times, with a pearl micrometer, made by W. Jones, London. The times were noted by a very good metal clock, with a second hand, regulated on the 17th, 18th, and 19th of September by equal altitudes of the sun's lower limb, observed with a best ten inch metal sextant, divided by a nonius to 30″; the equation of equal altitudes being applied. The results of these observations are

1811 Sept. 17, time of apparent noon per clock, by the mean of 4 altitudes	11*h*. 57′ 27″·05‴
18, - - - 3 - - -	37 ·20
19, - - - 5 - - -	11 ·50
Beginning of the eclipse per clock - -	0*h*. 43′ 4″
End do - - - -	3 47 59

The greatest difference of the observations on the 17th from the mean was 6″; on the 18th 18″; on the 19th 9″. Those observations made on the 18th were not so good as on the other days. The morning was so foggy, that the observations could not be made, till the sun was rather too near the meridian; and the day being windy, molasses was used for an artificial horizon, which gave but an ill defined image of the sun's limb. The daily rate of the clock will therefore probably be obtained most accurately by the observations of the 17th and

19th; but the eclipse happened so near to noon on the 17th, that the difference is but very small in using the rate indicated by the observations of the 17th and 18th. The beginning comes out nearly the same by both ways of computation, and the end hardly differs 2″. The mean of the results are

Beginning of the eclipse	0*h*. 45′ 37″	apparent time.
End	3 50 33	do.

The unobscured part of the sun at the middle of the eclipse was 10 divisions of a micrometer, the whole diameter being 90; hence the eclipsed part of the sun was 10⅔ digits.

2. *Results of observations for the variation of the needle.*

The azimuths of Sirius were observed with an accurate compass of the Rittenhouse construction; the other azimuths and altitudes were taken with a theodolite, furnished with an excellent telescope, spirit-level, and vertical arch, made by W. Jones, London.

Time of obs.	Obs. azimuths.	True alt.	Object.	Variation.
1811 Sept. 16	S 46° 45′ E	37° 15′	Sun	5° 33′
Oct. 18	N 6 20 W	11 10	Alioth	26
Nov. 15	N 153 51 E	22 51	Sun	33
- - -	N 154 28 E	23 08	Sun	24
1812 Feb. 1	N 130 45 E	11 25	Sirius	27
———	N 131 30 E	12 05	——	20
———	N 132 30 E	12 38	——	36
———	N 133 00 E	13 05	——	32
———	N 133 35 E	13 36	——	23
			Mean variation	5 28 W

3. *Results of observations for the latitude of Deerfield.*

These observations were made with the sextant. The index errors were determined by measuring the sun's diameter.

By meridian altitude of α Aquilæ	1811, Sept. 21	42° 32′ 32″ N
———	Sept. 23	33 02
Sun	Oct. 5	32 25
Sirius	Oct. 12	33 00
Sun	Oct. 21	31 58
Moon	Oct. 28	33 31
Sun	Nov. 2	31 59
———	Nov. 4	31 53
———	Nov. 23	32 31
———	Dec. 17	32 30
	Mean latitude	42 32 32 N

4. *Longitude of Deerfield from Greenwich.*

Longitude deduced from the distance of the Moon and Aldebaran, observed with the sextant Oct. 29, 1811. 4*h.* 49′ 45″ = 72° 26′ 15″.

Longitude from an observation of a lunar eclipse Jan. 15, 1805. 4*h.* 49′ 33″ = 72° 23′ 15″.

Longitude deduced from the beginning of the solar eclipse of Sept. 17, 1811, 4*h.* 49′ 26″ = 72° 21′ 30″; by the end of the same eclipse 4*h.* 50′ 46″ = 72° 41′ 30″; the calculation being made on the supposition that the solar and lunar tables are perfectly correct.*

....

[* Comparing the observations of this eclipse with those at Salem, making the calculations as in Mr. Bowditch's memoir on that subject, the longitude by the beginning is 4*h.* 49′ 55″, by the end 4*h.* 50′ 38″ W from Greenwich.]

XLI.

OBSERVATIONS OF THE COMET OF 1811.

BY JOHN FARRAR,

Hollis Professor of Mathematics and Natural Philosophy in Harvard College.

THE first time I saw this comet was on the 4th of September, but I was prevented by clouds from taking any observations, till the 6th, when I began to observe it. I continued my observations, when the weather would permit, from this time to the 13th of January, when it became too faint to be distinctly seen. This comet was visible in the early part of the year 1811, and was actually seen and recognised as a comet, not only by several observers in Europe, but as I have learnt since I completed my observations, by Mr. William Bond jun. an ingenious mechanic of Dorchester, Massachusetts, who has obligingly favored me with the following notices. "I remarked, says he, "on the 21st of April a faint whitish light near the constellation Ca-"nis Major, projecting a tail of about one degree in length, and set "down its place as follows. Right ascension 106°, declination 9° S. "April 24th 9 o'clock P. M. right ascension 108°, declination 7° or "8° S. Its motion and the situation of the tail convinced me, that it "was a comet. I noticed it several times in May, and supposed that "its motion was toward the western part of the constellation Leo."

The tail of the comet was separated into two branches by a dark indefinite line along the middle, the lower branch being somewhat the longest. Its apparent length varied from two to fourteen degrees. It appeared longest about the middle of October, and very much resembled the light of an aurora borealis. The nucleus was apparently round but ill defined. It had very much the colour and nearly the apparent magnitude of Saturn. The diameter of the head, including the coma, was found by a micrometer Nov. 6, to be nearly three minutes. Around the head for the space of four or five times its diameter there was a kind of dark ground, and then a luminous appearance, somewhat resembling a halo, and very apparent through an achromatic telescope, andeven distinguishable by the naked eye. This partial ring of light appeared to be of a parabolic form, and after describing a curve of nearly 180°, the two parts diverged, and passed on in nearly a rectilineal course, making the two branches of the tail. In figure it very much resembled a current of water, flowing round a stick, or other obstacle placed in it. See Plate II. Fig. 4.

From Sept. 6th. to Jan. 8, this comet described an arch of 132°, as seen from the earth. The apparent motion at first was about one degree per day; its velocity increased, till it amounted to a little more than $1\frac{3}{4}$° per day, and then began to decrease till it disappeared; when its daily motion, as refered to the earth, was only about 20′. It came within the circle of perpetual apparition, about the 20th of Sept. and continued within it about 20 days. It reached its greatest apparent northern declination 50° near the 2d of October, and its greatest northern latitude, $63\frac{1}{2}$°, about the 17th of the same month. When it was first seen, 6th of Sept. its longitude was about 18° less than that of the Sun. After continuing for some time at about the same distance it gained upon the sun, and on the 11th of Sept. came up with it, and passing it arrived at its greatest elongation 53° about the 10th of November. From this time it began to fall back with respect to the sun, and continued to approach it with an accelerated motion, till it was at length lost in the twilight. I began my observations, by taking the distances of the comet from Arcturus and Lyra, or Vega, and continued to make use of these stars, till Arcturus got so near the horizon, as to be subject to a very great refraction. I then employed the Pole Star instead of it, and afterwards Atair, the motion of the comet being directed nearly toward this star. I took the distances also of several other stars, as a check, some of which I have here given. There is some uncertainty in the first observations, on account of the irregularity of the refraction, the comet being very near the horizon, as also with regard to the last on account of its faintness.

The following distances are the means of from four to ten observations. They were taken with a good sextant, divided to half minutes, the times being carefully noted by means of a watch provided with a second hand. The watch was compared before and after the observations of each evening with a well regulated clock, and seldom found to vary more than 1″ or 2″ during the interval employed in observing.

	Arcturus.		*Lyra.*	
	App. times.	App. dist.	App. times.	App dist.
	d. h. ′ ″	° ′ ″	h. ′ ″	° ′ ″
Sept.	6 7 52 14	47 43 20	8 03 14	82 11 00
	7 8 35 30	46 48 00	8 20 30	81 15 00
	8 8 38 26	46 28 00	8 24 16	80 23 00
	9 7 59 20	45 38 20	7 54 40	79 32 18
	10 8 19 38	44 53 16	7 47 31	78 30 46
	13 8 32 25	42 45 22	8 26 58	75 36 37
	14 8 38 18	42 00 15	8 28 20	74 33 50
	16 7 57 19	40 28 30	7 46 49	72 29 00
	17 8 28 00	39 50 00	8 9 12	71 23 20
	18 7 39 23	38 58 00	7 27 02	70 18 50
	20 8 03 00	36 43 00	8 00 00	66 44 51
	24 7 42 33	34 33 30	7 40 55	62 56 16
	26 7 26 41	33 08 15	7 32 16	60 17 10

	Arcturus.		*Lyra.*	
	App. times.	App. dist.	App. times.	App. dist.
	30 7 12 00	30 49 30	7 19 20	54 38 30
Oct.	1 7 32 44	30 18 50	7 40 02	53 10 15
	2 7 33 12	29 54 45	7 49 40	51 37 45
	3 9 06 15	29 10 30	9 10 15	60 04 50
	11 6 27 30	29 54 15	6 33 30	37 16 45
	17 6 36 20	34 04 30	6 41 50	27 27 05
	Pole Star.		*Lyra.*	
	d. h. ′ ″	° ′ ″	h. ′ ″	° ′ ″
Oct.	9 9 49 39	43 08 15	9 20 39	40 26 15
	13 8 08 20	44 41 45	7 04 20	33 56 45
	14 9 07 25	45 28 15	9 02 25	32 10 15
	19 8 06 30	49 00 00	7 59 25	24 13 15
	21 8 58 10	50 34 15	8 55 00	21 07 15
	23 7 23 30	52 20 30	7 17 30	18 27 45
	27 7 25 00	55 50 30	7 16 00	13 52 15
	28 6 30 20	56 43 15	6 24 20	13 06 00
	29 7 03 50	57 40 15	7 01 20	12 24 45
Nov.	1 7 22 40	60 25 00	7 14 55	11 29 30
	2 7 15 05	61 17 45	7 07 05	11 32 37
	3 8 44 12	62 26 00	8 37 12	11 48 05
	4 7 23 00	63 06 45	7 18 30	12 12 45
	10 7 58 20	68 01 00	7 50 30	16 30 05
	11 8 08 30	68 38 15	8 02 50	17 21 55
	Atair.			
	d. h. ′ ″	° ′ ″	h. ′ ″	° ′ ″
Nov.	14 7 39 00	16 14 15	7 27 45	19 55 45
	15 7 56 51	15 10 35	7 45 51	20 50 35
	17 7 55 00	13 06 20	8 01 30	22 33 13
	18 8 18 15	12 03 30	8 09 45	23 29 00

	Atair.		*Lyra.*	
	App. times.	App. dist.	App. times.	App. dist.
	24 7 14 00	6 30 25	7 16 00	28 15 25
	25 7 44 00	5 38 05	7 33 00	29 00 05
	26 7 14 00	4 49 15	7 21 00	29 43 45
Dec.	1 7 49 00	0 55 59	8 00 00	32 04 00
	2 7 00 00	0 26 47	7 10 00	33 48 30
	4 7 06 00	1 20 00	7 14 00	35 04 50
	10 7 05 00	5 10 50	7 10 00	38 32 30
Jan.	5 6 32 00	17 57 57	6 58 00	49 41 26
	7 6 26 00	18 43 03	6 36 00	50 21 20
	8 6 01 00	19 10 10	6 18 00	50 41 10

	Benetnasch.		*Alioth.*	
	d. h. ′	° ′ ″	h. ′ ″	° ′ ″
Sept.	30 8 05	3 44 10	8 08 00	9 03 40
Oct.	1 7 45	2 13 40	7 47 00	9 48 10
	3 8 52	1 27 30	8 54 00	11 54 30
	9 9 07 39″	11 18 15	9 13 09	20 20 15
	11 6 38 30	14 40 15	6 42 30	23 21 45
	17 6 45 50	19 24 30	6 48 50	33 34 15

XLII.

ELEMENTS OF THE ORBIT OF THE COMET OF 1811.

BY NATHANIEL BOWDITCH.

THIS memoir contains the geocentric longitudes and latitudes of the comet of 1811, with an abstract of the calculations of the elements of its orbit, from a combination of all the observations, made at Cambridge, Nantucket, and Salem, in such manner as was supposed would produce the most accurate result.

The comet was seen in France before its conjunction with the sun, as early as the 25th of March, and continued visible till the end of May. It was observed about the same time at the Cape of Good Hope, and at other places south of the equator. It was also visible at Chilicothe in the month of May. No correct observations were however made in this part of the country till after the conjunction, about the 6th of September, when it was seen for the first time in most parts of New England. It was then near the feet of the Great Bear. Its apparent motion was direct, passing in succession through the northern parts of the constellations Bootes and Hercules, the middle of the Eagle and the south of the Dolphin. It disappeared near the northern part of the Water-Bearer about the 16th of January 1812. The apparent velocity when first observed in September was about a degree per day: it increased gradually till the middle of October, and was then $1\frac{3}{4}^{\circ}$; after which it continually decreased, and was about half a degree per day, at the time it ceased to be visible. The whole apparent path described by the comet was nearly a great circle about 140° in length. The comet was at its greatest north declination, $49\frac{1}{2}^{\circ}$, about the 2d of October, and at its greatest north latitude the 16th of the same month.

The geocentric longitudes and latitudes were deduced from distances of the comet from several fixed stars, observed by a sextant of reflection, Lyra, Arcturus, and Dubhe were first used; then the Polar Star, Benetnash, Etanin, Deneb, Atair, and Markab; making choice of those stars best adapted to the purpose from their situation and brightness. The observations were made by Professor Farrar at Cambridge, Hon. Walter Folger jun. at Nantucket and Boston, and Mr. John Carlton assisted me in the observations at Salem. In general the same stars were used by all the observers, without any previous concert, and the observations agreed as well as was to be expected. When any difference was found, the mean of the results was used. For greater accuracy the mean of several distances from the same star was frequently taken. To render these observations simultaneous, a small correction, depending on the daily variation of the distances of the comet from the stars, was found and applied to the observed distances. The correction for refraction was estimated by adding to the observed distance twenty times the correction in the column Var. of Shepherd's Tables, corresponding to the observed distance and the altitudes. The whole calculation being made in the same manner as in my memoir on the comet of 1807.

The calculation of the first approximate values of the elements of the orbit, was made by the elegant method of La Place, using the observations of September 6, 9, 12, 15, 18, and 23, which gave for the Perihelion Distance 1·043, the mean distance of the earth from the sun being unity, and the time of passing the Perihelion September 7*d*·375 mean time at Nantucket. These were corrected by the observations of September 6, 15, and 23, in the manner taught by La Place, in page 229, vol. 1, of his Mécanique Céleste, and the result was as follows. Perihelion Distance 1·052: Time of passing the Perihelion, Sept. 6*d.* 18*h.* mean time at Greenwich: Place of the Perihelion counted on the orbit 81°: Longitude of the ascending node 138°: Inclination of the orbit to the ecliptic 74°: Motion retrogade. To satisfy the public curiosity, I published these elements, in the Salem Gazette of October 11, 1811, with the apparent path of the comet, and its distances from the sun and earth, from February 1811 to February 1812, observing that the comet was one that had been before unknown to Astronomers, and that the elements might require a correction of two or three degrees, to be determined when a greater number of observations on a longer arch of the orbit should be obtained.

To find these corrections I combined the observations of September 6 and 30, and October 21, which made the Perihelion Distance 1·032: Time of passing the Perihelion, September 12*d.* 3*h.* mean time at Greenwich: Place of the Perihelion, counted on the orbit of the comet 75° 14′: Longitude of the ascending node 140° 24′ and inclination of the orbit 73°; which were published in the Salem Gazette of November 1, 1811. The process was repeated with the observations of September 6, October 21, and December 16, which gave these corrected values. Perihelion distance 1·032=D: Time of passing the Perihelion Sept. 11*d*·77 mean time at Nantucket=T: Place of the Perihelion counted on the orbit of the comet 75° 24′=P: Place of the ascending node 140° 21′=N: Inclination of the orbit to the ecliptic 73° 8′=I.

With these values, D, T, P, N, I, the geocentric longitudes and latitudes were calculated for all the observations from September 6 to December 20, and then the operation was successively repeated, with a small variation of each of these elements. Those used at the second operation were, D+·004, T, P, N, I; at the third D, T+·05, P, N, I; at the fourth D, T, P+10′, N, I; at the fifth D, T, P, N—

10′, I; and at the sixth D, T, P, N, I+10′. Supposing the longitudes and latitudes calculated in these different hypotheses to be denoted respectively by L′, L″, L‴, L^{iv}, L^{v}, L^{vi}, the corresponding observed longitude or latitude by L; the error of the observation by $x^{(r)}$; and the correct values of the elements of the orbit by $D + {\cdot}004\, d$; $T + {\cdot}05\, t$; $P + 10'p$; $N - 10'n$; $I + 10'i$; each of these observed longitudes or latitudes would furnish an equation of condition of this form $x^{(r)} = (L - L') + (L' - L'')\,d + (L' - L''')\,t + (L' - L^{iv})\,p + (L' - L^{v})\,n + (L' - L^{vi})\,i$; as was more fully explained in my paper on the comet of 1807.

As there were fifty seven observations, they produced one hundred and fourteen equations of condition, which are arranged in the following Table, (A) according to the order of the dates. The errors of longitude being denoted by $x(^1)$, $x(^2)$, &c. $x(^{57})$, those of latitude by $x(^{58})$, $x(^{59})$ &c. to $x(^{114})$. The coefficients are expressed in tenths of a second; the calculations being made to that degree of accuracy, by Taylor's logarithms, except in the four first observations, which were found to the nearest second.

$$x(^1) = -1730 + 1700{\cdot}d - 90{\cdot}t - 310{\cdot}p + 1820{\cdot}n - 3370{\cdot}i$$
$$x(^2) = -2240 + 1800{\cdot}d - 50{\cdot}t - 180{\cdot}p + 1830{\cdot}n - 3580{\cdot}i$$
$$x(^3) = -2700 + 1840{\cdot}d - 13{\cdot}t - 120{\cdot}p + 1820{\cdot}n - 3690{\cdot}i$$
$$x(^4) = -1810 + 1906{\cdot}d - 4{\cdot}t - 37{\cdot}p + 1830{\cdot}n - 3797{\cdot}i$$
$$x(^5) = -3764 + 2045{\cdot}d + 51{\cdot}t + 136{\cdot}p + 1846{\cdot}n - 4031{\cdot}i$$
$$x(^6) = -3270 + 2125{\cdot}d + 83{\cdot}t + 232{\cdot}p + 1857{\cdot}n - 4153{\cdot}i$$
$$x(^7) = -1235 + 2211{\cdot}d + 115{\cdot}t + 335{\cdot}p + 1870{\cdot}n - 4278{\cdot}i$$
$$x(^8) = -3041 + 2308{\cdot}d + 152{\cdot}t + 450{\cdot}p + 1889{\cdot}n - 4405{\cdot}i$$
$$x(^9) = -4063 + 2410{\cdot}d + 191{\cdot}t + 569{\cdot}p + 1909{\cdot}n - 4535{\cdot}i$$
$$x(^{10}) = -3756 + 2523{\cdot}d + 232{\cdot}t + 699{\cdot}p + 1932{\cdot}n - 4668{\cdot}i$$
$$x(^{11}) = -2994 + 2654{\cdot}d + 280{\cdot}t + 846{\cdot}p + 1961{\cdot}n - 4810{\cdot}i$$
$$x(^{12}) = -3491 + 3490{\cdot}d + 581{\cdot}t + 1773{\cdot}p + 2193{\cdot}n - 5507{\cdot}i$$

$$x^{(13)}=-2725+3697\cdot d+653\cdot t+1998\cdot p+2257\cdot n-5679\cdot i$$
$$x^{(14)}=-2854+4204\cdot d+829\cdot t+2544\cdot p+2428\cdot n-5980\cdot i$$
$$x^{(15)}=-4293+4478\cdot d+927\cdot t+2840\cdot p+2507\cdot n-6118\cdot i$$
$$x^{(16)}=988+4780\cdot d+1032\cdot t+3163\cdot p+2640\cdot n-6254\cdot i$$
$$x^{(17)}=-3067+5111\cdot d+1146\cdot t+3521\cdot p+2768\cdot n-6388\cdot i$$
$$x^{(18)}=-4036+5487\cdot d+1282\cdot t+3927\cdot p+2924\cdot n-6507\cdot i$$
$$x^{(19)}=-2359+5863\cdot d+1408\cdot t+4320\cdot p+3074\cdot n-6606\cdot i$$
$$x^{(20)}=-1931+6286\cdot d+1562\cdot t+4799\cdot p+3278\cdot n-6692\cdot i$$
$$x^{(21)}=-5343+6714\cdot d+1717\cdot t+5264\cdot p+3481\cdot n-6746\cdot i$$
$$x^{(22)}=-1731+7205\cdot d+1892\cdot t+5803\cdot p+3722\cdot n-6775\cdot i$$
$$x^{(23)}=-4967+7717\cdot d+2076\cdot t+6369\cdot p+3988\cdot n-6764\cdot i$$
$$x^{(24)}=-4793+8204\cdot d+2257\cdot t+6920\cdot p+4259\cdot n-6707\cdot i$$
$$x^{(25)}=-3146+9277\cdot d+2658\cdot t+8141\cdot p+4904\cdot n-6424\cdot i$$
$$x^{(26)}=-1473+10285\cdot d+3055\cdot t+9329\cdot p+5602\cdot n-5892\cdot i$$
$$x^{(27)}=-2515+10826\cdot d+3277\cdot t+9984\cdot p+6027\cdot n-5449\cdot i$$
$$x^{(28)}=-3919+11575\cdot d+3598\cdot t+10962\cdot p+6747\cdot n-4484\cdot i$$
$$x^{(29)}=-3839+12102\cdot d+3990\cdot t+12028\cdot p+8013\cdot n-1692\cdot i$$
$$x^{(30)}=-1005+11950\cdot d+3996\cdot t+12013\cdot p+8233\cdot n-872\cdot i \qquad \text{(A)}$$
$$x^{(31)}=-2212+11700\cdot d+3959\cdot t+11879\cdot p+8380\cdot n-112\cdot i$$
$$x^{(32)}=-198+10924\cdot d+3810\cdot t+11317\cdot p+8514\cdot n+1302\cdot i$$
$$x^{(33)}=-4244+9887\cdot d+3546\cdot t+10444\cdot p+8395\cdot n+2501\cdot i$$
$$x^{(34)}=-293+7588\cdot d+2897\cdot t+8323\cdot p+7902\cdot n+4101\cdot i$$
$$x^{(35)}=-648+7062\cdot d+2733\cdot t+7818\cdot p+7733\cdot n+4331\cdot i$$
$$x^{(36)}=175+6523\cdot d+2570\cdot t+7296\cdot p+7547\cdot n+4530\cdot i$$
$$x^{(37)}=1248+6011\cdot d+2421\cdot t+6792\cdot p+7356\cdot n+4637\cdot i$$
$$x^{(38)}=625+5075\cdot d+2126\cdot t+5856\cdot p+6977\cdot n+4876\cdot i$$
$$x^{(39)}=1108+4646\cdot d+1990\cdot t+5426\cdot p+6793\cdot n+4926\cdot i$$
$$x^{(40)}=1335+4247\cdot d+1861\cdot t+5021\cdot p+6612\cdot n+4953\cdot i$$
$$x^{(41)}=-4713+3877\cdot d+1743\cdot t+4643\cdot p+6438\cdot n+4956\cdot i$$
$$x^{(42)}=2298+2159\cdot d+1185\cdot t+2850\cdot p+5545\cdot n+4720\cdot i$$
$$x^{(43)}=438+1939\cdot d+1112\cdot t+2619\cdot p+5420\cdot n+4648\cdot i$$
$$x^{(44)}=2993+1733\cdot d+1041\cdot t+2403\cdot p+5302\cdot n+4584\cdot i$$
$$x^{(45)}=-988+915\cdot d+767\cdot t+1524\cdot p+4798\cdot n+4217\cdot i$$

$$x^{(46)} = 5243 + 783 \cdot d + 723 \cdot t + 1380 \cdot p + 4711 \cdot n + 4144 \cdot i$$
$$x^{(47)} = 4343 + 660 \cdot d + 680 \cdot t + 1246 \cdot p + 4629 \cdot n + 4070 \cdot i$$
$$x^{(48)} = 4608 + 340 \cdot d + 572 \cdot t + 894 \cdot p + 4412 \cdot n + 3855 \cdot i$$
$$x^{(49)} = -518 + 155 \cdot d + 508 \cdot t + 691 \cdot p + 4281 \cdot n + 3714 \cdot i$$
$$x^{(50)} = 1724 - 494 \cdot d + 286 \cdot t - 34 \cdot p + 3792 \cdot n + 3099 \cdot i$$
$$x^{(51)} = 3308 - 585 \cdot d + 253 \cdot t - 140 \cdot p + 3717 \cdot n + 2989 \cdot i$$
$$x^{(52)} = 2995 - 706 \cdot d + 213 \cdot t - 278 \cdot p + 3618 \cdot n + 2838 \cdot i$$
$$x^{(53)} = 2281 - 743 \cdot d + 199 \cdot t - 327 \cdot p + 3588 \cdot n + 2789 \cdot i$$
$$x^{(54)} = 727 - 777 \cdot d + 188 \cdot t - 360 \cdot p + 3559 \cdot n + 2742 \cdot i$$
$$x^{(55)} = 5324 - 811 \cdot d + 175 \cdot t - 399 \cdot p + 3530 \cdot n + 2695 \cdot i$$
$$x^{(56)} = 5607 - 928 \cdot d + 133 \cdot t - 537 \cdot p + 3428 \cdot n + 2526 \cdot i$$
$$x^{(57)} = 4300 - 1027 \cdot d + 101 \cdot t - 632 \cdot p + 3343 \cdot n + 2361 \cdot i$$
$$x^{(58)} = 160 - 2970 \cdot d + 1200 \cdot t + 3150 \cdot p + 2630 \cdot n - 640 \cdot i$$
$$x^{(59)} = 2960 - 2850 \cdot d + 1240 \cdot t + 3180 \cdot p + 2590 \cdot n - 610 \cdot i$$
$$x^{(60)} = 2340 - 2770 \cdot d + 1230 \cdot t + 3210 \cdot p + 2590 \cdot n - 600 \cdot i$$
$$x^{(61)} = 4436 - 2707 \cdot d + 1270 \cdot t + 3222 \cdot p + 2574 \cdot n - 581 \cdot i$$
$$x^{(62)} = 3655 - 2572 \cdot d + 1307 \cdot t + 3263 \cdot p + 2549 \cdot n - 533 \cdot i$$
$$x^{(63)} = 4316 - 2499 \cdot d + 1324 \cdot t + 3283 \cdot p + 2538 \cdot n - 503 \cdot i$$
$$x^{(64)} = 4768 - 2428 \cdot d + 1340 \cdot t + 3304 \cdot p + 2527 \cdot n - 470 \cdot i$$
$$x^{(65)} = 3550 - 2356 \cdot d + 1360 \cdot t + 3324 \cdot p + 2516 \cdot n - 431 \cdot i$$
$$x^{(66)} = 2213 - 2280 \cdot d + 1376 \cdot t + 3347 \cdot p + 2507 \cdot n - 387 \cdot i$$
$$x^{(67)} = 4020 - 2204 \cdot d + 1390 \cdot t + 3366 \cdot p + 2496 \cdot n - 339 \cdot i$$
$$x^{(68)} = 4367 - 2124 \cdot d + 1409 \cdot t + 3389 \cdot p + 2489 \cdot n - 282 \cdot i$$
$$x^{(69)} = 2908 - 1736 \cdot d + 1477 \cdot t + 3466 \cdot p + 2445 \cdot n + 52 \cdot i$$
$$x^{(70)} = 1990 - 1662 \cdot d + 1489 \cdot t + 3473 \cdot p + 2440 \cdot n + 185 \cdot i$$
$$x^{(71)} = 2603 - 1523 \cdot d + 1504 \cdot t + 3476 \cdot p + 2425 \cdot n + 412 \cdot i$$
$$x^{(72)} = 569 - 1460 \cdot d + 1507 \cdot t + 3467 \cdot p + 2417 \cdot n + 534 \cdot i$$
$$x^{(73)} = -297 - 1403 \cdot d + 1510 \cdot t + 3449 \cdot p + 2406 \cdot n + 667 \cdot i$$
$$x^{(74)} = 1651 - 1354 \cdot d + 1510 \cdot t + 3425 \cdot p + 2398 \cdot n + 818 \cdot i$$
$$x^{(75)} = 1032 - 1314 \cdot d + 1501 \cdot t + 3386 \cdot p + 2384 \cdot n + 978 \cdot i$$
$$x^{(76)} = 1452 - 1283 \cdot d + 1492 \cdot t + 3338 \cdot p + 2368 \cdot n + 1138 \cdot i$$
$$x^{(77)} = 660 - 1277 \cdot d + 1475 \cdot t + 3274 \cdot p + 2350 \cdot n + 1324 \cdot i$$
$$x^{(78)} = 2723 - 1280 \cdot d + 1455 \cdot t + 3193 \cdot p + 2323 \cdot n + 1501 \cdot i$$

$$x^{(79)} = 4652 - 1302 \cdot d + 1423 \cdot t + 3091 \cdot p + 2293 \cdot n + 1704 \cdot i$$
$$x^{(80)} = 4201 - 1345 \cdot d + 1395 \cdot t + 2967 \cdot p + 2257 \cdot n + 1918 \cdot i$$
$$x^{(81)} = 1920 - 1418 \cdot d + 1347 \cdot t + 2827 \cdot p + 2212 \cdot n + 2111 \cdot i$$
$$x^{(82)} = 895 - 1639 \cdot d + 1236 \cdot t + 2461 \cdot p + 2091 \cdot n + 2543 \cdot i$$
$$x^{(83)} = 386 - 1990 \cdot d + 1075 \cdot t + 1990 \cdot p + 1913 \cdot n + 2923 \cdot i$$
$$x^{(84)} = 1814 - 2215 \cdot d + 1006 \cdot t + 1679 \cdot p + 1805 \cdot n + 3176 \cdot i$$
$$x^{(85)} = 2466 - 2723 \cdot d + 800 \cdot t + 1059 \cdot p + 1549 \cdot n + 3496 \cdot i$$
$$x^{(86)} = 1525 - 4088 \cdot d + 332 \cdot t - 490 \cdot p + 834 \cdot n + 3911 \cdot i$$
$$x^{(87)} = 2977 - 4483 \cdot d + 200 \cdot t - 925 \cdot p + 613 \cdot n + 3942 \cdot i$$
$$x^{(88)} = 1641 - 4858 \cdot d + 78 \cdot t - 1333 \cdot p + 393 \cdot n + 3935 \cdot i$$
$$x^{(89)} = 2240 - 5577 \cdot d - 150 \cdot t - 2109 \cdot p - 50 \cdot n + 3834 \cdot i$$
$$x^{(90)} = 2522 - 6240 \cdot d - 353 \cdot t - 2814 \cdot p - 523 \cdot n + 3630 \cdot i$$
$$x^{(91)} = 4877 - 7280 \cdot d - 653 \cdot t - 3918 \cdot p - 1299 \cdot n + 3041 \cdot i$$
$$x^{(92)} = 2649 - 7467 \cdot d - 703 \cdot t - 4118 \cdot p - 1468 \cdot n + 2885 \cdot i$$
$$x^{(93)} = -3087 - 7644 \cdot d - 747 \cdot t - 4307 \cdot p - 1637 \cdot n + 2716 \cdot i$$
$$x^{(94)} = 2714 - 7799 \cdot d - 789 \cdot t - 4473 \cdot p - 1797 \cdot n + 2527 \cdot i$$
$$x^{(95)} = 1948 - 8045 \cdot d - 848 \cdot t - 4747 \cdot p - 2090 \cdot n + 2215 \cdot i$$
$$x^{(96)} = -3366 - 8138 \cdot d - 868 \cdot t - 4856 \cdot p - 2222 \cdot n + 2055 . i$$
$$x^{(97)} = 470 - 8212 \cdot d - 881 \cdot t - 4946 \cdot p - 2343 \cdot n + 1902 \cdot i$$
$$x^{(98)} = 2655 - 8272 \cdot d - 895 \cdot t - 5025 \cdot p - 2458 \cdot n + 1750 \cdot i$$
$$x^{(99)} = - 462 - 8371 \cdot d - 895 \cdot t - 5257 \cdot p - 2996 \cdot n + 990 \cdot i$$
$$x^{(100)} = 210 - 8355 \cdot d - 889 \cdot t - 5268 \cdot p - 3066 \cdot n + 883 \cdot i$$
$$x^{(101)} = 207 - 8329 \cdot d - 879 \cdot t - 5273 \cdot p - 3129 \cdot n + 786 \cdot i$$
$$x^{(102)} = -2304 - 8127 \cdot d - 822 \cdot t - 5232 \cdot p - 3383 \cdot n + 380 \cdot i$$
$$x^{(103)} = -1277 - 8076 \cdot d - 810 \cdot t - 5216 \cdot p - 3424 \cdot n + 313 \cdot i$$
$$x^{(104)} = -1430 - 8023 \cdot d - 797 \cdot t - 5197 \cdot p - 3462 \cdot n + 251 \cdot i$$
$$x^{(105)} = 2132 - 7849 \cdot d - 757 \cdot t - 5129 \cdot p - 3556 \cdot n + 90 \cdot i$$
$$x^{(106)} = 1759 - 7727 \cdot d - 731 \cdot t - 5079 \cdot p - 3609 \cdot n - 1 \cdot i$$
$$x^{(107)} = - 927 - 7104 \cdot d - 606 \cdot t - 4813 \cdot p - 3777 \cdot n - 289 \cdot i$$
$$x^{(108)} = -2090 - 6984 \cdot d - 583 \cdot t - 4763 \cdot p - 3778 \cdot n - 325 \cdot i$$
$$x^{(109)} = -4190 - 6810 \cdot d - 553 \cdot t - 4688 \cdot p - 3823 \cdot n - 365 \cdot i$$
$$x^{(110)} = -3362 - 6753 \cdot d - 544 \cdot t - 4668 \cdot p - 3831 \cdot n - 376 \cdot i$$
$$x^{(111)} = 704 - 6700 \cdot d - 535 \cdot t - 4642 \, p - 3838 \cdot n - 388 \cdot i$$

$$x(^{112}) = \quad 1005 - 6645 \cdot d - \ 526 \cdot t - \ 4619 \cdot p - 3844 \cdot n - \ 397 \cdot i$$
$$x(^{113}) = - \ 708 - 6438 \cdot d - \ 492 \cdot t - \ 4535 \cdot p - 3867 \cdot n - \ 424 \cdot i$$
$$x(^{114}) = - \ 502 - 6247 \cdot d - \ 461 \cdot t - \ 4458 \cdot p - 3884 \cdot n - \ 444 i.$$

To deduce from these equations the values of the unknown quantities d, t, p, n, i, I divided them into four nearly equal portions, and supposed that in each the sum of the errors of longitude or latitude was equal to 0; due regard being had to the signs. This hypothesis gave $x(^1) + x(^2) \ldots + x(^{29}) = 0$, $x(^{30}) + x(^{31}) \ldots + x(^{57}) = 0$, $x(^{58}) + x(^{59}) \ldots + x(^{86}) = 0$, $x(^{87}) + x(^{88}) \ldots + x(^{114}) = 0$. These substituted in the sums of the corresponding equations (A) give the system of equations (C).

$$\left.\begin{aligned}
0 &= -86097 + 150823 \cdot d + 34887 \cdot t + 106305 \cdot p + \ 91396 \cdot n - 15198 \cdot i \\
0 &= \quad 35861 + \ 92103 \cdot d + 41788 \cdot t + 107728 \cdot p + 158553 \cdot n + 96120 \cdot i \\
0 &= \quad 69935 - \ 58772 \cdot d + 37980 \cdot t + \ 86569 \cdot p + \ 66916 \cdot n + 24015 \cdot i \\
0 &= \quad 7005 - 202553 \cdot d - 17489 \cdot t - 122408 \cdot p - \ 72168 \cdot n + 35116 \cdot i
\end{aligned}\right\} (C)$$

Which by the usual rules of elimination give

$$\left.\begin{aligned}
d &= \quad 0{\cdot}2814729 + 0{\cdot}1248260 . t \\
p &= -0{\cdot}9198046 - 0{\cdot}1727901 \cdot t \\
n &= \quad 0{\cdot}5858239 - 0{\cdot}2635675 \cdot t \\
i &= -0{\cdot}5782452 + 0{\cdot}0740628 \cdot t
\end{aligned}\right\} (E)$$

These values substituted in the equations (A) give

$$\left.\begin{aligned}
x(^1) &= 2048 - 554 \cdot t \\
x(^2) &= 1574 - 542 \cdot t \\
x(^3) &= 1128 - 516 \cdot t \\
x(^4) &= 2028 - 523 \cdot t \\
&\&c. \qquad \&c.
\end{aligned}\right\} (F)$$

To render the sum of the errors $x(^1)$, $x(^2)$, $x(^3)$, &c. taken positively as little as possible, I made use of the method of La Place in Vol. II. page 135 of his Mécanique Céleste. First by changing the signs of the terms of those equations where the coefficients of t were negative; then arranging them according to the magnitudes of the quotients $\frac{2048}{-554}, \frac{1574}{-542}, \frac{1128}{-516}, \frac{2028}{-523}$, &c. found by dividing the constant term of each equation by the coefficient of t, noticing the signs. In this way the system of equations (G) was obtained.

$x(^{103})=9\cdot t-939$	$-x(^{65})=203\cdot t-1553$	$x(^{31})=1150\cdot t-4871$	$x(^{26})=814\cdot t-470$
$x(^{41})=95\cdot t-6987$	$x(^{38})=270\cdot t-2065$	$x(^{37})=402\cdot t-1679$	$x(^{114})=520\cdot t-179$
$-x(^{16})=77\cdot t-4587$	$x(^{110})=402\cdot t-2996$	$x(^{28})=1038\cdot t-4198$	$x(^{78})=242\cdot t-81$
$x(^{104})=30\cdot t-1081$	$-x(^{61})=346\cdot t-2554$	$-x(^{90})=239\cdot t-949$	$-x(^{10})=429\cdot t-142$
$-x(^{68})=119\cdot t-2273$	$x(^{40})=148\cdot t-1078$	$x(^{81})=255\cdot t-1004$	$-x(^{5})=502\cdot t-99$
$x(^{73})=154\cdot t-2840$	$x(^{35})=546\cdot t-3825$	$-x(^{4})=523\cdot t-2028$	$-x(^{9})=446\cdot t+167$
$x(^{18})=36\cdot t-628$	$x(^{39})=207\cdot t-1444$	$-x(^{50})=540\cdot t-2046$	$x(^{71})=105\cdot t+159$
$-x(^{17})=27\cdot t-448$	$x(^{70})=52\cdot t-350$	$-x(^{1})=554\cdot t-2048$	$-x(^{49})=445\cdot t+750$
$x(^{72})=128\cdot t-1924$	$-x(^{51})=554\cdot t-3721$	$-x(^{101})=125\cdot t-425$	$-x(^{99})=169\cdot t+310$
$x(^{83})=195\cdot t-2574$	$-x(^{94})=329\cdot t-2119$	$x(^{32})=1070\cdot t-3298$	$x(^{111})=414\cdot t+1064$
$-x(^{42})=150\cdot t-1962$	$x(^{23})=387\cdot t-2405$	$x(^{85})=128\cdot t-388$	$x(^{112})=426\cdot t+1361$
$-x(^{46})=352\cdot t-4558$	$-x(^{52})=570\cdot t-3531$	$-x(^{2})=542\cdot t-1574$	$x(^{22})=306\cdot t+1058$
$-x(^{91})=317\cdot t-3912$	$x(^{36})=470\, t-2898$	$x(^{30})=1177\cdot t-3364$	$-x(^{58})=456\cdot t+1663$
$-x(^{64})=235\cdot t-2798$	$-x(^{62})=289\cdot t-1731$	$-x(^{59})=393\cdot t-1103$	$-x(^{88})=110\cdot t+545$
$-x(^{56})=606\cdot t-6387$	$x(^{76})=215\cdot t-1250$	$-x(^{100})=148\cdot t-397$	$x(^{80})=262\cdot t+1306$
$x(^{21})=228\cdot t-2355$	$x(^{84})=199\cdot t-1133$	$-x(^{54})=582\cdot t-1339$	$-x(^{15})=124\cdot t+627$
$-x(^{48})=417\cdot t-4237$	$x(^{34})=627\cdot t-3555$	$x(^{25})=641\cdot t-1435$	$-x(^{43})=183\cdot t+938$
$-x(^{55})=588\cdot t-5972$	$-x(^{92})=323\cdot t-1807$	$-x(^{11})=408\cdot t-905$	$-x(^{45})=335\cdot t+1760$
$-x(^{47})=371\cdot t-3741$	$-x(^{7})=477\cdot t-2648$	$-x(^{3})=516\cdot t-1128$	$x(^{79})=248\cdot t+1800$
$x(^{109})=388\cdot t-3823$	$-x(^{42})=150\cdot t-803$	$x(^{27})=911\cdot t-1970$	$x(^{20})=158\cdot t+1214$
$-x(^{87})=69\cdot t-646$	$x(^{74})=178\cdot t-949$	$-x(^{89})=184\cdot t-364$	$x(^{19})=94\cdot t+938$
$x(^{77})=228\cdot t-2100$	$x(^{24})=466\cdot t-2475$	$-x(^{8})=462\cdot t-849$	$-x(^{93})=325\cdot t+3807$
$-x(^{63})=261\cdot t-2370$	$-x(^{14})=169\cdot t-869$	$x(^{107})=313\cdot t-545$	$-x(^{96})=307\cdot t+3680$
$-x(^{98})=282\cdot t-2497$	$-x(^{53})=576\cdot t-2862$	$-x(^{6})=489\cdot t-604$	$x(^{106})=133\cdot t+2142$
$x(^{82})=243\cdot t-2075$	$x(^{108})=345\cdot t-1712$	$-x(^{12})=276\cdot t-329$	$x(^{105})=93\cdot t+2505$
$-x(^{57})=624\cdot t-5185$	$x(^{29})=1185\cdot t-5823$	$-x(^{60})=397\cdot t-472$	$x(^{69})=21\cdot t+633$
$x(^{75})=196\cdot t-1621$	$-x(^{95})=317\cdot t-1545$	$-x(^{66})=176\cdot t-185$	$-x(^{86})=24\cdot t+948$
$x(^{33})=948\cdot t-7596$	$-x(^{13})=246\cdot t-1084$	$-x(^{97})=293\cdot t-235$	$-x(^{102})=13\cdot t+1981$
$-x(^{44})=216\cdot t-1726$		$x(^{113})=476\cdot t-369$	

(G)

The sum of the coefficients of t in all these equations is $39947=\text{F}$. The sum of the coefficients of the first 59 equations is 19387, which is less than $\frac{1}{2}$ F, and by adding the next (or 60th) coefficient the sum becomes 20425, which exceeds $\frac{1}{2}$ F, consequently, by La Place's rule, the second member of the 60th equation of the system (G) must be put $=0$, to render the sum of the errors a minimum. This gives

$1038t - 4198 = 0$, whence $t = 4{\cdot}0443$, which substituted in the system (E) gives the following values.

$$d = 0{\cdot}78631$$
$$t = 4{\cdot}0443$$
$$p = -1{\cdot}61862$$
$$n = -0{\cdot}48012$$
$$i = -0{\cdot}27871$$

These substituted in the assumed elements give the corrected values,

$\mathrm{D} + {\cdot}004{\cdot}d = 1{\cdot}0351452$

$\mathrm{T} + {\cdot}05{\cdot}t$ = September 11*d.* 972215 mean time at Nantucket.

$\mathrm{P} + 10'{\cdot}p = 75^\circ\ 07'\ 49''$

$\mathrm{N} - 10'{\cdot}n = 140\ 25\ 48$

$\mathrm{I} + 10'{\cdot}i = 70\ 05\ 13$

The differences between the geocentric longitudes and latitudes, calculated directly by these elements, and the observed values, being taken for $x(^1)$, $x(^2)$, $x(^3)$, &c. give $x(^1) + x(^2) \ldots + x(^{29}) = -45''{\cdot}6$; $x(^{30}) + x(^{31}) \ldots + x(^{57}) = -18''{\cdot}9$; $x(^{58}) + x(^{59}) \cdots + x(^{86}) = -57''{\cdot}7$; $x(^{87}) + x(^{88}) \ldots\ldots + x(^{114}) = -20''{\cdot}9$, which vary but very little from the assumed hypothesis, which required that the second members of these equations should be $= 0$, and though these differences were not worthy of notice, I thought it best to repeat part of the process for correcting them, with a view of verifying by this means the preceding calculations; using the elements last found instead of D, T, P, N, and I. It is sufficient to state the result of these observations, which were ${\cdot}004{\cdot}d = -0{\cdot}0000142$; ${\cdot}05{\cdot}t = 0{\cdot}000192$; $10'{\cdot}p = 0$; $-10'{\cdot}n = -2''$; $10{\cdot}i = -2''$, whence the

Correct elements of the orbit are as follows.

Perihelion distance 1·035131, the mean distance of the earth from the sun being unity.

Time of passing the perihelion

September	11*d.* 23*h.* 17′ 11″	mean time at Salem.
	12 04 00 48	Greenwich.
	12 04 10 09	Paris.

Long. of the perihel. counted on the orbit of the comet	75° 07′ 49″
Longitude of the ascending node	140 25 46
Inclination of the orbit to the ecliptic	73 05 11

Motion retrograde

With these elements I computed the geocentric longitudes and latitudes of the comet, at the time of each of the observations at Cambridge, Boston, Salem, and Nantucket, and have inserted them in the following table, with the corresponding observed values.

Mean times of observation at Salem.	Observed longitudes.	Calculated longitudes.	Differences.		Observed lat. North	Calculated lat. North.	Differences.	
1807 *d. h.* ′ ″	° ′ ″	° ′ ″	′ ″	′ ″	° ′ ″	° ′ ″	′ ″	′ ″
Sep. 6 7 56 52	145 45 04	145 45 22		—0 18	29 25 47	29 31 35		—5 48
8 7 54 28	146 55 30	146 56 30		—1 00	31 03 14	31 04 04		—0 50
9 7 56 52	147 32 29	147 34 11		—1 42	31 50 00	31 51 42		—1 42
10 7 38 47	148 12 41	148 12 48		—0 07	32 41 26	32 39 31	1 55	
12 7 56 52	149 33 12	149 36 24		—3 12	34 20 35	34 19 40	0 55	
13 7 56 52	150 18 19	150 20 35		—2 16	35 12 57	35 10 46	2 11	
14 7 56 52	151 07 57	151 06 43	1 14		36 05 51	36 02 46	3 05	
15 7 56 52	151 53 17	151 54 57		—1 40	36 56 52	36 55 40	1 12	
16 7 31 42	152 41 15	152 44 31		—3 16	37 47 38	37 48 31		—0 53
17 7 21 21	153 34 17	153 36 54		—2 37	38 45 03	38 42 47	2 16	
18 7 56 52	154 32 29	154 33 42		—1 13	39 42 41	39 39 42	2 59	
23 7 56 52	159 55 55	159 57 12		—1 17	44 30 26	44 29 16	1 10	
24 6 53 56	161 09 43	161 09 34	0 09		45 26 17	45 26 29		—0 12
26 7 56 52	163 58 17	163 57 57	0 20		47 31 16	47 30 17	0 58	
27 7 17 54	165 23 34	165 25 26		—1 52	48 27 15	48 29 36		—2 21
28 6 47 35	167 05 54	166 58 46	7 08		49 25 38	49 29 21		—3 43
29 7 02 15	168 41 36	168 41 02	0 34		50 30 30	50 30 55		—0 25
30 7 56 52	170 32 04	170 32 53		—0 49	51 32 27	51 33 51		—1 24
Oct. 1 7 01 36	172 25 16	172 23 06	2 10		52 30 59	52 31 39		—0 40
2 7 56 52	174 32 53	174 29 47	3 06		53 31 15	53 33 13		—1 58
3 6 46 00	176 30 46	176 33 10		—2 24	54 30 02	54 28 33	1 29	
4 7 56 5[illegible]	179 01 51	178 58 02	3 49		55 32 50	55 28 10	4 40	
5 8 40 21	181 28 18	181 29 43		—1 25	56 28 42	56 24 48	3 54	
6 7 35 04	183 57 55	183 58 54		—0 59	57 15 14	57 15 12	0 02	
8 7 56 52	189 44 16	189 42 21	1 55		58 51 31	58 53 20		—1 49
10 6 18 59	195 53 01	195 48 22	4 40		60 11 14	60 14 07		—2 53
11 9 03 41	199 37 53	199 35 05	2 48		60 52 48	60 53 25		—0 37
13 6 25 40	206 22 36	206 22 36	0		61 46 04	61 45 50	0 14	
17 6 25 40	221 42 16	221 44 02		—1 46	61 26 46	61 28 31		—1 45
		Sums.	27 53	—27 53		Sums.	27 00	—27 00

Mean time of observation at Salem.	Observed longitudes.	Calculated longitudes.	Differences.		obs. lat. North.	Calcul. lat. North.	Differences.	
1811 *d. h.* ′ ″	° ′ ″	° ′ ″	′ ″	′ ″	° ′ ″	° ′ ″	′ ″	′ ″
Oct. 18 7 56 52	225 53 58	225 51 41	2 17		62 23 52	62 23 16	0 36	
19 7 56 52	229 41 17	229 41 39		—0 22	62 10 30	62 12 09		—1 39
21 7 56 52	237 07 57	237 06 17	1 40		61 31 55	61 32 33		—0 38
23 7 56 52	243 56 48	244 03 09		—6 21	60 32 01	60 32 04		—0 03
27 7 56 52	256 02 04	256 03 48		—1 44	57 49 33	57 45 10	4 23	
28 6 25 40	258 28 24	258 31 05		—2 41	57 00 21	56 59 31	0 50	
29 6 25 40	260 58 00	260 59 38		—1 38	56 00 18	56 08 51		—9 33
30 6 25 40	263 19 31	263 19 38		—0 07	55 17 53	55 16 34	1 19	
Nov. 1 6 25 40	267 33 56	267 35 34		—1 38	53 29 06	53 28 39	0 27	
2 6 25 40	269 31 33	269 32 34		—1 01	52 25 26	52 33 38		—8 12
3 6 25 40	271 22 03	271 22 50		—0 47	51 36 40	51 38 15		—1 35
4 6 25 40	272 55 45	273 06 44		-10 59	50 45 01	50 42 45	2 16	
10 6 25 40	281 42 43	281 42 24	0 19		45 14 43	45 16 22		—1 39
11 6 25 40	282 50 57	282 53 46		—2 49	44 23 51	44 24 10		—0 19
12 6 25 40	284 03 09	284 01 43	1 26		43 32 41	43 32 50		—0 08
17 6 25 40	288 53 58	288 59 09		—5 11	39 26 42	39 30 05		—3 23
18 6 25 40	289 56 47	289 51 34	5 13		38 42 59	38 44 29		—1 30
19 6 25 40	290 45 43	290 41 58	3 45		37 58 17	37 59 53		—1 36
21 6 25 40	293 06 45	293 02 30	4 15		35 56 33	35 52 05	4 48	
24 6 25 40	294 24 08	294 28 22		—4 14	34 36 14	34 31 45	4 29	
Dec. 4 6 25 40	300 29 19	300 29 32		—0 13	28 44 52	28 43 40	1 12	
6 6 25 40	301 34 00	301 31 31	2 29		27 43 05	27 43 38		—0 33
9 6 25 40	303 01 47	302 59 44	2 03		26 15 03	26 18 49		—3 46
10 6 25 40	303 28 51	303 27 58	0 53		25 49 33	25 51 51		—2 18
11 6 25 40	303 54 01	303 55 42		—1 41	25 30 05	25 25 31	4 34	
12 6 25 40	304 28 56	304 22 55	6 01		25 04 57	24 59 48	5 09	
16 6 25 40	306 13 52	306 07 17	6 35		23 25 17	23 22 41	2 36	
20 6 25 40	307 49 48	307 45 18	4 30		21 57 13	21 54 00	3 13	
		Sums	41 26	–41 26		Sums	35 52	–35 52

It would have been in vain to have attempted to calculate the elliptical hypothesis by these observations, since the differences between the observed and calculated places are, in general, within the limits of the errors of the observations.

The tail of the comet was bifurcated, and near the middle part of the space between the two forked points the colour was as dark as the unilluminated part of the heavens, as was observed by Rev. Dr. Prince of Salem. The apparent angular length of the tail increased from its first appearance in September till near the middle of October.

On the 16th of October the apparent length, observed by Professor Farrar at Cambridge, was $14\frac{1}{2}°$: and if we suppose the direction to be opposite to the sun, the real length would exceed 50 millions of miles.

The elements of the orbit of this comet are wholly different from any of those whose orbits have already been calculated, as may be seen by comparing with the tables, published in the systems of Astronomy of La Lande or Vince. The perihelion distance of this comet is so nearly equal to that of the distance of the earth from the sun, that were it not for the great inclination of the orbit and the present situation of the perihelion, the comet might approach towards the earth so as to be thirty times as near the sun. But in the present situation of the orbit, the comet cannot possibly approach so near to the earth, as several of the known comets have done.

XLIII.

ESTIMATE OF THE HEIGHT OF THE WHITE HILLS IN NEW HAMPSHIRE.

BY NATHANIEL BOWDITCH.

THE White Hills in New Hampshire, which are the highest mountains in New England, have been estimated by Dr. Belknap in his history of New Hampshire, to be above 10,000 feet above the level of the sea; but from some barometrical observations, made in July 1804, by several gentlemen who ascended the mountains, it appears that his computation is by far too great, and that the real height does not much exceed 7000 feet. This will evidently appear by comparing the observations given in the following Table. Those on the top of Mount Washington, the highest of the White Hills, were made by Doctor Cutler and Professor Peck. Those at Mr. Messervey's in the town of Adams (not far from the foot of the mountain) were made by a person, who observed the state of the Barometer and Thermometer, at intervals of 30 minutes, the whole day the company were on the mountain. The observations at Salem were made by Doctor Holyoke, and those at Boston by the late Rev. Mr. Emerson. All these observations were made in the shade. The Barometer varied but very little on the sea coast for several days before and after the 28th of July. The range from the 25th to the 30th of July at Salem was from 30·00 to 30·11; and at Boston from 29·9 to 30·1. The smallness of these variations is in general conducive to the accuracy of the result of the calculation by barometrical observations.

Place of observation	Times	barom.	therm.
	d. h. h.		
At the summit of Mount Washington	July 28 1 to 3	23·39	54
At Messervey's in Adams	July 27 7 a. m.	28·99	62
	28 6·30	29·04	57
	7	·07	60
	7.30	·07	65
	8·0	·07	68
	8·30	·08	70
	9·0	·08	74
	9·30	·11	76
	10·0	·11	75
	10·30	·11	79
	11·0	·11	79
	11·30	·13	80
	noon.	·13	82
	0·30	·13	82
	1·0	·13	82
	1·30	·13	83
	2·0	·13	86
	2·30	·13	86
	3·0	.13	87
	3·30	·12	77
	4·0	·12	75
	4·30	·12	76
	5·0	·12	77
	5·30	·13	79
	6·0	·13	81
	6·30	·13	75
At Salem by Dr. Holyoke	7·0	·13	72
	July 27 8 a. m.	30·02	68
	2 p. m.		82
	7 p. m.		72
	10 p. m.	30·09	65
	July 28 8 a. m.	30 12	74
	2 p. m.		82
	7 p. m		73
At Boston by Rev. Mr. Emerson	10 p. m	30·11	69
	July 27 8 a. m	30·00	66
	2 p. m.	·00	78
	7 p. m.	·00	74
	10 p. m.	·00	68
	July 28 8 a. m.	·10	69
	2 p. m	·10	78
	7 p. m.	·10	76
	10 p. m.	·10	73

The mean of the 26 observations made at Adams, on the 28th of July, gives Barometer 29·11 inches, Thermometer 76·3. The mean of Dr. Holyoke's observations in the same day is, Barometer 30·115 inches, Thermometer 76·3. The observations of Mr. Emerson, who was probably situated a little higher above the level of the sea, than Dr. Holyoke, did not differ sensibly from these. Computing from these observations the elevation of Adams above Salem (by the rule given in Dr. Maskelyne's introduction to Taylor's logarithms) it becomes 980 feet. The observation of July 27, calculated in the same way, gave 965 feet. As there were 26 observations on the 28th of July, and but one on the 27th July, the mean of all will be nearly 979 feet. To this add 34 feet, the height of Dr. Holyoke's barometer above the level of the sea, the sum 1013 feet, is the elevation of Mr. Messervey's house in Adams, above the level of the sea. Dr. Belknap estimates this height to be nearly 3000 feet, which is about three times its real value.

By comparing the observations made at the top of Mount Washington, viz. Barometer 23·39 inches, and Thermometer 54 degrees; with the mean of the observations at Adams at the same time; Barometer 29·13, Thermometer 84·8; the result is 6149 feet for the difference of elevation of these two places. To this add 1013 feet, the height of Adams above the level of the sea, and we have the height of Mount Washington above the level 7162 feet. This estimate may also be made by comparing the observations at Mount Washington, with those made at Salem at the same time, viz. Barometer 30·115 inches, and Thermometer 82 degrees, which give 7021 feet, to which add 34 feet (the elevation of Dr. Holyoke's barometer) and we have 7055 feet, for the height of the mountain. The mean of this and the former estimate is 7108 feet, which may be assumed as the elevation of the summit of Mount Washington, above the level of the sea.

XLIV.

METHOD OF DISPLAYING AT ONE VIEW ALL THE ANNUAL CYCLES OF THE EQUATION OF TIME, IN A COMPLETE REVOLUTION OF THE SUN'S APOGEE.

BY JAMES DEAN, A. M. A. A. S.

Prof. Math. and Nat. Phil. in the University of Vermont.

Communicated in a letter to Nathaniel Bowditch, A. M. A. A. S.

FROM my first understanding the difference between mean and apparent time, I particularly wished to see the effect of *differently combining* the causes which produce it. But I could not think of computing a whole table for every longitude of the sun's apogee; nor even if that were done, would they exhibit the constituent parts or the transition from one table to another. The accompanying draught in some measure answers my purpose, and has given me some new views of the subject. The construction of the curves will naturally suggest the manner of their operation. After drawing and properly graduating the ecliptic, the circle of the year, and that for the revolution of the sun's apogee, a slender circle of 4 inches diameter was drawn for a standard of mean time. From this circle was set off at the distance of every 5° the reduction of the ecliptic to the equator, converted into time on a scale of 30′ to an inch, on the *outside* of the circle when it is *positive*, and on the *inside* when it is *negative*, and these points connected by a curve. The situation of any point in this curve compared with the circle evidently shows that part of the equation of time which arises from the obliquity of the earth's axis, for the day against which it is taken. On the moveable paper was drawn an equal circle for the same purpose with the other, and a line drawn through it to represent the line of apsides. From this circle, was set off at the distance of every 10° the equation of the sun's centre converted into time, on the same scale with the other, but the position of the points is reversed, the *negative* equation being on the *outside* and the *positive* on the *inside*, and the paper cut through those points. By this *inversion* the sum of the two equations when they are alike, and their difference when unlike, is easily discerned, whatever may be the position of the line of apsides. When the space expressing the equation contains the circle of mean time, the two causes conspire to produce the effect, but when this space lies wholly without or within the circle of mean time, the result is the difference of the two causes. Where these curves intersect each other, it is evident that the positive and negative causes, being equal, cancel each other, and the apparent time coincides with the mean.

Turning this paper again and again, backward and forward, and comparing with the tables, has led me to some conclusions, which bare reflection on the causes may have produced in some minds, though it never suggested them to me. I cannot say they are very valuable, but they may serve to amuse a speculating moment, and *possibly* suggest relations on other subjects, leading to important conclusions. The equation by the obliquity of the equator being the greatest, there must be always four days in each year, that is one belonging to each of the cardinal points of the ecliptic, on which the mean and apparent time coincides. These days I beg leave to call *mean days*, and they never can be more than 27 days from that in which the sun passes those points. Each moves through its 53 or 54 days forward in about 12716 years, and then returns in about 6920 years. The equinoctial mean days advance into the succeeding months when the sun on them is nearest to its apogee, and retrogade when it is nearest its perigee. On the contrary, the solstitial mean days *recede* when the sun on them is nearest its apogee, and *advance* when it is nearest its perigee. The distance of any two of these mean days must always be between 40 and 120 days. In summer and winter there will always be periods of at least 40 days in which the sun will be too slow; and in spring and autumn similar periods, in which it will be too fast. When the apsides coincide with the equinoxes, the summer and autumn equations are equal but contrary, and also the spring and winter, and two of the mean days, are on the equinoxes, and the solstitial mean days each about 67 days from that equinox in which is the sun's perigee. When the sun's apsides coincide with the solstices, the spring and summer equations are equal, and the autumnal and winter; two of the mean days are on the solstice, while the equinoctial mean days are about 67 days from that solstice in which is the sun's apogee. The mean day belonging to the vernal equinox is now advancing in the calendar at the rate of one day in about 347 years, that belonging to the summer solstice is retreating at the rate of a day in 92 years, that belonging to the autumnal equinox is advancing at the rate of a day in 242 years, that belonging to the winter solstice is advancing a day in 201 years. If the equation by the eccentricity of the earth's orbit were just equal to that from the obliquity of its equator, the motion of the mean days in the calendar would be equal to one fourth of the year, advancing during three fourths of the revolutions of the apogee, and receding the other fourth; and when the apsides were in the octants, two of them would coincide, and there would be only three mean days in the year. If the equation from the eccentricity were the greatest, the mean day formed by the coincidence of the other two would vanish, and there would be a number of years about this position of the apsides with only two mean days in each. The number of these years would increase with this equation, till with an equation from the eccentricity more than double that from the obliquity there never could be but two mean days in a year, and these would revolve through the year with the apsides.

On Venus the greatest equation from the obliquity of its axis is $2h.\ 24'\ 16''$, the sun of course makes mean time four times in a year, and the eccentricity of its orbit produces but very small fluctuation of those times. On Mercury the greatest equation from the eccentricity is $1h.\ 34'\ 40''$, and unless the obliquity of its equator be more than double that of the earth, the mean and apparent time can never coincide but twice in one of their years. On Saturn the equation from the eccentricity is greater than from the obliquity, but less than double of it, of course it has sometimes two mean days, and sometimes four in a year; the other planets have only two.

After twice delineating this draught certain mechanical facilities occurred which, should it be thought worth engraving, a workman might be glad to obtain. The curves are composed of segments of circles; in the broad oval on the lower paper, one sign about each of the cardinal points is described on the centres ♈ ♋ ♎ ♑ respectively, and the intermediate segments of two signs each, on the centres *v, e, a, h,* respectively. On the moveable paper the 3d, 4th, 8th, 9th, 10th, and 11th signs were described with the radius of the mean circle, on a point distant from its centre by the greatest equation; the 1st, 2d, 5th, 6th, 7th, and 12th signs reckoning from A, with a radius about $\frac{1}{30}$ of an inch less, on centres to meet. It is scarcely necessary to mention, that the parallel lines expressing minutes are described on the same centres with the corresponding segments of their principals. If the use of a thin transparent paper should be deemed inconvenient, it will be equally accurate, though not quite so obvious, to draw parallels on the outside of the oval.

XLV.

AN ACCOUNT OF SOME ELECTRICAL PHENOMENA.

BY REV. TIMOTHY ALDEN, A. M.

Communicated in a letter to the late Rev. John Eliot, D. D.

Newark, N. J. 29th August, 1812.

REVEREND AND DEAR SIR,

I THINK the following narrative will not be unacceptable to the American Academy of Arts and Sciences. It is, however, submitted to you for such disposal, as your benevolence may suggest.

On the evening of the 28th of May, 1809, in time of a severe tempest, the mansion house of the Rev. Uzal Ogden, D. D. of this village, was somewhat injured by an electric explosion. The lightning entered at the ridge-pole by the chimney into the upper apartment, in which there was no fire place. It shivered a picture frame, hanging by the chimney, and from that passed to a brush, the bristles of which were secured by wire, lying on a table, and split it into several pieces, the sharp ends of some of which were driven upwards with such force, at an angle of about 45°, as to perforate and remain strongly fixed in the planchment.

A young lady of Dr. Ogden's family was sitting in a chair, leaning her right cheek against her hand, with her elbow on the table before mentioned. The fluid, after its effect upon the brush, was directed to her right elbow, where it broke the skin. A small portion of it was conducted by the arm to her face, on which it made a slight contusion, but did not affect the sensorium, so as to deprive her of recollection for a moment.

The principal stream proceeded from the elbow to the axilla and down the right side, leaving a narrow red streak, to the ball of the little toe, which, from the position of the foot, rested on the floor and was considerably hurt. Her gown of muslin was set on fire, and her stocking of silk was crimped, so as to look like a piece of crape over the path of the fluid.

After leaving its flesh conductor, the lightning tore up several boards of the floor, and was attracted by a wire, which it followed, through the third and second stories, into the basement, to a bell at the end of it, which hung in the chimney corner. It then went to the andirons and to the embers on the hearth, which were scattered in every possible direction.

The first sensation which the lady felt, after receiving the shock, was, to use her own language, " *that she was as big as a house.* In a little time, her usual sensibility returned, except on her right side.

Doctor Abraham Clark, a distinguished physician, who resided within a few steps, was immediately called in. As soon as he ascertained the condition of his patient, he sent for his Galvanic trough, which was furnished with sixty pairs of plates, and, in less than fifteen minutes after the alarming incident, got it into operation. Previously to the use of the Galvanic electricity all pulsation, on the right side, seemed to have been suspended. In a short time the elbow began to smart, where the skin had been fractured, and circulation was gradually restored. Something of the torpor, however, remained, for a day or two; but in a week, or less, the patient was perfectly recovered from the effects of the explosion.

The happy result from the prompt use of the Galvanic electricity, at a time, when no other could have been obtained, in this particular instance, ought to be generally known, as a precedent of no small importance in cases of injury by lightning on the human frame.

As the GALVANIC TROUGH is so readily prepared for operating, it seems highly expedient that it should not be forgotten in instances, like that, of which I have the happiness to communicate this account.

XLVI.

ACCOUNT OF A SINGULAR PROPERTY OF LAMPREY EELS.

BY JOSEPH TILDEN, Esq.

Communicated in a letter to the Hon. John Davis, LL. D.

Boston, Nov. 29, 1809.

DEAR SIR,

PERHAPS some account of a phenomena, which I have never seen described, may be worthy of attention; it must excite curiosity and may be productive of useful inquiry; I mean the effect produced by human saliva on *Lampreys*, or *Lampre-eels*.* I will endeavour at your request to state to you the few observations I was able to make.

In the neighbourhood of the falls at Machias, in the District of Maine, there are great numbers of these fish adhering to the rocks by means of the suction about their heads; they hold on with so much strength as to make it difficult to remove them by striking or throwing stones at them, but on spitting into the water they instantly spring out of it in the greatest agitation.

It is surprising that as this fact has been long known to the people in the vicinity of Machias, it should not have become more public. I have to regret that it was not in my power to satisfy some inquiries, which must naturally be excited by such an extraordinary scene. The place which the *Lampreys* assume is under the falls, where the fresh joins the salt water; the season for them I understand is in May and June. At the time they were affected by the saliva they appeared to be in pain, starting sometimes to the number of 20 or more several feet above the surface of the water in a horizontal po-

* The Petromyzon Marinus of Linnæus.

sition, with the most disgusting appearance, not unlike the writhing movements of snakes; when they fell into the water they went down the stream and did not resume their former place. I tried the saliva of a dog on them, but it had no effect. I could not observe whether the effect was first produced on one and by him communicated to the others. It would seem impossible that so small a quantity of saliva should impregnate so large a quantity of water (say several hundred tons) as to form a mixture or combination and change its properties so as to affect animals.

I understand that in the season for them these fish are abundant in this neighbourhood, particularly at Watertown.

XLVII.

ON THE VARIATION OF THE MAGNETICAL NEEDLE.

BY NATHANIEL BOWDITCH.

THE variation or declination of the magnetical needle, in the vicinity of Boston, has decreased since the first observations made in this country, at the rate of a degree in 30 or 40 years. For, by the papers published in the first volume of the Memoirs of the American Academy, it was 9° 00′ W in the year 1708; 8° 00′ W in the year 1742; and about 7° W in the year 1782. Within three or four years, it has been mentioned in several periodical publications that the variation had ceased to decrease, and was then rapidly increasing. This was stated to be the case, particularly in New York, by persons, who, from their official situations as public surveyors, were supposed to be most competent to judge of the subject; and observations were adduced to prove that this change had taken place between the years 1804 and 1807. Thus one of the boundary lines of Ranssellaer parish in Albany, was found in the year 1800 to bear N 46° 48′ W by compass; and in the year 1806, N 46° 12′ W; the true bearing being N 51° 46′ W. Whence it was inferred that the variation had increased 36′ during that period. In Herkimer in New York the variation was observed in the years 1800, 1804, and 1807: in the first interval of four years it had decreased 4′, and in the last interval of three years had increased 15′. A turnpike road, which was laid out by compass in 1805, had varied in its bearing in 1807, 45′, indicating that the variation had increased by that quantity. These are the chief observations, that I have known to be produced, to prove that a change had taken place in New York; but they by no means warrant the conclusion that has been drawn from them, since no notice whatever is taken of the diurnal variation of the needle, which sometimes exceeds any of the changes that have been observed. For if we examine Professor Sewall's observations in the first volume of the Memoirs of the American Academy, we shall find that in an interval of two or three months, in the year 1782, the declination changed at Cambridge from 6° 21′ W, to 7° 08′ W, varying 47′; and I have observed at Salem, in the year 1810, that the declination varied 48′ in a short period of time. Either of these diurnal changes exceeds the alteration observed at New York; and as there can be no doubt that the diurnal variation is nearly as great there as at Cambridge or Salem, it follows that the differences observed in New York are not too great to be accounted for by the diurnal motion alone, without resorting to the hypothesis of an irregular increase in the mean quantity of the variation. It may also be observed that the variation found at the same time and place with different instruments will frequently vary half a degree or a degree; and, by changing the place of the instrument a few feet, the same effect will sometimes be produced. This is more particularly the case in compact places, when the observations are made from the windows or on the top of a building; the nails and other iron used in constructing it, having frequently a great effect on the position of the needle. Notwithstanding the difficulty of obtaining the correct values of the variation, it is of importance to ascertain it, at regular intervals, as correctly as possible, particularly in this country, where most of the boundary lines of lands are determined by the compass. To assist in this object, I shall here give an abstract of my observations made at Salem in the years 1805, 1808, 1810, and 1811.

The observations in the year 1805 were made at a house in Summer Street, Salem, with a theodolite, furnished with a quadrant of altitude, telescope, &c. graduated to minutes. After making the usual adjustments, and fixing as nearly as possible the quadrant of altitude, and the north point of the needle at the commencement of the graduation of their respective circles, I estimated the errors of these last adjustments, and applied them respectively to the observed altitudes and azimuths of the sun, in a similar way to the method of correcting for the index error of an observation made with a quadrant of reflection. To ascertain these index errors to a greater degree of accuracy, I generally took the mean of ten observations of the needle, and three observations of the quadrant, before and after each set of observations. The instrument was placed within the house, at an eastern window in the morning, and at a western in the evening, at the distance of two or three feet from the wall, (or farther when it could be done) in order to avoid as much as possible the effect of the iron in the walls of the building. Having obtained in this way the sun's true altitude and magnetic azimuth, the true azimuth was calculated and the variation deduced by the usual rules of spherical trigonometry. The observations were as follows.

	d.	h.	′			° ′
1805 November	18	9	15	A. M.	4 observations	5 58 W.
		4		P. M.	5	6 17
	19	9		A. M.	6	6 02
		2		P. M.	6	5 56
	21	2		P. M.	10	6 15
	23	9		A. M.	9	5 56
		2	30	P. M.	6	5 45
	26	2		P. M.	10	5 51
	27	9		A. M.	12	5 42
		2		P. M.	10	6 01
	28	9		A. M.	10	5 43
		3		P. M.	12	6 06
	29	9		A. M.	3	5 50
	30	9		A. M.	12	6 01
				Mean of	115 observations	5 57 W.

In the year 1808 at a house in Summer Street about an eighth of a mile south of the place where the above observations were made, I observed the variation with another, more highly finished theodolite furnished with a needle of four inches in length, suspended on an agate. The places where the instrument was fixed, and method of observing, were exactly similar to those beforementioned.

	d. h. ′		° ′
1808 June	27 7 1 A. M.	12 observations	5 11 W.
	5 45 P. M.	20	5 22
	28 6 26 A. M.	20	5 25
	29 6 44 A. M.	20	5 08
	6 22 P. M.	20	5 26
July	1 7 24 A. M.	20	5 25
		Mean of 112 observations	5 20 W.

In the year 1810, at a house in the northern part of Market Street, Salem, about a quarter of a mile east of the place of observation in 1805, the variation was observed as above by both theodolites, the results are—

	d. h. ′		Theodolite used in 1808. ° ′ ″		Theodolite used in 1805. ° ′ ″
1810 April	1 4 52 P. M.	20 obs.	5 43 32 W		
	2 4 39 P. M.	20	5 45 29		
	3 7 54 A. M.	20	5 51 12		
	4 32 P. M.	20	5 40 31		
	4 7 57 A. M.	20	5 48 03	20 obs.	5 24 13 W
	4 19 P. M.	20	5 36 34	20	4 57 56
	8 8 15 P. M.	20	6 08 50	20	5 18 06
	Mean of	140 obs.	5 47 44	60 obs. mean	5 13 25 W

The difficulty of ascertaining the precise value of the variation appears evidently from these observations. For at the same moment on the 8th of April 1810, with two excellent theodolites in the same place, the variation differed above 50 minutes, which is greater than any of the changes observed in New York. I am induced to believe that these differences arose in a great degree from the shortness of the needles; and, perhaps in part from the imperfection of the brass of which the instruments were made. To obviate these difficulties I procured a needle 24 inches in length, suspended on an agate, and had it neatly fixed in a mahogany box, moveable at one end on a pivot by which the box was attached to a board, marked with a graduated arch of a circle, subdivided in such manner that minutes of a degree could easily be read by means of a nonius. The box was made wholly of wood and ivory, and when fixed in its place there was no iron near it. A table about three feet in height was fixed in the middle of a room of the building in the north part of Market-street, and by means of the theodolite and the sun's azimuth, I marked on the table, with great care, a *true* meridian line, and then placed the box on it, and observed the differences between the true and magnetic meridian for every hour, when convenient, from 6 A. M. to 10 P. M. from April 1810, to May 1811. The greatest variation observed during this time was 6° 44′ W. The least 5° 56′ W. To ascertain whether the building affected the needle, I fixed a true meridian line on a table in the garden adjoining the house, at 30 feet distance from any building, and nearly five feet from the ground, and by the mean of 48 observations, I found that the variation in the garden by this instrument was less by 3′ 25″ than in the house, so that it was necessary to subtract this quantity from all the observations to obtain the true variation. The mean variation for each hour of the day, and for each month of the year, as deduced from these observations, and corrected for the error 3′ 25″, are given in the following tables.

Time.	Mean Variation for the month.
1810 April	6° 21′ 21″
May	6 23 36
June	6 25 42
July	6 28 51
August	6 29 44
September	6 25 21
October	6 21 42
November	6 19 11
December	6 12 35
1811 January	6 20 55
February	6 21 19
March	6 20 29
April	6 23 39
May	6 21 38

Hour.	Mean Variation from April 1810 to May 1811.
6h A. M.	6° 19′ 01″
7	6 19 07
8	6 19 09
9	6 20 28
10	6 21 15
11	6 22 46
12	6 24 07
1 P. M.	6 25 47
2	6 27 09
3	6 27 00
4	6 25 57
5	6 24 26
6	6 23 19
7	6 21 55
8	6 21 11
9	6 20 54
10	6 20 38

The whole number of observations was 5125, and the mean of all made the variation 6° 22′ 35″ W, which may be assumed as the mean variation at Salem in the year 1810.

These observations were made about two miles south of the place where the late President Willard observed the variation in August 1781 to be 7° 2′ W, as may be seen by examining his paper on the subject, in the first volume of the Memoirs of the Academy. The difference of the variation at the two places, at the same time, was probably not more than 2′; so that from 1781 to 1810, a period of 29 years, it had decreased about 38 minutes, or 1′ 19″ in a year, which is at nearly the usual rate. From which I am inclined to believe, that the variation has not experienced any change in its direction, in this part of the country, and that the needle continues to approach the true meridian with nearly the same velocity, as at the time of the earliest observations on record.

The variation observed by Doctor Williams at Rutland, in Vermont, leads to the same result. His observations at that place were

1789 April 17	7° 3′ W
1810 May 19	6 4
1811 Sept. 9	6 1

Whence he concludes, that the magnetic variation at Rutland, for 22 years past, has been decreasing at the annual rate of 2′ 49″·5.

XLVIII.

DESCRIPTION OF A COMETARIUM.

BY JAMES DEAN, A.M. A.A.S.
Prof. Math. and Nat. Phil. in the University of Vermont.

Communicated in a letter to Nathaniel Bowditch, A. M. A. A. S.

I HAVE been for some months excessively engaged in a course of experimental lectures, during which I have constucted an instrument to represent the unequal motion of the planets round the sun, and the equation of the centre. As I conceive it equally useful with Ferguson's cometarium, a description of which the compilers of the Encyclopædia have thought proper to introduce, and much more convenient and easily constructed, I take the liberty to obtrude a short description of it on your patience. I shall refer to those expedients only by which the unequal motion is effected, as the rest may be supplied according to any one's peculiar taste in mechanics. A and B (Pl. II. Fig. 6.) are two toothed wheels of the same diameter, turned uniformly, and in the same time, by two pinions on the same arbor C. The wheel A, turned by the upper pinion, carries a hollow arbor, which rising through the dial plate carries an arm with an arch of 60°, on which the equation of the centre may be reckoned. The wheel B under the other carries the flat iron bar, DE sliding through a slit in the upper end of its arbor. In the end E of this bar, which is bent upwards, is a triangular notch, in which rests the tail or horizontal part EF, of a thick iron wire bent at a right angle, and turning in the hollow arbor. This carries on its top, above the arbor, a slender rod representing the vector radius, and moving with any desired degree of inequality. For when the wire FE is passing over the arbor of the wheel B, it is carried slower than the wheel ; but when the bar DE is passing under the hollow arbor of the wheel A, the wire being shorter, the arm DE is carried faster than the wheel. The wheel B is set in a frame by itself, moveable on the centre C, so that it is not detached from the pinion, while the distance between the centres of the wheels, and of course the inequality of the motion may be chosen at pleasure. If a very great inequality, like those of the comets, be desired, the claw E may be moved nearer its arbor, even so near as just to pass round the arbor in which the perpendicular part of the wire turns; but in that case the wire should pass through an eye which may turn in the bar DE, on account of the great obliquity of the two to each other.

The advantages of this construction I conceive to be its being capable of representing any degree of eccentricity, from that of Venus to that of Mercury ; that toothed wheels are much more secure than banded ones ; and that circular ones are much more easily formed than elliptical ones. The only disadvantage, which I know of is, that it represents the equation of the centre greatest, when the *true* anomaly is exactly 3 or 9 signs. But the principal use of all such instruments, as orreries, globes, maps, &c. to me has been, to give a a general notion of the subject. A slight difference of degree cannot much affect our *conceptions*, and *accurate measures* of distance or quantity must be preserved in quite a different manner. If this subject require any illustration to youthful minds, (which I find clearly to be the case) this method of effecting it seems so simple and obvious that I can scarcely imagine it to have escaped those who have tortured vulgar fractions for ratios of planetary motions far more accurate than our conceptions can take cognizance of; and yet had it ever been proposed, I see not why it has not been as much noticed as the more limited, though the more difficult one, introduced into the En. Brit.

XLIX.

AN ACCOUNT OF AN EARTHQUAKE IN NEW-ENGLAND.

BY HON. SAMUEL TENNEY, Esq.

Communicated in a letter to Joshua Fisher, M. D.

Exeter, 29*th March*, 1811.

DEAR SIR,

THE earthquake, which happened on the evening of the 9th of November last, appears, by accounts from various quarters, to have been felt through a considerable extent in this part of New England. In the judgment of most elderly people it was more severe than any other that has been observed since that of the year 1755, commonly called the Great Earthquake. For this reason, but more especially because it was accompanied by some very singular circumstances, I have thought that an account of it might not be unworthy of a place on the records of the American Academy. I shall place at your disposal a description of its various phenomena, as they appeared to me and several of my neighbours, with the addition of some circumstances collected, by inquiring from many persons in various quarters and at different distances. As I was perfectly free from surprize or agitation, I think I can give it with accuracy ; and I shall certainly give it without colouring.

As I was sitting by the fire-side, the younger part of the family being in bed and the house perfectly quiet, at about a quarter past 9 o'clock, I heard a very heavy and singular noise directly under my feet. My first idea was, that the foundation of the chimney and the walls under that end of the house had suddenly given way, and been violently forced into the cellar ; and I cast my eyes on the hearth, expecting to see it follow : but as I knew that these were perfectly firm and sound, I instantly abandoned it. A second conjecture was formed and immediately given up on a reflection, that the cause was totally inadequate to the effect. A third was rendered unnecessary by a tremendous report in the atmosphere, apparently at a very small distance from the house. I thought it equal to that produced by the discharge of an 18 or 24 pound cannon at the distance of half a mile, and much resembling it in tone and duration. I now concluded it to be an earthquake ; and expecting, from its singular commencement, that we should have a severe shock, I set myself to notice the phenomena, that might attend its progress, with all possible accuracy. This report, though so heavy and to appearance so near, gave no sensible concussion to the house. But it was instantly succeeded by the sound usually attending an earthquake, which I need not describe. This continued, with some little variation of intensity, forty or fifty seconds, as near as I could judge, though some thought it a minute or more ; then, after a few seconds, it ceased to be heard. It was accompanied, from the beginning, till the sound began to die away, by a most beautiful vibration of the floor under me. The vibrations from first to last were to appearance as perfectly isochronous as the oscillations of a pendulum, and, as near as I could judge, passed through a space of about one third of an inch, succeeding one another about as rapidly as the strokes of the teeth of the weight wheel of an eight day clock, when wound up in the usual leisurely manner.

To most people in this town the first noise appeared, as it did to me, to be under foot, though to others it appeared differently, some comparing it to one thing and some to another. All described it as very loud. A maid in my family, who was sitting by the kitchen fire, in another part of the house, thought a hogshead of cider had fallen from its blocks, and with all the barrels in the cellar, was tumbling over the plank floor. The loud report that succeeded seemed to most people to be at their very doors. A gentleman in N. Hampton, seven miles eastward of this town, heard the report, but did not notice the previous rumbling; and described it precisely as it appeared to me. A similar report was heard at Conway, seventy or eighty miles north, though not near so loud. From the circumstance of this report having been heard in places so distant one from another, while in most others it was not noticed at all, it is natural to infer, that there was a number accompanying the earthquake in its progress. My mind was so strongly impressed, at the time, with a belief that a large body of elastic vapour had burst from the bowels of the earth, at no great distance, that I fully expected to hear of a discovery of some striking marks of it on its surface. The only instance in which such a report has been recorded, as attending any earthquake in this country, is one mentioned by Dr. Williams, in his "Observations and Conjectures on the Earthquakes of New England," in the first volume of the Memoirs of the American Academy, that happened on the 3d of June 1744.

The opinions of people relative to the course of this earthquake are various. I attempted to ascertain it by observing the direction of the vibrations; but not having turned my attention to the subject seasonably, I was not able to satisfy myself. Within the limits of New-Hampshire it appears, from the information I have by inquiry obtained, to have operated with the greatest violence over the tract of country between Haverhill, Coos, and Portsmouth, which is nearly midway between the Northeastern and Southwestern limits of the earthquake. From the bearing of these two places from each other, we may fairly conclude, that its general course was in this direction. And this corresponds with the general course of all the larger earthquakes that have been observed in this part of the country.

The violence of this shock may be estimated by the following circumstances of its effects. In several places crockery was observed to clatter on the shelves, and in some places it was thrown off. In some, doors were unlatched, and stone walls shaken down. The pendulum of a clock was so much agitated that it struck both sides of its case for nearly a minute after the noise had ceased, a circumstance, which its owner had never observed before. A pile of boards on a wharf in Portsmouth was observed to clatter considerably. Teams stopped in the road, in several places, and refused to proceed till the shaking was over. The shock was perceived on the water as well as on the land. The people on board a vessel in Exeter river were very sensible of it ; and a vessel coming into Portsmouth harbour received so violent a concussion, that the captain sprung out of his birth and hastened on deck, believing it had run on a reef of rocks, though he knew of none in his course.

Several persons in different towns, who happened to be awake, perceived a slighter shock towards morning on the same night ; but it does not appear to have roused any who were asleep.

Thus, Sir, I have given you as accurate an account of this earthquake as I can make from my own observation and the information I have obtained from others. Should you deem it worthy of the notice of the Academy, you may lay it before them—otherwise you will retain it in your own hands. In either case you will confer an equal obligation on your cordial friend, and most obedient servant.

L.

ACCOUNT OF SEVERAL SHOCKS OF AN EARTHQUAKE IN THE SOUTHERN AND WESTERN PARTS OF THE UNITED STATES.

By his Ex'y. WINTHROP SARGENT, ESQ.

Governor of the Missisippi Territory.

Communicated in a letter to a member of the Academy.

Gloster Place, 2 miles south of Natchez, April 2, 1812.

I HAVE, my dear Sir, delayed communication upon the subject of the earthquakes, which this country has been experiencing, (and upon some parts of the river almost incessantly) in the hope of correct information from the interior, to the west and northwest of Natchez; but as yet I do not learn that the effects have been felt beyond St. Louis upon the north, and Natchitoches or Nagadoches to the west; and I am inclined to believe if there were any more advanced toward the Spanish Dominions, they must have been very feeble, though the great waste between settlements in that direction will forever deprive us of certain information.

I shall not pretend to hazard a conjecture as to the sources of those mighty concussions, nor am I perfectly satisfied of the existence of volcanoes in the west and northwest, notwithstanding the report of lava, scoria, and pumice, in those quarters. An intelligent traveller at the mouth of the Missouri, upon some of the first shocks and explosions being noticed, set his compass, and was of opinion, that they had proceeded in a direct line from New Madrid. From *this place* to the lower Chickasaw Bluffs upon the river (a distance of about eighty geographical miles) they seem to have been most awful and tremendous—dismaying men and beasts.* Considerable of the country is said to be sunk and forming new lakes, banks of the Missisippi thrown down, one or two islands swallowed up, and the channel of the river materially changed, inhabitants moved, or moving off, or living in tents. Those earthquakes decreased in force from the Bluffs to this place, nor have they been repeated as between them and New Madrid. The first, which was of as much magnitude as any that have occurred, was not felt twenty miles down the Missisippi upon the river, though it extended to Fort Stoddert, forty miles above Mobile Bay; to Nash and Knoxville in Tennessee; Charleston, South Carolina; Richmond and Norfolk in Virginia; Baltimore in Maryland; Louisville and all Kentucky; Lake Erie; Cincinnati, state of Ohio; Vincennes, Territory of Indiana; St. Louis upon the Missisippi, and Nagadoches, which lies west northerly about two hundred miles distant. In many of these places the brick work of chimnies was affected—in some thrown down to a level with the tops of the houses, and a strong vibratory motion given to every article suspended, and that was free to move. In Charlestown, South Carolina, and at Natchitoches or Nagadoches the bells in their church steeples were rung by the motion of the buildings. This earthquake occurred at my house within one or two minutes of 2 o'clock, correct solar time, upon the morning of the 16th of December 1811; the brick floor of the basement story, which is six feet below the surface of the earth, was evidently agitated—furniture considerably jarred, and a bed in an east and west direction appeared to have a motion from north to south. A bed in a third story was more, but alike moved, and in the

* Old trees, with their roots in the bed of the river, were seen rising and sinking by the current, so as to resemble the motion in sawing. Planters are without motion, generally erect, and both dangerous to navigators.

middle story glass, plate, and China were put in motion upon the shelves of a large moveable cupboard: I should observe to you that the building is of brick, lofty, (thirteen feet stories) and very substantially constructed. In cisterns at Natchez ten feet square, water was thrown up on the N E and S W sides full six inches, and the hanging leaves of tables, in slight buildings, had considerable motion. An old servant, who is very wakeful, and in whom I have some confidence, observes, that this earthquake was immediately preceded by a noise like near and very low thunder. Precisely at 7 o'clock A. M. we had another shock which was light, and gave only a small tremulous motion to our beds and bed curtains. Some persons living in wooden houses believe that they felt many small shocks between the hours of 7 and 8. A few minutes past 11 A. M. of the succeeding day, another shock of an earthquake was felt at Natchez and the vicinity; not powerful, like the first, but giving a considerable vibratory motion to articles suspended from the ceilings of stores and shops in that city: neither of those earthquakes exceeded one minute in duration.

Upon the Thursday morning of January 23, 1812, 35 minutes after 3 o'clock A. M. (solar time) we experienced another shock of an earthquake of one minute duration; not of so great force, as that of the 16th of December, but giving motion to our beds, glass, China, &c. thermometer stood at 50°, barometer 30·18; weather cloudy; wind S E and moderate. At noon the barometer had fallen, and thermometer risen much; some little faint sunshine in the day—sprinkling of rain in the afternoon—generally cloudy—wind strong in squalls from between S and E, increasing after the earthquake.

Friday, Feb. 7th, 3 hours and 10 minutes A. M. an earthquake of equal force, duration, and effect with that upon the 16th of December. The night preceding was rainy with S E wind, sometimes moderate, sometimes strong—and distant thunder. Sun appeared once or twice dimly through the day, but was generally obscured by clouds with rain before noon—light N W wind—at 10*h.* 6′ P. M. another shock, not equal to that in the morning, but giving some motion to our beds and furniture, and continuing one minute—the stars shone uncommonly bright, and the atmosphere was remarkably serene at this time, and continued so during the night—moon rose clear, but was succeeded by a dense vapour rising to the tops of the trees which was dissipated half an hour after sun rising—the day fair and wind S W and light. The three last shocks only have been felt at New Orleans, nor can I learn that any other earthquakes have ever been experienced there, or any where upon the river, except a small shock between Kaskaskias and the Missouri, upon the 8th of January, 1795, 3 o'clock in the morning, and two others upon the 11th and 12th of February, 1804.

Of the earthquakes noticed in the annals of New England, July 2d, 1638, Oct. 29th, 1653, 1658, 1660, Jan. 26th, 1663, 1665, 1668, 1669, 1670.—1705, 1720, Oct. 29th, 1727, Sept. 5th, 1732, Feb. 6th, 1737, Dec. 7th, 1737, June 3, 1744, Nov. 18th, 1755, Nov. 22, Dec. 19th, same year; July 8th, 1757, March 12th, 1761, Nov. 1st, same year; 1766, Oct. 18th, 19th, 1769, 1771; Nov. 29th, 1783, and May 8th, 1804; it seems the centre, or place of greatest violence has been in latitude about 43°, where the Merrimack enters into the Atlantic, and their central course from the N W to the S E through this point. Their effects upon the Atlantic coast have been limited by Nova Scotia upon the N E, and Maryland on the S W. Of those very awful concussions, which commenced in Jan. 1663, and continued to the July following, the date of our settlements would not admit of any record, but if they had extended to the Missisippi, we should most probably have had some account of them by tradition. Marquette, a Jesuit from Quebec, with an inhabitant of the name of

Joliet, who visited the Missisippi in 1673, by lake Michigan, Fox and Ouisconsing rivers, and passed down to the 33° of latitude, returning by land through the Illinois country, take no notice of any effects of that earthquake, which had been so tremendous in their own city.

In 1727 there were settlements of enlightened French people at Natchez, and upon the upper Missisippi, but they have given us no account of the violent earthquake of that, or the year 1755. I think therefore we have sufficient reason to infer, that none have ever occurred upon the inhabited parts of this river since the discovery of America, except those detailed in this communication.

The following account of the earthquakes is taken from the memoranda of a gentleman of respectability, who was descending the Missisippi in Dec. 1811, *in a flat boat, and from the* 15*th to the* 24*th an observer from the little Prairie (which is about ten leagues below New Madrid), to the lower Chickasaw Bluffs.*

On the evening of the 15th, my observer's boat was secured to the left, or eastern bank of the river, three leagues below the little Prairie, and on Monday morning of the 16th Dec. precisely at 2 o'clock, he was awakened by a rocking of the boat, and a sound resembling her running over a sand bar—succeeded by the falling in of the opposite bank—apparently to a very great extent, with an agitation of the river resembling great ebullition. The trees clashed together with great violence, and there were noises as of roaring cannon— weather warm —morning dark and cloudy: this was the first shock—very soon two others followed of less violence, the whole duration not exceedingeight minutes—the left bank of the river was much cracked, and threatened to fall in—at day light, which must have been about half past 6 o'clock, or, as the morning was dark and cloudy, perhaps 7, the boat was cast off, and immediately experienced another shock, more violent than either of the former—the left bank of the river fell in—its agitation increased, rising up like water spouts to an alarming height—though there was great depth of water, the channel appeared to be changed, and the current very much increased—the heavens were obscured by dense black smoke, which ascended from the bed of the river, with roaring noises so powerful as to prevent the communication of orders on board the boat. In a short time followed nine feeble shocks with a continued agitation of the river and innumerable explosions—in a few minutes there were light shocks—and the trees on both sides, principally on the right, were violently clashing together and falling in—*Sawyers and Planters multiplied in every direction, and to a great extent, and appeared to have been produced at the moment from the bottom of the river—one island was entirely swallowed up, and another evidently doomed to the same fate—it was sundered in many parts and directions, and the whole appeared almost in a state of fusion. At 10*h.* 50′ there was another shock, greater than the last, and the river was again in violent agitation—black and uncommonly turbid—11*h.* 25′ another shock, the river being disturbed as at the last—11*h.* 50′ a shock, more violent than the two preceding, not agitating the river so much, but rendering it more turbid. The interior of the country opposite the Bayon river appeared to be sunk or settled to a great extent, and near to the mouth of this stream the banks had fallen in for a considerable distance—many hundred trees had slid into the Missisippi, standing upright and immersed in full thirty feet water—others with their roots in the air and branches in the bed of the river. In general the effects were more like those of a tornado or whirlwind, than of an earthquake. Trees to a great extent

* See last note.

were rooted up, or twisted, broken, and cast in every possible direction. At 1 o'clock the sun appeared dimly—weather oppressively warm, and producing uncommon languor. At 1*h.* 20′ and 1*h.* 25′ there were shocks of less violence than the last, but the river was much agitated and covered with foam and froth. At 1*h.* 30′ a long and heavy shock was felt, succeeded by one of less force, and the heavens were darkened—weather warm as in the Indian summer—3 o'clock two shocks in quick succession. At 5 o'clock, after proceeding about 50 miles in the course of the day, the boat was put to shore at the point of a willow island, which point had been detached from the island about forty yards; in about 10 minutes in this position, my observer experienced a considerable shock, and at 5*h.* 15′ one so violent that the willow point and whole island trembled like an aspen leaf—the river was violently agitated and full of whirlpools, much endangering the boat from the suction. The sun set in clouds—wind rose and the weather became cold—at 5*h.* 30′ a very severe shock—5*h.* 50′ one less so, but succeeded by very violent shocks at the following times, viz. 6*h.* 45′, 7*h.* 35′, 8*h.* 5′, 8*h.* 50′, 8*h.* 55′, 9*h.* 25′, at 9*h.* 50′ two in quick succession, and at 11*h.* 45′ and 11*h.* 50′ also violent shocks, succeeded by two others less so.

Tuesday morning 17th, 12*h.* 12′ a most dreadful shock, followed by another sixteen minutes afterward—weather cloudy, a few stars only to be seen, and those surrounded by circles—at 5*h.* 30′ a very awful shock, succeeded by two less so—at 10*h.* 50′ a very tremendous shock, which seemed as though it would rend the island and main shores to atoms—the river was greatly agitated, and resembled a most violent ebullition—the island shaken and cleft in all directions, vomiting up coal and water—" the boat laboured as in a rough sea, and made much water"—at 11*h.* 15′ two shocks—11*h.* 24′ a loud roaring sound, and in two minutes a violent explosion—at 11*h.* 35′ a light shock, but the river was exceedingly perturbed—11*h.* 48′, 12*h.* 30′, and P. M. 2*h.* 43′, severe shocks with a shower of rain—at 3*h.* 17′ a light shock and strong wind, with very cloudy weather—at 3*h.* 30′ severe shock and no rain—3*h.* 55′ light shock, thunder and lightning and heavy rain—4*h.* 10′ light shock and little rain, high wind and cold—4*h.* 50′ a moderate shock, wind very high, rain with a red western sky—5*h.* 35′ a shock like the last—5*h.* 55′ wind moderating; many stars visible and comet peculiarly brilliant—6*h.* 45′ two shocks, fine clear night, and very strong wind.

Wednesday 18th, at 12*h.* 20′, A. M. 1*h.* 10′, and 2*h.* 25′ very severe shocks—2*h.* 30′ repeated, with high wind and extreme cold—at 3*h.* a light shock—at 3*h.* 5′ a very hard shock continuing some time—4*h.* 40′ a very severe shock—4*h.* 43′ one less so, and river very much agitated—7*h.* 30′ a very severe shock—10*h.* 8′ a light shock—11*h.* 10′ a severe shock—4*h.* 30′ P. M. a light shock. At this time my observer explored the island of willows and Indian grass, about 1000 acres, which was rent in many directions into pits, clefts, and chasms of various forms, some of which appeared deep, and had ejected water, and coal in pieces of ten or twelve pounds weight; one pit measured 60 feet in circumference, and was 15 deep. At 5*h.* 50′ was experienced another severe shock—and at 8*h.* 43′ one more severe—weather very cold and night fair—during the night there were four shocks, but less violent than either of the two preceding.

Thursday 19th, 5*h.* 20′ a shock of greater severity and duration than any of the preceding—the sun rose brilliant with a clear sky, and before noon my observer cast off his boat from the island (No. 32.) and made a distance of about seventeen miles, to the second Chickasaw Bluffs, during the day. At 1*h.* 30′ P. M. he experienced another shock—at 2*h.* 17′ another, neither violent—at 8*h.* 30′ a light shock

—at 11*h.* 30′ a very severe one, and at 12*h.* one less severe. Friday 20th, the boat was in motion early in the morning, and progressed during the day about forty miles, to island No. 42, which is near the lower Chickasaw Bluffs, mentioned in my communication—at 9*h.* 20′ a light shock—at 11*h.* 10′ A. M. a great and awful one. Saturday 21st and Sunday 22d, the boat was stationary near the Bluffs on account of a dense fog. On Monday 23d, cast off late in the day—drifted only three miles, and was blown ashore by a violent gale of wind—arrived at Natchez the 4th of January. Saturday the 21st no shocks, but rumbling sounds—Sunday 22d, 11*h.* A. M. a light shock—Monday 23d, 2*h.* P. M. several shocks in quick succession—no others have been noted by my observer; probably had he continued at any distance above the Bluffs, he would have experienced them more or less all the month of March.

In reading this account it may be useful to have recourse to the Missisippi Navigator.

Meteorological observations from the diary of Gov. Sargent, taken at Gloster Place, Missisippi Territory, at sun rising, setting, and at 2 P.M. *for December,* 1811. *Rain in* 225 *parts of an inch.*

Days.	Ther.	Bar.	Rain.	State of the weather.
Sunday.	32	30·15		Fair—light south wind.
1	64	30·14		
	57	30·11		
Monday.	53	30·11		Cloudy—light southeast wind.
2	64	30·14		
	60	30·11		
Tuesday.	59	30.7		Forenoon cloudy—drizzly—afternoon fair—light south wind.
3	71	30·7		
	61	30·11		
Wednesday.	60	30·11		Cloudy—moderate—southeast wind.
4	74	29·98		
	62	30		

Days.	Ther.	Bar.	Rain.	State of the weather.
Thursday.	43	30·5		Rain last night—day fair—
5	63	30		moderate northwest wind.
	54	30	54	
Friday.	33	30·5		Frost—fair—light westerly wind.
6	63	30·5		
	54	30·5		
Saturday.	38	30·11		Frost—fair—
7	58	30·5		wind northwest, and rather strong.
	52	30·5		
Sunday.	29	30·3		Fair—light westerly wind.
3	56	30		
	52	30		
Monday.	30	30·8		Fair—light, variable winds.
9	60	30·15		
	51	30·7		
Tuesday.	36	30·15		Light frost—calm and fair.
10	51	30·15		
	50	30·10		
Wednesday.	40	30·16		Fair—light northerly breeze
11	68	30·11		through the day.
	56	30·11		
Thursday.	52	30·11		Cloudy—light southeast wind,
12	60	30·11		and small showers.
	59	30·7	53	
Friday.	58	30·7		Rain last night—day cloudy,
13	59	30·7		and light northerly wind.
	56	30·7	42	
Saturday.	60	30·10		Cloudy and calm.
14	55	30·8		
	52	30·6		
Sunday.	50	30		Sunshine till noon—
15	69	29·98		remainder of the day cloudy and light
	52	30		variable winds.
Monday.	52	30·14		Two o'clock a. m. earthquake—star light—foggy
16	69	30·3		morn.—2d earthq. 7 o'cl.—sunshine from 9 a. m.
	54	30·1		to 8 p. m.—light southeast wind in the day. Star
Tuesday.	60	30·2		light night, with black clouds interspersed, morn.
17	69	30·4		foggy, at 9 clouds and sunshine, S. W. wind, mod.
	60	30·14		till noon, veered to N.W. increasing, gale at sunset, earthquake about 7 a. m.
Wednesday.	35	30·34		Dense and black clouds, strong N. W. wind all
18	46	30·27		night, wind N.W. till 2, with fair weather rest of
	44	30·27		the day, moderate and cold.
Thursday.	22	30·25		Moderate N. W. wind and fair—appearance of
19	46	30·10		a change of weather.
	41	30·11		

Days.	Ther.	Bar.	Rain.	
Friday.	44	30·11		Cloudy—wind E.S.E. and rather strong—
20	60	30·11		small sprinkling of rain at noon.
	58	30·11		
Saturday.	54	30		Strong S. E. wind latter part of night, rain to-
21	56	30		wards morn.—strong N.E. wind a. m. with rain,
	56	29·80	112	—calm and cloudy p. m. till 5—after fair.
Sunday.	56	29·90		Rain last night and forenoon—weather cloudy—
22	54	29·76		light N. E. wind a. m. and calm p. m.
	53	29·76	129	
Monday.	48	29·88		Strong N.W. wind before day light, and all day
23	53	29·96		fair weather.
	48	30		
Tuesday.	27	30·10		Moderate N. W. wind, and fair weather.
24	46	30·10		
	42	30·10		
Wednesday.	27	30.8		Light S. W. wind, and fair.
25	58	30·11		
	49	30·12		
Thursday.	31	29·96		Fair weather—moderate wind west of south.
26	63	29·85		
	52	29·85		
Friday.	40	29·85		Fair moderate wind west of north.
27	57	29·90		
	51	29·86		
Saturday.	40	30		Light frost—fair, light, and variable winds.
28	61	30·3		
	56	30·2		
Sunday.	48	30·4		Light, variable winds and sunshine till 4 o'clock,
29	64	29·99		evening cloudy and appearance of rain.
	62	29·90		
Monday.	58	30		Rain latter part of night and most of day—wind
30	60	29·80		E.S.E. strong till 12*h*.—p. m. light—eve. cloudy
	60	29·70	578	—appearance of rain—N. E. wind—thunder.
Tuesday.	56	29·56		Heavy showers of rain till 11 last night—mode-
31	42	29·66		rate wind E. and E. S. E. at 2 strong in squalls
	56	29·79		from W. with thunder—S.W. wind—rain.

LI.

ABSTRACT OF METEOROLOGICAL OBSERVATIONS, MADE AT CAMBRIDGE, NEW ENGLAND.

BY JOHN FARRAR,

Hollis Prof. Math. and Nat. Phil. in Harv. Coll. *communicated Jan.* 1813.

THE following tables exhibit the result of a regular course of observations, made by the late President Webber, from January 1790 to June 1807, and continued from that time to the present by myself. The place of observation is elevated about 31 feet above the mean level of the sea. From 1790 to July 1802 a barometer, furnished by the Meteorological Society at Manheim, was used; from this latter time to the beginning of 1810 a barometer made by Champney; and during the years 1811 and 1812, one made by W. & S. Jones, London, provided with a floating gage and a scale of correction. The two last instruments are graduated into English inches and hundredths, the first into French inches, lines and tenths. The heights are reduced to the temperature of 55 of Fahrenheit's scale, a correction being applied for the variation above and below this point; and the observations with the Manheim barometer have been reduced to English inches and hundredths.

The observations on the temperature from the commencement to August 1795 were made with a mercurial thermometer, attached to Reaumur's scale, placed about four feet from the ground, under cover, but exposed to a free air, and sufficiently protected from any undue reflection of heat, as well as from the direct rays of the sun. From August 1795 to July 1803 Fahrenheit's thermometer, made by Champney, was used, placed abroad in the open air, about 11 feet from the ground. From July 1804 to the present time a very good thermometer, made by the Messrs. Jones, London. The observations with Reaumur's thermometer are reduced to Fahrenheit's scale, for the purpose of a more ready comparison.

		Barometer.			Thermometer.		
1790		7 o'cl. A.M.	2 o'cl. P.M.	9 o'cl. P.M.	7 a.m.	2 p.m	9 p.m.
Jan.	Greatest	30·46	30·51	30·49	47	53	47
	Mean	29·94	29·96	29·97	32	35	33
	Least	29·53	29·54	29·43	20	13	18
Feb.	Greatest	30·50	30·45	30·49	41	47	45
	Mean	29·94	29·95	29·85	27	31	30·5
	Least	29·20	29·44	29·07	6·5	8	5
March.	Greatest	30·71	30·54	30·50	54	55	54
	Mean	30·03	30·00	30·03	34	41	36·5
	Least	29·27	29·11	29·37	12	15	17
April.	Greatest	30·36	30·25	30·25	59	61	59
	Mean	29·82	29·86	29·85	44·5	49·5	45·5
	Least	28·83	29·16	28·83	34	34	32
May.	Greatest	30·54	30·50	30·50	62	75	71
	Mean	30·06	29·96	29·92	54	62·5	58
	Least	29·51	29·53	29·52	47	47	47
June.	Greatest	30·23	30·20	30·21	73	86	77
	Mean	29·94	29·98	29·99	65	72	68
	Least	29·76	29·76	29·80	58	62	58
July.	Greatest	30·18	30·16	30·16	75	84	77
	Mean	29·89	29·87	29·88	67	74	71
	Least	29·64	29·58	29·59	61	66	63
Aug.	Greatest	30·31	30·30	30·25	77	88	84
	Mean	30·04	30·03	30·02	65	78	69
	Least	29·82	29·17	29·80	57	58	59
Sept.	Greatest	30·45	30·44	30·47	71	79	77
	Mean	30·13	30·12	30·12	60	68	63
	Least	29·68	29·66	29·73	46	55	52
Oct.	Greatest	30·33	30·27	30·40	53	71	63
	Mean	29·91	29·89	29·95	49	57	53
	Least	29·56	29·46	29·57	32·5	38	36
Nov.	Greatest	30·22	30·22	30·30	57	57	56
	Mean	29·95	29·85	29·89	38	43	39
	Least	29·52	29·50	29·60	18	25	23
Dec.	Greatest	30·51	30·33	30·63	39	38	37
	Mean	29·96	29·91	29·88	13	24	18
	Least	29·24	29·02	29·24	−11·5	4	−2
Year.	Greatest	30·71	30·54	30·63	77	88	84
	Mean	29·968	29·950	29·946	47·1	54	50
	Least	28·83	29·02	28·83	6·5	8	5

N. B. The numbers at the bottom of the therm. table shew the extremes and means for the *year of the seasons*, and not for the civil year. This sign — signifies below zero.

1791.		*Barometer.* 7 A. M.	2 P. M.	9 P. M.	*Thermometer.* 7 a.m.	2 p.m.	9 p.m.		*Winds.* N	NE	E	SE	S	SW	W	NW	*Weather.* fair.	mostly fa.	cloudy.	mostly clo.
Jan.	G.	30·49	30·53	30·54	41	47	47	M.	2		2		4	7	7	9	6	3	17	4
	M.	29·90	29·85	29·91	24	30	27	N.	2	1	1		3	11	4	8	7	7	12	5
	L.	29·47	29·19	29·36	0	12	8	*N.*	1	2	2		3	9	7	7	14	1	12	4
Feb.	G.	30·43	30·37	30·44	47	49	41	M.	3	2		2	2	8	4	7	12	3	10	4
	M.	29˙94	29·89	29·95	18	28	24	N.	4	1	1		5	8	4	5	12	4	8	4
	L.	29·07	28·83	29·09	−2	3	5	*N.*	4	1	1	1	4	3	3	11	12	4	9	3
March.	G.	30·57	30·58	30·54	49	73	54	M.	3	3		1	3	6	1	14	12	2	13	4
	M.	30·04	30·03	30·04	36	46	39	N.	2	2	3		6	8	1	9	13	5	12	1
	L.	29·57	29·54	29·31	13	23·5	20	*N.*	2	4	2	1	6	3	2	11	17	1	12	1
April.	G.	30·40	30·27	30·37	54	80·5	64	M.	4	1		1	1	8	4	11	19	3	5	3
	M.	29·90	29·85	29·91	45	56	51·5	N.	4	2	6	3	2	5	2	6	13	4	6	7
	L.	29·33	29·31	29·31	31	40	39	*N.*	2	3	2	5	1	4	6	7	18	2	4	6
May.	G.	30·31	30·33	30·30	74	88	80	M.	2	4		2	3	12	1	7	14	3	6	8
	M.	30·05	29·91	30·05	57	67	59·5	N.	4	2	5	5	3	7	2	3	11	2	6	12
	L·	29·68	29·62	29·70	43	49	39	*N.*	3	3	5	2	6	6	1	5	15	3	7	6
June.	G.	30·37	30·37	30·30	74	88	80	M.	2	1	1	2	3	11	2	8	14	2	9	5
	M.	29·98	29·94	29·95	67	75	70	N.		1	4	1	6	11	3	4	9	8	6	4
	L.	29·38	29·31	29·56	54	67	46	*N.*		3	3	1	1	15	2	5	16	3	4	7
July.	G.	30·35	30·38	30·38	79	92	86	M.	3	1	1		6	10	3	7	14	4	5	7
	M.	30·01	29·96	30·02	69	81	73	N.	2	3	7	1	3	9	3	3	8	8	3	12
	L.	29·61	29·61	29·67	59	72	62·5	*N.*	1		6		8	8	1	7	12	5	5	9
Aug.	G.	30·43	30·43	30·43	89	89	79·5	M.	3	4	3		6	8	1	6	12	6	10	3
	M.	30·01	30·02	30·02	69	79	71·5	N.	2	3	8	4	4	5	3	2	13	5	5	8
	L.	29·61	29·60	29·59	59	73	62·5	*N.*	2	4	6	3	4	7	2	3	14	5	8	4
Sept.	G.	30·43	30·43	30·34	71	78	76	M.	5	6		3	4	4		8	11	3	14	2
	M.	30·05	30·03	30·04	60	67	62	N.	2	8	3	1	4	6	3	3	4	6	12	8
	L.	29·79	29·71	29·76	46	59	52	*N.*	4	7	2	2	1	7	3	4	6	5	13	6
Oct.	G.	30·53	30·37	30·44	72	75	70	M.	5	1		1	1	4	6	13	11	4	11	5
	M.	29·94	29·90	39·92	43	53	48	N.	5	2	1	2	3	6	4	8	9	6	7	9
	L.	29·17	29·11	29·33	29	41	36	*N.*	5	2		1	2	7	4	10	14	3	7	7
Nov.	G.	30·35	30·40	30·45	61	68	67	M.	4	1		2	5	5	6	7	12	8	9	1
	M.	29·97	29·94	29·98	36	46	41	N.	4	4	1	1	7	7	3	3	12	4	9	5
	L.	29·29	29·12	29·38	17	31	25	*N.*	1	4	1	1	6	5	4	8	17	1	10	3
Dec.	G.	30·48	30·41	30·48	59	50	48	M.	4		1		2	6	9	9	7	2	12	10
	M.	29·88	29·85	29·87	28	35	31	N.	4	1	1		1	9	5	10	5	9	12	5
	L.	28·90	28·92	29·00	8	18	14	*N.*	4	1	1			11	5	9	12	2	12	5
Year.	G.	30·57	30·58	30·54	89	92	86	M.	40	24	8	14	40	89	44	106	144	42	121	56
	M.	29·972	29·931	29·972	44·7	54·5	48·9	N.	36	30	41	18	47	92	37	64	116	68	98	80
	L.	28·90	28·83	29·09	-11·5	3	-2	*N.*	29	34	31	17	42	85	40	87	167	35	103	61

N. B. The table of the winds and weather is to be distinguished from that of the bar. and therm. The former shows the number of winds for each point of the compass, and the face of the sky, divided into four aspects for *morning* marked M, *noon* marked N, and *night* marked *N.* The numbers at the bottom of these columns are the sums of the respective columns.

		Barometer.			*Thermometer.*				*Winds.*								*Weather.*			
1792.		7 A. M.	2 P. M.	9 P. M.	7 a.m.	2 p.m.	9 p.m.		N	NE	E	SE	S	SW	W	NW	fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30·41	30·37	30·33	37	47	28	M.	4	2				8	7	15	18	1	7	5
	M.	29·85	29·80	29·87	13	22	17·5	N.	4	1	1	1		3	8	13	14	7	7	3
	L.	29·00	28·85	29·31	−11·5	−2	−5	*N.*	4	1			1	4	9	12	18	1	10	2
Feb.	G.	30·32	30·27	30·23	37	47	39	M.	9					3	6	11	7	7	9	6
	M.	29·86	29·87	29·89	22	31·5	29·5	N.	6	4				5	2	12	9	5	8	7
	L.	29·02	29·38	26·43	12	20	16	*N.*	6	2			1	4	3	13	14	1	11	3
March.	G.	30·45	30·35	30·42	53	60	56·5	M.	3	3	3		3	6	3	10	8	5	12	6
	M.	29·89	29·85	29·91	37	46	40	N.	2	5	5	1	1	6	1	10	7	5	11	8
	L.	29·02	29·18	29·26	28·5	34·5	32	*N.*	3	4	5	1	1	6	1	10	11	3	10	7
April.	G.	30·56	30·53	30·51	61	68	68	M.	7	2	2	3	1	6	3	6	9	2	17	2
	M.	30·07	30·04	30·06	45	55	49	N.	2	4	9	5	2	4		4	9	4	10	7
	L.	29·61	29·61	29·59	32	35·5	34·5	*N.*		2	6	5	4	4		9	14	5	8	3
May.	G.	30·27	30·24	30·27	77	88	80·5	M.	2	3		[illegible]	1	10	1	12	14	3	8	6
	M.	30·02	29·98	30·00	56	68	60	N.	1	5	8	1	1	7	7	1	8	10	7	6
	L.	29·77	29·72	29·76	47	47	44·5	*N.*	1	3	5	1	1	12	7	1	12	6	9	4
June.	G.	30·30	30·27	30·24	77	89	81	M.	6	6	2	1	3	2	2	8	9	5	5	11
	M.	30·05	30·03	30·02	62	72	65·5	N.		5	12		5	3	3	2	9	7	7	7
	L.	29·70	29·72	29·74	50·5	55	52	*N.*	2	5	11		5	4	2	1	10	9	8	3
July.	G.	30·24	30·31	30·30	79	87	79	M.	1	3	4	1	1	10	3	8	12	4	8	7
	M.	30·02	29·99	30·02	68	78	71·5	N.	1	2	8	1	2	8	3	6	9	7	6	9
	L.	29·47	29·46	29·62	59	64	61·5	*N.*	3	1	7	1	3	9	1	6	12	3	5	11
Aug.	G.	30·23	30·23	30·17	76	91	81·5	M.	1	5	1		5	7	6	6	12	5	7	7
	M.	29·95	29·91	29·95	42	71	70	N.		4	8		4	8	2	5	7	10	3	11
	L.	29·52	29·52	29·67	52	66	55	*N.*	2	3	3		5	9	2	7	13	4	5	7
Sept.	G.	30·47	30·49	20·46	73	83·5	75	M.	7	2		2	4	5	2	8	11	6	8	5
	M.	30·09	30·07	30·06	56·5	67	60	N.	6	4	6		4	6	2	2	7	7	5	11
	L.	29·76	29·80	29·19	39·5	54	39·5	*N.*	4	4	[illegible]		3	7	2	5	9	6	8	7
Oct.	G.	30·47	30·31	30·48	62·5	70	59	M.	6		2	1	4	6	5	7	11	3	9	8
	M.	30·02	29·94	30·00	48·5	59	53	N.	2	2	6		4	8	3	6	14	2	7	8
	L.	29·51	29·02	29·64	32	45	39·5	*N.*	3	3	6		3	6	4	6	17	5	8	1
Nov.	G.	30·33	30·25	30·33	56·5	71	59	M.	6	[illegible]	1		2	6	7	5	10	3	10	7
	M.	29·93	29·86	29·91	39	48·5	43	N.	6	2	3		1	8	4	6	10	8	6	6
	L.	29·38	29·46	29·52	25	30	27	*N.*	3	2	3		1	7	4	10	13	3	11	3
Dec.	G.	30·42	30·39	30·42	40·5	48	45	M.	2				3	4	4	18	12	3	11	5
	M.	29·84	29·83	29·87	22	31	26·5	N.	[illegible]	1		1	2	8	1	13	10	12	5	4
	L.	29·42	29·37	29·32	3	17	11	*N.*	1	2		1	1	8	4	14	12	4	12	3
Year.	G.	30·56	30·53	30·51	79·1	91	81·5	M.	54	28	15	11	27	68	49	114	133	47	111	75
	M	29·968	29·931	29·963	43·1	55·1	46·2	N.	35	39	66	10	26	74	36	80	113	84	82	87
	L.	29·00	28·85	29·19	−11·5	−2	−5	*N.*	32	32	51	9	29	80	39	94	157	50	105	54

1793		*Barometer.* 7 A.M.	2 P.M.	9 P.M.	*Thermometer.* 7 a.m.	2 p.m.	9 p.m.		*Winds.* N	NE	E	SE	S	SW	W	NW	*Weather.* fair.	mostly fa.	cloudy	mostly cl.
Jan.	G.	30·51	30·23	30·41	39	43	41	M.	7			1	1	5	3	14	9	4	14	4
	M.	29·85	29·80	29·88	25	31	29	N.	4	1		1		6	1	18	10	1	14	6
	L.	29·24	29·19	29·48	8	12	8	*N*.	3	1		1	1	6	2	17	9	7	11	4
Feb.	G.	30·59	30·59	30·50	52	54	52	M.	3	1	1	1	3	6	1	12	6	3	13	6
	M.	30·00	30·04	30·03	26	35	30	N.	4	3		1	5	4	1	10	7	3	14	4
	L.	29·17	29·41	29·06	–2	13	8	*N*.	3	3	1	1	3	3	2	12	11	1	14	2
March.	G.	30·53	30·61	30·56	54	71	63	M.	5	3			4	8	3	8	12	5	10	4
	M.	30·02	30·08	30·06	36	45	40	N.	2	4	1	1	3	13	3	4	6	13	10	2
	L.	29·19	29·60	29·18	16	22	22	*N*.	1	4		1	2	15	3	5	13	5	9	4
April.	G.	30·45	30·49	30·46	59	71	61	M.	3	6	3	1	4	5	3	5	12	2	10	6
	M.	30·03	30·03	30·04	47	56	51	N.		5	10		6	4		5	12	5	6	7
	L.	29·54	29·54	29·54	35	48	40	*N*.		6	7	1	6	5	2	3	14	5	9	2
May.	G.	30·49	30·50	30·48	75	90	78	M.	3	6	2	2	5	9	1	5	11	3	6	11
	M.	30·16	30·14	30·13	57	66	59	N.	1	4	8		2	10	1	4	9	5	7	10
	L.	29·80	29·83	29·82	45	55	47	*N*.	1	5	6		4	11		4	13	6	6	6
June	G.	30·24	30·23	30·17	81·5	91	86	M.		3	2		3	15	4	3	7	5	9	9
	M.	29·97	29·97	29·97	67·5	77	72	N	1	2	7	1	3	13	2	2	2	11	6	10
	L.	29·68	29·61	29·63	53	57	55	*N*.		1	6		5	14	1	3	12	5	6	7
July.	G.	30·22	30·23	30·20	79·5	91	83·5	M.	4	1	4		6	8	1	6	10	5	8	8
	M.	29·99	29·98	30·00	71·5	79·5	74	N.		1	9	1	4	6	4	6	2	11	5	13
	L.	29·62	29·67	29·64	60	71	67	*N*.		4	7	2	5	6	3	4	13	6	5	7
Aug.	G	30·33	30·37	30·34	78	92	79·5	M.	6	2	4		5	10		4	14	2	6	9
	M.	30·13	30·12	30·12	70	83	73	N.		2	13	1	3	10	1	1	8	11		7
	L.	29·87	29·86	26 85	58	70	61·5	*N*.	1	2	11	1	4	8	1	3	16	6	5	5
Sept.	G.	30·64	30·41	30·41	77	87	80	M	7	1	1	2	2	6	2	9	7	5	6	12
	M.	30·08	30·03	30·05	62	69	65	N.	4	2	7	1	1	7	2	6	4	6	7	8
	L.	29·67	29·66	29·66	45	59	54	*N*.	4	2	7		2	7	1	7	7	6	9	8
Oct.	G.	30·61	30·61	30 61	65	74	66	M.	7	1			4	9	3	7	14	3	7	7
	M.	30·06	30·05	30·04	47	63	51	N.	6		3		2	6	7	7	10	5	7	9
	L.	29 59	29·50	26·55	25	35	32	*N*.	6	1	3		2	7	6	6	12	3	11	5
Nov.	G.	30·43	30·42	30·37	58	63	67	M.	8		3	1	3	5	4	6	8		16	6
	M.	29·97	29·94	29·98	38	45	41	N.	6	1	3	2	2	3	3	10	8	3	14	5
	L.	29·10	29·06	29·62	25	32	28	*N*.	5	1	2	1	2	4	2	13	11	1	13	5
Dec.	G.	30·08	29·98	30·07	40	45	44	M.	1	1		2	2	10	6	9	6	6	6	13
	M.	29·74	29·68	29·70	28	34	31	N.	2	2	1	2	2	5	5	12	6	4	10	11
	L.	29·00	29·05	28·93	3	10	2	*N*	2	1	1		1	6	5	15	9	10	8	4
Year.	G.	30·64	30·61	30·61	81·5	92	86	M.	54	25	20	10	42	96	31	87	116	43	111	95
	M.	29·997	29·987	30·00	46·3	55·8	50	N.	30	27	62	11	33	87	30	85	84	78	100	92
	L.	29·00	29 05	28·93	–2	12	8	*N*.	26	31	51	8	37	92	28	92	140	61	106	59
						56½														

1794.		*Barometer.* 7 A. M.	2 P. M.	9 P. M.	*Thermemeter.* 7 a.m.	2 p.m.	9 p.m.		*Winds.* N	NE	E	SE	S	SW	W	NW	*Weather.* fair.	mostly fa.	cloudy.	mostly cl
Jan.	G.	30·62	30·63	30·69	51	56	47	M.	2				2	7	5	15	8	6	10	9
	M.	29·90	29·86	29·88	24	27	28	N.	1	2		1	3	8	3	13	11	8	8	4
	L.	29·14	29·09	29·02	2	13	8	*N.*		2		1	1	10	2	15	14	6	8	3
Feb.	G.	30·54	30·52	30·43	36	41	47	M.	3		1	2		1	8	13	8	5	6	9
	M.	29·89	29·87	29·87	22	31	27	N.	3	2	2	1	2	1	6	11	10	5	8	5
	L.	29·11	29·28	29·28	7	20	27	*N.*	3	2	1	1	2	4	3	12	11	4	9	4
March.	G.	30·66	30·69	30·70	43	68	61	M.	5	3	1	1	3	6	5	9	11	4	11	5
	M.	30·07	30·04	30·04	35·5	46	41·5	N.	2	5	3	2	2	5	2	10	11	6	9	5
	L.	29·42	29·45	29·36	0	12	6·5	*N.*	2	6	2	1	3	5	2	10	12	7	10	2
April.	G.	30·74	30·56	30·53	58	76	66	M.	3	7	1	1	3	6	2	7	14	3	9	4
	M.	30·13	30·12	30·13	45	56·8	50	N.	1	6	8	2	2	2	4	5	11	6	6	7
	L.	29·49	29·56	29·37	30	41	36	*N.*	1	6	9		2	3	4	5	15	3	8	4
May.	G.	30·45	30·42	30·37	73	84	78	M.	1	13	1	2	1	8	2	3	4	3	13	11
	M.	30·06	30·05	30·04	57·5	67	61	N.	1	10	7	1	3	6		3	1	8	11	11
	L.	29·78	29·72	29·72	38	49	37	*N.*	2	8	8		1	9		3	2	11	11	7
June.	G.	30·17	30·17	30·14	73	89·6	82	M.	2	5	4		1	11		7	9	4	10	7
	M.	29·96	29·96	29·95	63	73	68	N.		4	9	2	2	8	2	3	3	11	6	10
	L.	29·62	29·70	29·56	53	63	58	*N.*	1	4	8	1	1	12	1	2	9	9	7	5
July.	G.	30·36	30·41	30·36	79·5	90	84	M.	5	3			5	14	2	2	9	7	2	13
	M.	30·08	30·08	30·08	70·5	79	74	N.	1	2	9	1	1	10	3	4	9	6	4	12
	L.	29·82	29·83	29·86	58	64	64	*N.*		1	7	2	4	11	1	5	7	4	5	10
Aug.	G.	30·36	30·35	30·32	78	88	83	M.	1	1	4	3	8	3	1	10	5	8	6	12
	M.	30·08	30·06	30·06	68	78·5	73	N.	2	2	12	4	2	8		2	2	15	5	9
	L.	29·81	29·79	29·73	58	72	66	*N.*		3	12		6	6	1	5	10	6	11	4
Sept.	G.	30·33	30·31	30·41	76	84	78	M.		1		2	2	9	3	13	11	8	4	7
	M.	30·03	30·00	30·02	63	72	65	N.		1	6		1	7	4	11	7	11	6	6
	L.	29·70	29·64	29·68	47	58	47	*N.*		1	4		1	11	2	12	16	6	3	5
Oct.	G.	30·56	30·58	30·49	65	67·5	61·5	M.	4	5	1		1	5	3	12	10	3	7	11
	M.	30·05	30·01	30·04	45	55·5	49·5	N.	3	5	4		1	7	1	10	7	2	11	10
	L.	29·51	29·47	29·45	31	42	35	*N.*	3	5	4		1	6		12	16	4	9	2
Nov.	G.	30·54	30·50	30·41	65	70	63	M.	1	1	1	3	3	3	6	12	5	8	7	10
	M.	30·00	29·98	29·99	36·5	46	41	N.	3	1		1	5	6	1	13	7	10	5	8
	L.	29·52	29·41	29·55	22	25	25·5	*N.*	1	2			6	5	4	12	10	4	10	6
Dec.	G.	30·35	30·35	30·33	53	64	60	M.	1	3	1		3	10	6	7	6	8	8	9
	M.	29·96	29·93	29·93	38	47	42	N.	1	4	1		2	11	2	10	4	7	8	12
	L.	29·51	29·52	29·20	25	32	36	*N.*	1	2	3		2	11	3	9	8	10	8	5
Year.	G.	30·74	30·69	30·70	79·5	90	84	M.	27	42	15	14	32	83	43	110	100	66	92	107
	M.	30·017	29·997	30·002	46·5	55·6	50·7	N.	8	44	61	15	26	79	28	95	83	95	87	99
	L.	29·11	29·09	29·02	2	10	2	*N.*	14	42	58	6	30	93	23	102	130	79	99	57

1795.		Barometer. 7 A. M.	2 P. M.	9 P. M.	Thermometer. 7 a.m.	2 p.m.	9 p.m.		Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	33·36	30·35	30·32	47	42	38	M.	9		1	1	2		3	15	6	5	13	7
	M.	29·96	29·94	29·95	23	30	28	N.	12	2		1		2	4	10	2	9	12	8
	L.	28·97	29·00	29·18	4	13	9	*N.*	9	1		1	1	2	3	14	7	4	14	6
Feb.	G.	30·20	30·15	30·67	33	45	47	M.	10	1		1	1	5	4	6	4	4	15	5
	M.	29·80	29·73	29·81	22·4	30	26	N.	10	1	1	2	1	1	8	4	4	7	12	5
	L.	29·35	29·22	29·09	−1	9	5	*N.*	7	4	1		1	2	6	7	11	4	10	3
March.	G.	30·44	30·45	30·49	58	65	51	M.	4	1	3		1	9	7	6	7	6	12	6
	M.	29·85	29·85	29·89	37	41	36	N.	3	1	4		4	3	10	6	3	7	10	11
	L.	29·09	28·97	29·14	20	27	26	*N.*	3	1	5		5	3	10	4	11	4	9	7
April.	G.	30·48	30·44	30·40	59	66	60	M.	6	7			2	1	1	13	8	7	9	6
	M.	29·89	29·89	29·89	43	52	48	N.	2	4	9		2	2	3	8	5	7	11	7
	L.	29·42	29·37	29·50	21	29	23	*N.*	1	4	7	1	3	2	3	9	10	7	9	4
May.	G.	30·27	30·28	30·26	68	82	71	M.	5	4	2	3	5	5		7	6	4	16	5
	M.	30·05	30·03	30·04	54·5	65	59	N.	1	5	7	2	3	4	3	6	4	6	12	9
	L.	29·69	29·71	29·76	40·5	47	46	*N.*	1	5	4	1	6	4	3	7	7	3	16	5
June.	G.	30·58	30·55	30·47	75	86	78	M.	6	3		1	3	3	3	6	13	3	4	5
	M.	30·04	30·04	30·02	63	74	68·5	N.	2	1	1	1	3	6	2	4	6	11	4	9
	L.	29·71	29·68	29·61	55	65	60	*N.*	2	1	11	1	5	5	1	4	14	5	2	9
July.	G.	30·20	30·22	30·20	76	87	81	M.		3	4	1	7	6	1	9	8	3	10	10
	M.	30·00	29·99	29·99	67	77	73·5	N.		1	17	1	2	4	2	4	7	8	7	9
	L.	29·62	29·65	29·59	64	64	66	*N.*		2	13	1		7	2	6	12	4	7	8
Aug.	G.	30·33	30·37	30·37	76·5	91	88	M.	2	5	4	2		11	3	4	5	6	8	11
	M.	30·04	30·04	30·04	67·8	77·8	71·6	N.		6	9		1	9	2	4	2	13	5	11
	L.	29·67	29·63	29·80	51	60	58	*N.*		6	7		3	8	4	3	11	4	8	8
Sept.	G.	30·36	30·33	30·32	74	89	79	M.	1	1	3	1	4	8	1	10	9	8	3	10
	M.	30·03	30·03	30·06	60·4	71	61·8	N.	1	1	4	3	6	6	1	8	4	13	6	8
	L.	29·58	29·67	29·59	44	55	43	*N.*	1	2	3	2	3	8	1	10	9	9	8	4
Oct.	G.	30·66	30·67	30·66	62	75	66	M.	4	2	3	1	2	12	2	5	11	5	5	10
	M.	30·06	29·69	30·01	47·8	59·7	51·7	N.	3	2	5	2	2	11	3	3	6	11	8	6
	L.	29·54	29·31	29·33	30	46	37	*N.*	2	1	5	1	3	11	3	5	13	5	9	5
Nov.	G.	30·66	30·62	30·63	61·5	69	61	M.	8		1		1	4	4	12	9	8	7	6
	M.	20·94	20·93	29·96	35·5	46·9	39	N.	5		4		3	4	2	12	6	11	5	8
	L.	29·21	29·19	29·21	23·5	38	26	*N.*	5		4		3	4	3	11	13	3	6	8
Dec.	G.	30·41	30·42	30·42	44·5	51	47	M.	2	1	2		3	6	7	10	10	3	14	4
	M.	29·85	29·77	29·87	30·5	38·3	32·4	N.	3		3		3	4	8	10	6	6	11	9
	L.	29·30	29·19	29·14	7·5	27	10	*N.*	2		3	1	2	5	7	11	12	3	11	5
Year.	G.	30·66	30·67	30·67	76·5	91	88	M.	57	28	23	11	31	70	36	103	96	62	116	85
	M.	29·959	29·934	29·961	46·6	55·9	50·4	N.	42	24	74	12	30	56	48	79	55	108	103	100
	L.	28·97	28·97	29·09	−1	9	5	*N.*	33	27	63	9	35	61	46	91	129	55	109	72

1796.		*Barometer.* 7 A. M.	2 P. M.	9 P. M.	*Thermometer.* 7 a.m.	2 p.m.	9 p.m.		*Winds.* N	NE	E	SE	S	SW	W	NW	*Weather.* fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30·23	30·44	30·41	41	50·5	51	M.	8				1	5	6	11	9	1	15	6
	M.	29·97	29·95	29·99	23	35·8	25·7	N.	3	1	1	2	2	6	4	12	5	6	13	1
	L.	29·07	29·35	29·56	−1	4	6	*N.*	3	1	1	1	1	7	4	13	14	2	10	5
Feb.	G.	30·35	30·32	30·40	45	47	39·5	M	1	1	1	3	1	5	1	16	9	2	10	8
	M.	29·92	30·00	30·09	21·3	33	25·8	N.	2	1	2	4	2	2	2	14	9	4	11	5
	L.	29·14	29·01	29·06	−1·5	24·5	4·5	*N.*	2	2	1	2		6	2	14	12	3	12	2
March.	G.	30·61	30·59	30·61	42	60	46	M.	9	1	1	2	5	4	1	8	8	4	13	6
	M.	30·01	29·97	29·97	28·4	39·4	32	N.	8	1	2	1	5	5	3	6	10	6	10	5
	L.	28·99	28·66	28·59	12	29·5	14·5	*N.*	5	1	3	1	5	6	2	8	12	3	14	2
April.	G.	30·37	30·37	30·32	57	78	65·5	M	5	3	1	1	2	5	5	8	9	6	9	6
	M.	29·96	29·92	29·94	41	56	46	N.	1	3	9	3	1	4	2	7	6	5	7	12
	L.	29·55	29·54	29·59	29	37·5	32·5	*N.*	2	2	8	2	1	3	3	9	14	4	8	4
May.	G.	30·73	30·46	30·40	66	75	67	M.	2	3	2		6	9		9	4	8	9	10
	M.	29·97	29·92	29·90	51·7	62·7	54·5	N.	1	3	6	2	10	4		5	2	7	7	15
	L.	29·52	29·54	29·42	39	47·5	43	*N.*	1	3	3	2	9	6	9	6	10	3	14	4
June.	G.	30·27	30·27	30·26	73	86	78·5	M.	1	3	3		3	13		7	2	8	8	12
	M.	30·05	30·05	30·05	62	73·5	64·3	N.	2	2	9		6	5	2	3	2	10	5	13
	L.	29·59	29·56	29·61	52	54	53	*N.*		2	9		7	5	1	6	5	6	7	12
July.	G.	30·32	30·30	30·34	78·5	90	76	M.	6		1		3	10	2	9	5	5	7	14
	M.	30·03	30·02	30·02	68	78·5	70·5	N		1	12		4	8	1	5	4	7	5	15
	L.	29·85	29·73	29·68	60	68	63	*N.*		2	10		5	8	1	5	7	4	9	11
Aug.	G.	30·42	30·49	30·40	74	88·5	79	M			3	1	6	9	2	7	3	12	5	11
	M.	30·14	30·14	30·12	64	79·5	68	N.		1	10		2	7	8	3	2	14	2	13
	L.	29·87	29·72	29·87	47	64·5	56	*N.*	2		7	1	8	5	4	4	13	10	2	6
Sept.	G.	30·36	30·41	30·36	70	81	77	M	3	1	2		4	8	8	4	5	12	7	6
	M.	29·94	29·92	20 93	54·5	69·5	59·5	N.		1	5	2	6	7	9	1	6	13	5	6
	L.	29·27	29·27	29·41	40	56	47	*N.*		1	5	1	3	4	1	3	13	8	5	4
Oct.	G.	30·59	30·62	30·65	54	72	62	M	6	3	4	1		7	4	4	6	5	10	9
	M.	30·24	30·12	30·20	43	54	46·5	N.	2	3	10		2	3	4	7	5	10	10	6
	L.	29·56	29·54	29·51	28	43	33	*N.*	1	4	11	1	2	4	3	5	13	4	12	2
Nov.	G.	30·55	30·50	30·57	47	56	53·5	M.	4		2		3	5	4	11	7	8	8	6
	M.	29·96	39·99	59·98	31·5	42	35·5	N.	2	1	4	2	2	5	1	11	9	6	8	6
	L.	28·84	29·41	29·51	11	24	17	*N.*	1	2	2	5	2	5	1	12	12	4	11	3
Dec.	G.	30·26	30·15	30·30	36	42	41	M.	5	1					10	15	9	4	8	10
	M.	29·70	29·69	29·71	19	28·5	22·5	N	3		2		2	1	6	17	8	10	9	4
	L.	28·87	29·10	29·29	−6·5	91	1	*N.*	2	1	1	1	1	1	5	19	15	5	9	2
Year.	G.	30·73	30·62	30·65	78·5	90	79	M.	53	16	20	9	36	80	43	109	76	75	109	104
	M.	29·991	29·974	29·992	43·2	55·1	46·8	N.	24	18	72	19	44	57		9	68	98	92	101
	L.	28·84	28·66	29·56	−1·5	14	4·5	*N.*	19	21	61	17	46	60	58	104	134	57	113	57

1797		Barometer. 7 A. M.	2 P.	9 P. M.	Thermometer. 7 a.m.	2 p.m.	9 p.m.		Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair.	mostly fa.	cloudy.	mostly cl.
	G.	30·62	30·66	30·65	34	44	39·5	M.	2	2			4	4	3	16	10	5	10	6
Jan.	M.	30·02	29·98	30·02	17	28	20·5	N.	1	1	1		2	6	6	14	11	5	7	8
	L.	29·51	29·49	29·35	-12·5	6	-3·5	*N.*	1	1	1		1	9	4	14	16	4	10	1
	G.	30·43	30·27	30·40	46	54	45	M.	4	1	1	3	3	3	4	9	9	1	13	5
Feb.	M.	29·92	29·88	29·90	29·5	37	35	N	4	2	1	2	4	5	4	6	6	6	10	6
	L.	29·50	29·33	29·46	14·5	19	15	*N.*	3	2		1	5	4	2	11	9	7	11	1
	G.	30·49	30·47	30·55	52	68	52	M.	3	1	4	2	2	4	2	13	7	7	14	3
March.	M.	29·98	29·94	29·95	32·5	42·4	32·3	N.			6	3	6	4	2	10	7	8	11	5
	L.	29·29	29·24	29·40	13	22	16	*N.*		1	4	1	5	4	2	14	10	8	11	2
	G.	30·26	30·21	30·25	59	80	60	M.	6	6	3		5	6	1	5	6	8	10	6
April.	M.	26·98	29·95	29·98	41·3	52	43·5	N.	2	6	6		5	5	3	5	5	6	12	7
	L.	29·33	29·27	29·46	26	35	33	*N.*	2	6	6	1	3	5	3	6	12	3	13	2
	G.	30·24	30.33	30·23	63	81·5	65	M.	2	2	3	3	4	7	1	9	8	4	13	6
May.	M.	29·94	29·88	29·94	49·2	63	50·5	N.	2	1	12	2	3	3	2	6	6	4	10	11
	L.	29·50	29·41	29·60	39·5	40	37	*N.*	2	2	11	4	2	2	2	6	12	2	14	3
	G.	30·30	30·31	30·28	71	89	78	M.	3		2	2	4	7	2	10	10	9	5	6
June.	M.	30·03	30·03	30·03	60·7	72	64·4	N.	1	1	7	2	4	7	1	7	5	13	4	8
	L.	29·67	29·67	29·78	51	56	51	*N.*		1	8	1	4	8	1	7	12	5	7	6
	G.	30·15	30·15	30·14	75	89	78·5	M.	3		2	3	6	7	4	6	9	9	8	9
July.	M.	30·00	29·99	29·99	66·5	80·7	72·2	N.			12	3	5	6		5	1	15	2	12
	L.	29·72	29·67	29·73	64	73	67·5	*N.*			11	2	7	4	2	5	9	9	4	9
	G.	30·25	30·26	30·27	71	82	71	M.	1	6	7	3	1	4	1	8	6	3	13	9
Aug.	M.	30·02	30·00	30·02	64	73	66	N.	1	5	10	1	4	4	1	5	1	8	10	12
	L.	29·72	29·71	29·70	54	68	57·5	*N.*	1	6	11		2	2	3	6	9	4	11	7
	G.	30·35	30·47	30·35	67	83	74	M.	6			1	2	4	11	6	8	10	5	7
Sept.	M.	29·99	29·99	30·01	53	68	57·5	N.	5	2	5		1	7	8	2	5	11	6	8
	L.	29·43	29·54	29·58	42	51	49	*N.*	4	2	5	1	1	5	7	5	14	8	4	4
	G.	30·42	30·40	30·46	62	73	66	M.	1	3		2	1	5	14	5	7	11	8	5
Oct.	M.	29·90	29·90	29·89	41·5	55	46	N.	1	2	2	3	2	3	10	8	3	6	12	10
	L.	29·43	29·20	29·08	30	43	35	*N.*	2	1		2	3	2	11	10	12	7	8	4
	G.	30·50	30·55	30·56	66	69	68	M.	2		1		6	4	10	7	4	9	7	10
Nov.	M.	29·91	29·86	29·89	32	42	34	N.	1		1	1	3	5	12	7	3	13	7	7
	L.	29·37	29·32	29·15	16	25	19	*N.*	3		2	1	4	4	11	5	8	7	9	6
	G.	30·45	30·42	30·41	44	57	41	M.	1	1			1	7	8	13	10	6	6	9
Dec.	M.	30·01	29·99	30·02	20·5	29·5	24·5	N.	2	1	1		3	3	11	10	10	9	6	6
	L.	29·91	29·28	29·53	1	3	4	*N.*	2	1	1		3	5	10	9	10	6	14	1
	G.	30·62	30·66	30·65	75	89	78·5	M.	35	22	25	19	37	62	61	107	94	78	112	81
Year.	M	29·975	29·947	29·970	42·1	53·4	45·2	N.	20	21	64	17	40	58	60	85	63	104	97	100
	L.	29·26	29·20	29·08	-12·5	6	-3·5	*N.*	20	23	60	14	40	52	58	98	133	70	115	46

1798		Barometer. 7 A.M.	2 P.M.	9 P.M.	Thermometer. 7 a.m.	2 p.m.	9 p.m.	Winds.	N	NE	E	SE	S	SW	W	NW	Weather. fair.	mo.fa	clo'y.	mo.cl
Jan.	G.	30·42	30·42	30·47	50·5	51	44	M.	5	1		1	4	5	3	12	7	4	13	7
	M.	29 98	29·94	29·97	26·5	31·5	25·5	N.	4	1	2	2	3	4	3	12	6	8	11	6
	L.	29·46	29·55	29·57	5	17	7	*N*.	4	1	2	1	3	8	1	11	17	1	11	2
Feb.	G.	30·65	30·61	30·63	35 5	43	37·5	M.	8	3	1		1		4	11	7	3	11	7
	M.	30·01	29·94	30·02	21	30	24	N.	8	2	2	1	1		5	9	7	3	10	8
	L.	29·51	29·36	29·54	–2	13	3·5	*N*.	7	4	2	2		1	3	9	11	3	11	3
March.	G.	30·47	30·45	30·41	40·5	72	56	M.	3	2	2	1	3	5	6	9	9	5	12	5
	M.	29·89	29·85	29·86	31	41	34·5	N.	1	5	2	2	3	6	2	10	7	7	7	10
	L.	29·04	29·33	29·05	11	29	23	*N*.	1	4	1	1	3	6	2	11	15	8	8	5
April.	G.	30·47	30·47	30·47	68	78	68	M.	3	4	5	1	3	7	2	5	13	1	14	1
	M.	30·02	29·99	30·02	43·5	49·5	46	N.	3	7	6	1	5	4	2	2	7	6	14	3
	L.	29·38	29·36	29·43	27	33	38	*N*.	2	6	5		4	5	2	5	14	2	12	2
May.	G.	30·53	30·49	30·45	68	84	71	M.	1	4	3	3	2	7	3	11	12	2	13	4
	M.	30·00	29 98	29·99	54·5	66	57	N.	1	6	5		2	7	2	5	7	6	10	8
	L.	29·46	29·42	29·50	45	50	45	*N*.		6	7		4	7	1	6	12	1	13	5
June	G.	30·25	30·24	30·24	73·5	84	77·5	M.	5	4	1	2	3	13	1	3	6	8	8	8
	M.	29·99	29·98	29·97	61·5	73	65	N.	2	3	7		4	9		3	2	12	8	8
	L.	29·76	29·72	29·77	53·5	57·5	53	*N*.	1	3	4	3	8	11		3	10	6	6	8
July.	G.	30·21	30·18	30·18	80	93·5	82	M.	1	2	1	1	3	11	2	8	9	11	6	5
	M.	29·98	29·97	29·97	66·5	78·5	69·5	N.			7		3	12	3	5	1	19	2	9
	L.	29·80	29·73	29·73	56	60	59	*N*.			5	1	4	13	1	8	15	4	4	8
Aug.	G.	30·32	30·34	30·27	79	93	83	M.	2	2	2		2	8	7	7	10	6	6	8
	M.	30·05	30·03	30·04	69·5	82	72·5	N.	1		11		1	11	3	4	4	13	1	13
	L.	29·79	29·71	29·76	57	71	63	*N*.	1		8	4	2	11	2	8	18	8	3	2
Sept.	G.	30·40	30·40	30·33	75	88	75	M	4	1	7	3	1	4	3	6	9	7	8	6
	M.	30·03	30·02	30·03	58	72	62	N.	1		12	2	2	3	4	5	3	14	3	10
	L.	29·71	29·59	29·65	40	54	40	*N*.			13	1	2	5	2	6	14	5	7	4
Oct.	G.	30·54	30·58	30·56	58	73	61	M.	8	5	2	2	2	3	2	8	9	5	12	5
	M.	30·04	30·02	30·04	47·5	56·5	47	N.	2	7	9	2	2	3	1	5	10	10	9	2
	L.	29·43	29·42	29·34	29·5	39·5	31·5	*N*.	2	8	8	1	1	4		6	16	3	10	2
Nov.	G.	30·50	30·49	30·45	48·5	57	50	M.	6	1		1	2	3	5	12	9	4	9	8
	M.	29·98	29·97	29·99	32	41	34	N.	7		3		1	5	3	11	8	8	10	4
	L.	29·12	29·25	29·26	18	30	20	*N*.	3	1	4		1	5	2	14	11	3	12	4
Dec.	G.	30·50	30·44	30·46	39·5	44	38	M.	8		1		1	3	2	16	6	7	11	7
	M.	29·84	29·81	29·84	20	27	22·5	N.	6		1		1	2	3	18	5	10	10	6
	L.	29·18	29·20	29·09	3	14	11	*N*.	5	1			1	3	1	20	15	3	12	1
Year.	G.	30·65	30·61	30·63	80	93·5	83	M.	54	29	25	13	27	69	40	108	106	63	123	71
	M	29·984	29·959	29·978	44·1	54·9	46·8	N.	36	31	67	17	28	66	31	89	67	116	95	47
	L.	29·04	29·20	29·05	–2	3	3·5	*N*.	26	34	59	11	33	79	17	93	168	42	109	46

1799.		*Barometer.* 7 A. M.	2 P. M.	9 P. M.	*Thermometer.* 7 a.m.	2 p.m.	9 p.m.		*Winds.* N	NE	E	SE	S	SW	W	NW	*Weather.* fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30.64	30 64	30·68	41·5	49	39	M.	4	2	2			5	2	16	8	3	13	7
	M.	30·12	30·12	30.11	22	30·5	24·5	N.	6	1	1		3	2	2	16	8	6	18	4
	L.	29·53	29·50	29·41	–6	2	–5	*N.*	4	1	1		3	2	4	16	12	7	10	2
Feb.	G.	30·64	30·67	30·62	48	51	44	M.	2	1		3	1	3	4	14	6	8	9	5
	M.	29 96	29·92	29·94	20	31·5	23	N.	1	4		1	3	3	2	14	10	5	10	3
	L.	29·52	29·23	29·43	4	16	10	*N.*	1	4	1		3	2	3	14	19	1	7	1
March.	G.	30·51	30·59	30·50	38·5	53	42	M.	7	1			2	5	2	14	6	1	16	8
	M.	29·89	29·86	29·89	23·5	34	28	N.	1	4	3	1	3	3	4	12	8	9	8	6
	L.	29·10	29·25	28·89	–6·5	14	4	*N.*	1	4	4		3	3	4	12	10	4	13	4
April.	G.	30·29	30·23	30·27	55·5	71	58·5	M.	4		2		3	3	6	12	12	2	10	6
	M.	29·78	29·77	29·84	39	51·5	41·5	N.	2		9		2	1	7	9	11	9	6	4
	L.	29·15	29·17	29·16	25	32·5	28	*N.*	1		7		2	3	4	13	15	7	8	1
May.	G.	30·34	30·35	30·33	66	86	71	M.	4	1			5	8	2	11	10		8	12
	M.	29·92	29·92	29·93	51	64	50·5	N.	3	2	5	1	4	3	3	10	3	10	8	9
	L.	29·54	29·48	29·62	35	44	40	*N.*	2	3	3		7	4	3	9	9	6	10	5
June.	G.	30·40	30·41	30·35	76	90	79	M.	3		3		6	10	2	6	5	2	10	13
	M.	29·99	29·98	29·93	62·5	74	61·5	N.	1	1	8	1	4	7	2	6		12	5	13
	L.	29·31	29·46	29·25	46	46	44	*N.*	1	1	9	1	5	6	2	5	3	9	9	9
July	G.	30·27	30·26	30·25	76	88	79	M.	1	4	3	1	2	9	3	8	5	12	7	7
	M.	35·05	29·99	29·99	64·5	88·5	70	N	1	2	14	2	4	4		4	2	14	5	10
	L.	29·73	29·72	29·74	58	67	62	*N.*		2	11	1	5	6	4	2	11	5	8	7
Aug.	G.	30·37	30·41	30·41	75	90	80	M.	5	2	1		3	7	7	6	5	10	4	12
	M.	30·01	30·01	30·02	66	78·5	69·5	N.		3	5	3	4	7	4	5	3	14	4	10
	L.	29·70	29·65	29·72	51	67	58	*N.*		3	5	3	4	8	3	5	11	8	3	9
Sept.	G.	30·29	30·26	30·23	71	80	72	M.	7	3	5	3		4	1	7	2	8	14	6
	M.	30·07	30·05	30·06	58	66	59	N.		5	11	2	1	2	1	8	1	9	10	10
	L.	29·74	24·83	29·85	44	57·5	48	*N.*	1	4	10	1	2	3		9	10	4	11	5
Oct.	G.	30·47	30·35	30·44	59	67	64·5	M.	5		2	1	2	5	3	13	9	6	10	6
	M.	30·07	30·00	30·06	42·5	55	48·5	N.	3	1	4	3	4	3	3	10	8	8	11	4
	L.	29·64	29·61	29·49	28	37	34	*N.*	2	1	6	1	4	3	3	11	11	6	6	8
Nov.	G.	30·31	30·33	30·38	55	66·5	62	M.	4	1	2		2	8	7	6	9	5	8	8
	M.	29·88	29·85	29 87	37	46·5	39·5	N.	3	1	1	1	3	9	3	9	6	6	8	10
	L.	29·33	29·32	29·18	22	33	25	*N.*	2	1	3	1	1	8	5	9	13	3	9	5
Dec.	G.	30·34	30·33	30·35	39	40	41·5	M.	8		1		1	3	5	13	8	4	16	3
	M.	29·90	29·87	29·88	24·5	32	27·5	N.	9		2		1	2	6	11	3	8	14	6
	L.	29·32	29·18	29·20	5	20	13	*N.*	6	1	1	1	1	2	5	14	11	1	17	2
Year.	G.	30·64	30·67	30·68	76	90	80	M.	54	15	22	8	27	70	44	126	85	61	125	93
	M.	29·970	29·945	29·960	42·1	53·4	44·8	N.	27	24	63	15	36	46	37	114	63	110	102	89
	L.	29·10	29·17	28·89	–6	2	–5	*N.*	21	25	61	9	40	50	40	119	135	61	101	58

1800.		*Barometer.* 7 A. M.	2 P. M.	9 P. M.	*Thermometer.* 7 a.m.	2 p.m.	9 p.m.		*Winds.* N	NE	E	SE	S	SW	W	NW	*Weather.* fair.	mostly fa.	cloudy.	mostly cl
Jan.	G.	30·48	30·46	30·45	43	48·5	37	M.	5				2	3	6	15	14	1	12	4
	M.	29·81	29·77	29·81	22·5	31·5	25·5	N.	6		1		2	2	9	11	7	4	10	10
	L.	28·77	28·73	29·05	−2	10	3·5	*N.*	2	1	1		1	4	11	11	18		11	2
Feb.	G.	30·32	30·34	30·35	38	48	33	M.	1	3			1	3	2	18	9	6	7	6
	M.	29·87	29·88	29·85	23	32·5	26	N.	4	3	1			1	3	16	4	10	7	7
	L.	29·34	29·36	29·29	6	19	11	*N.*	2	2	2			2	3	17	10	4	9	5
March.	G.	30·58	30·55	30·46	43·5	59	49	M.	6	2	1		1	4	3	14	13	2	13	3
	M.	29·82	29·81	29·84	29	40	32	N.	5	2	3	1	3	2	3	12	10	5	11	5
	L.	29·31	29·29	29·39	6·5	23	12	*N.*	3	2	4	1	3	2	3	13	10	4	11	7
April.	G.	30·40	30·32	30·25	59	82	65	M.	5	3	1	1	6	3	2	9	7	6	10	7
	M.	29·95	29·92	29.96	46	57	48	N.		2	4		8	3	2	11	6	8	8	8
	L.	29·46	29·34	29.48	33	40	39	*N.*	1	2	3		7	2	3	12	6	8	14	2
May.	G.	30·37	30·33	30·34	60	76	65	M.	7	4	2		4	3	2	9	10	3	12	6
	M.	30·03	30·03	30·03	51	62	54	N		2	17	1	2	1	1	7	7	3	10	11
	L.	29·55	29·59	29·78	43	42	43	*N.*		2	14		4	2	3	6	9	5	12	5
June.	G.	30·16	30·19	30·16	73	89	75	M.	3	1	1	1	4	7	3	10	11	5	6	8
	M	29·92	29·90	29.91	63	75	62	N.			9		2	9	1	9	4	9	5	12
	L.	29·52	29·49	29·62	50	64	54	*N.*	1		8		3	7	3	8	12	6	3	9
July.	G.	30·45	30·43	30·45	80	95	83	M.	5	1	7		1	7	3	7	11	7	4	9
	M.	30·10	30·10	30·10	68·5	82	71	N.			17	1	3	4	2	4	8	8	2	13
	L.	29·72	29·73	29·78	55	69	59	*N.*			16		2	8	2	3	13	6	8	4
Aug.	G.	30·32	30·32	30·32	76	87	80	M.	3	5	2	2	2	9	2	6	13	5	8	5
	M.	30·06	30·02	30·03	65	76·5	67·5	N.	1	1	9	1	2	8	3	6	10	8	8	5
	L.	29·59	29·63	29·79	53	62	59·5	*N.*		1	7		2	9	2	10	13	5	9	4
Sept.	G.	30·45	30·50	30·47	69	83	70	M.	6	3	5		2	5	2	7	8	5	11	6
	M.	30·13	30·08	30·09	57·5	68·5	60	N.	1	4	12		1	6	1	5	3	7	8	12
	L.	29·64	29·59	29·65	46	55	49	*N.*	2	3	11		2	5	2	5	13	4	8	5
Oct.	G.	30·64	30·54	30·74	64	69·5	63	M.	4	1	3		5	4	5	9	10	5	11	5
	M.	30·06	30·10	30·12	46	58	49	N.	2	5	6	1	2	5	4	6	6	12	6	7
	L.	29·33	29·29	29·27	33	45	40·5	*N.*	1	5	1	2	3	4	6	9	14	3	11	3
Nov.	G.	30·30	30·34	30·40	57	60	47	M.	3	3			2	4	4	14	8	4	14	4
	M.	29·90	29·87	29·89	34	40·5	46	N.	3	2		1	2	3	2	17	3	7	13	7
	L.	29·22	29·24	29·28	8	31	19	*N.*	1	2			1	4	4	18	10	2	13	5
Dec.	G.	30·44	30·47	30·47	56	60	53	M.	3		1	3	2	4	4	14	9	4	7	11
	M.	30·01	29·99	30·01	30	38·5	32·5	N.	1	2	1	3		6	3	14	5	10	12	3
	L.	29·32	29·41	29.10	16	30	21	*N.*	2	1	2	3	1	5	3	14	7	6	15	3
Year.	G.	30·67	30·55	30·74	80	95	83	M.	5	26	22	7	32	5[illegible]	38	132	123	53	115	74
	M.	29·972	29·956	29·970	44·5	54·6	46·5	N.	23	23	80	9	28	50	34	118	73	91	100	100
	L.	28·77	28·73	29·05	−2	10	3·5	*N.*	15	21	69	6	29	54	45	126	135	53	124	54

		Barometer.			*Thermometer.*				*Winds.*								*Weather.*			
1801		7 A. M.	2 P. M.	9 P. M.	7 a.m.	2 p.m.	9 p.m.		N	NE	E	SE	S	SW	W	NW	fair.	mostly fa.	cloudy	mostly cl.
Jan.	G.	30·66	30·71	30·69	37	50	43	M.	4	1	1	1		1	2	21	6	8	9	8
	M.	29·94	29·90	29·93	22	32	24·5	N.	3	1	1	1	1	1	4	19	6	4	10	11
	L.	29·33	29·31	29·30	–1	11·5	3	*N.*	3	1	1	1		2	3	20	9	3	16	3
Feb.	G.	30·59	30·55	30·60	50	62	48	M.	2		1	2		8	2	13	8	3	8	9
	M.	30·06	30·01	30·04	24	34·5	25	N.	2		2	2		6	3	13	10	5	6	7
	L.	29·26	29·34	29·51	3·	17·5	5	*N.*	2		2			7	4	13	14	1	9	4
March.	G.	30·63	30·53	30·53	47	56	43	M.	4	8	6	1	1	2		9	5	2	22	2
	M.	29·91	29·87	29 91	36·6	43·4	35·6	N.	3	10	8	1			1	8	4	4	18	5
	L.	29·40	29·31	29·38	21	32·5	23	*N.*	3	10	6	1	1	3		7	7	1	19	4
April.	G.	30·40	30·41	30·41	63	70	54	M.	4	10	3	1		3		9	6	4	13	7
	M.	30·04	30·02	30·03	43·8	51·1	41·2	N.	3	5	13	2		1	1	5	9	5	10	6
	L.	29·37	29 22	29·73	3·5	34	31	*N.*	4	4	10	3	2	2		5	13	2	14	1
May.	G.	30·14	30·12	30·11	71	88	67	M.	3	5	3	1	4	7	2	6	4	5	12	10
	M.	29·87	29·85	29·87	57·8	66·2	55·3	N.		3	14		5	4	3	2	4	6	11	10
	L.	29·47	29·45	29·43	51	52	47	*N.*		3	13		4	7		4	5	4	14	8
June.	G.	30·22	30·18	30 18	78	97	79	M.	2	5	1	2	3	8	3	6	12	2	10	6
	M.	29·97	29·93	29·95	63·2	76·8	60·3	N.		2	12	1	4	5	2	4	3	9	4	14
	L.	29 58	29·62	29·68	8	48·5	44	*N.*		1	11	2	3	7	2	4	9	7	10	4
July.	G.	30·25	30·23	30·25	82	97	81	M.	1	1	4	1	9	8		7	8	4	8	11
	M.	29·96	29·92	29·95	70·4	83·5	68·2	N.			10	2	5	7		7	3	14	3	11
	L.	29·65	29·61	29·59	57	71	55	*N.*		1	7	1	7	8		7	11	4	7	9
Aug.	G.	30·22	30·15	30·14	78	93 5	81	M.	2		1	2	5	7	4	10	7	7	7	10
	M.	29·93	29·89	29·85	56·3	79·	65·2	N.	1		6	2	4	6	1	11	2	13	5	11
	L.	29·56	29·34	29·65	54	66	52	*N.*			5	1	6	6	2	11	11	5	5	10
Sept.	G.	30·45	30.44	30 45	80	93·5	79	M	6	1	4	2	2	7	2	6	9	4	4	13
	M.	30·12	30·07	30·09	61·2	73·9	59·9	N.	1	2	14		1	7		5	7	13	2	8
	L.	29·85	29·68	29·71	39	51	38	*N.*	1	1	12			8	3	5	15	5	5	5
Oct.	G.	30·36	30·49	30·36	62	74	64	M.	3	1	2	1	4	4	5	11	14	6	5	6
	M.	30 08	30·02	30·05	45·5	62·9	46·8	N.		2	5	1	4	6	3	10	12	7	3	9
	L.	29·65	29·68	29·68	27	46	25	*N.*	3	2	6		[illegible]	9	2	6	17	4	4	6
Nov.	G.	30·58	30·49	30·51	79*	67	60	M.	3	1		1	7	2	3	13	10	3	10	7
	M.	30·14	30·09	30·15	37·1	45·9	35·9	N.	3	1	2	1	6	4	2	11	8	4	8	10
	L.	29·59	29·59	29·77	17	30	23	*N.*	1	1	1	1	6	[illegible]	4	14	11	3	11	5
Dec.	G.	30·35	30·32	30·33	49	55	40	M.	4		1	4	1	1	1	18	8	4	9	10
	M.	29·90	29·83	29·85	26·8	36·6	29·6	N.	3	1	1	4	4	2		17	8	5	10	8
	L.	29·56	29·47	28 87	10	18·5	14	*N.*	3	1	2	2	2	2	3	16	12	2	13	4
Year.	G.	30·66	30·71	30·69	82	97	81	M.	38	33	27	19	36	59	24	129	97	52	117	99
	M	29·993	29·950	29·972	46·4	57·3	45 9	N.	19	27	88	17	34	45	20	112	76	89	90	110
	L.	29·26	29·22	28·87	–1	11·5	3	*N.*	20	25	76	12	34	63	23	112	134	41	127	63

* This is probably a mistake, although it is distinctly written in the original minutes, and is stated to have occurred twice during the month, viz. on the 16th and 28th.

1802.		*Barometer.* 7 A. M.	2 P. M.	9 P. M.	*Thermometer.* 7 a.m.	2 p.m.	9 p.m.		*Winds* N	NE	E	SE	S	SW	W	NW	*Weather.* fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30·65	30·72	30·76	52·5	60	53	M.	1	1	1		8	5	4	11	9	3	7	12
	M.	30·11	30·03	30·10	30	38·9	31·5	N.	2	1	1	1	3	8	6	9	10	2	8	11
	L.	29·05	28·97	29·19	7	16	7·5	*N.*		1	1		4	7	5	13	13	3	7	6
Feb.	G.	30·78	30·69	30·72	39	57	39	M.	2	2	2	1	2	3	2	14	9	3	12	4
	M	30·16	30·09	30·15	22·6	34·1	23·6	N.	3	1	3	1	4	4	2	10	6	8	10	4
	L.	29·60	29·30	29·24	−3	10	1	*N.*	3	1	4	2	1	4	4	9	10	5	13	
March.	G.	30·62	30·58	30·62	53	74	52	M.	6	2		3	1	5	3	11	10	7	11	3
	M.	30·07	30·03	30·06	32·4	33·9	33·1	N.	4	3	4		3	6	4	7	5	7	12	7
	L.	29·36	29·38	29·40	13	26	15·5	*N.*	3	2	4		2	7	3	10	7	5	11	8
April.	G.	30·62	30·47	30·47	53	74	53	M.	3	1	5	1	2	5	1	12	12	5	7	6
	M.	30·09	30·04	30·03	43·1	55	41·2	N.	2		7	1	3	4	2	11	6	8	6	10
	L.	29·77	29·68	29·67	30	38	27	*N.*	3		5		4	3	3	12	15	4	8	3
May.	G.	30·36	30·22	30·30	63	82	60	M.	6	7	3	1	4	1	2	7	4	2	15	10
	M.	29·89	29·83	29·88	51·5	60·5	49	N.	3	7	11	1	2	2	1	4	4	3	13	11
	L.	29·24	29·32	29·37	39	46	36	*N.*	3	5	12	1	3	2	1	4	6	3	18	4
June.	G.	30·45	30·41	30·44	79	91	76	M.	4	1	1		8	6	3	7	5	3	9	13
	M.	30·05	29·98	30·00	65·6	77·6	61·7	N.		1	8	1	7	6	2	5	3	9	4	14
	L.	29·72	29·64	29·68	55	62	51	*N.*	1	3	4		10	7		5	9	6	5	10
July.	G.	30·34	30·33	30·29	80	92·5	76	M.	2	2	5	1	2	12	1	6	5	5	14	7
	M.	30·09	30·03	30·13	68·9	80·9	67·4	N.	1	1	1	1	1	7	1	8	1	15	4	11
	L.	29·75	29·69	29·85	57	66	57	*N.*		1	10	1	2	9	1	7	12	8	6	5
Aug.	G.	30·42	30·36	30·37	76·5	91	79	M.	3	2	3	1	3	7	2	10	3	5	18	4
	M.	30·10	30·09	30·10	68·4	81·6	67·3	N.	1	4	9	1	2	5	2	7	2	9	6	14
	L.	29·88	29·80	29·88	60	58*	60	*N.*	1	5	10		5	5		5	7	5	15	4
Sept.	G.	30·41	30·37	30·43	76	87	74	M.	3	1	1	1	4	6	3	11	6	8	5	11
	M.	30·03	30·00	30·00	60·4	74·2	59·6	N.	1		3	4	3	6	2	11	1	13	6	10
	L.	29·75	29·71	29·74	37	58	40	*N.*			4	3	2	10	2	9	9	9	11	1
Oct.	G.	30·52	30·46	30·44	71	84	68	M.	6	3			2	3	4	13	5	9	10	7
	M.	30·20	30·13	30·15	49·6	62·3	50·7	N.	4	7	5	2		5	2	6	3	9	10	9
	L.	29·80	29·79	29·82	31	42	32	*N.*	6	3	4	1	3	4	3	7	11	4	13	3
Nov.	G.	30·36	30·37	30·41	57	63	55	M.	6	1	1	3	2	3	4	10	9	6	7	8
	M.	30·09	30·05	30·07	35·8	49·7	36·6	N.	4	1	4	1	2	2	6	10	8	5	8	9
	L.	29·39	29·31	29·65	25	36	27	*N*	5		4	1	2	2	3	13	15	3	7	5
Dec.	G.	30·74	30·71	30·77	48	60	55	M.	5	1	1	1	1	6	2	14	8	4	13	6
	M.	30·15	30·07	30·15	27·9	37·2	30·5	N.	3	3	1		3	7	3	11	6	3	11	11
	L.	29·77	29·60	29·56	−2	9	0	*N.*	3	1	1		4	5	3	14	9	3	12	7
Year.	G.	30·78	30·72	30·77	80	92·5	79	M	47	24	23	12	39	62	31	126	85	60	128	91
	M.	30·086	30·031	30·068	46·3	57·9	45·9	N.	[illegible]	[illegible]	67	14	33	62	33	98	55	91	98	121
	L.	29·00	28·97	29·19	−3	10	1	*N.*	28	22	63	9	42	64	28	108	123	58	128	56

* This is probably a mistake. It is noted as having occurred on the 25th, when the thermometer stood in the morning at 72, and in the evening at 66, there being few clouds through the day, and the wind south-west.

1803		Barometer. 7 A.M.	2 P.M.	9 P.M.	Thermometer. 7 a.m.	2 p.m.	9 p.m.		Winds. N.	NE	E	SE	S	SW	W	NW	Weather. fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30·51	30·37	30·39	54	55	45·5	M.	1		2		2	10	3	13	6	6	11	8
	M.	29·93	29·87	29·92	22·6	33·1	24·2	N.	2		1	1	2	10	5	10	3	9	9	10
	L.	29·33	29·32	29·47	-1	7·5	2	N'.			1		3	11	4	12	16	2	12	1
Feb.	G.	30·71	30·61	30·69	52	59	56	M.	6			2	3	4	6	7	3	7	10	8
	M.	30·18	30·12	30·15	26·8	39·2	29·8	N.	6	1		2	6	4	5	4	4	4	12	8
	L.	29·53	29·35	29·48	5	16	8	N'.	6	1		2	5	6	6	8	8	4	13	3
March.	G.	30·59	30·61	30·61	58	74	55	M.	2	2	2	2	2	4	3	14	8	8	9	11
	M.	30·13	30·05	30·14	32	44·1	32·3	N.	1	2	6		4	5	1	12	7	10	8	6
	L.	29·50	29·19	29·71	6	19	9	N'.	1	3	6		3	4	1	13	14	3	10	4
April.	G.	30·56	30·49	30·55	63	79	64	M.	10	5	2		6	2		5	5	3	14	8
	M.	30·09	30·09	30·08	44·5	52·2	42·8	N.	5	7	8	2	4	2		2	6	6	11	7
	L.	29·29	29·68	29·39	30	33	31	N'.	3	8	7		6	3		3	11	2	15	2
May.	G.	30·60	30·56	30·49	65	85	66	M.	5	4	3	4	4	3	2	6	12	3	7	9
	M.	30·12	30·08	30·09	52·1	60·9	47·1	N.	1		18	1	3	2	1	5	9	12	7	3
	L.	29·68	29·58	29·72	37	44	32	N'.		2	15	1	5	2		6	16	4	4	7
June	G.	30·40	30·36	30·39	84	94	80	M.	3	1	5	1	5	3	4	8	7	4	9	10
	M.	29·96	29·91	29·97	65·2	81·2	64·2	N.		1	10	1	3	7	1	7	2	11	10	7
	L.	29·55	29·25	29·66	51	62	51	N'.		2	6	2	2	11	1	6	5	7	13	5
July.	G	30·21	30·18	30·18	82	95	80	M	5	2	4		5	6	3	6	5	7	13	6
	M.	29·95	29·90	29·93	70·5	81·1	70	N.		2	10	3	2	7	3	4	3	9	6	13
	L.	29·66	29·65	29·71	59	60	56	N'.	1	2	7	1	5	7	4	4	6	8	11	6
Aug.	G.	30·37	30·30	30·29	78	91	82	M.	2	1	3		3	8	3	11	6	7	6	12
	M.	29·93	29·87	29·91	69·5	80·6	65·4	N.		1	12		2	6	2	8	4	14	3	10
	L.	29·67	29·63	29·65	51	70	56	N'.		2	10		3	6	2	8	15	4	5	7
Sept.	G.	*			71	82	70	M	4	1	1	2	4	6	1	11	13	6	4	7
	M.				48·9	67·6	56·6	N.	2		12		4		2	10	7	12	3	8
	L.				37·5	62	45	N'.	2		11	1	3	1	2	10	17	5	4	4
Oct.	G.				54	77	67	M.	2		3	1	2	7	4	12	13	2	10	6
	M.				44·1	60·3	47	N.	2		4	4	4	4	3	10	11	7	8	5
	L.				28	45	32	N'.	2		3	3	4	7	2	10	12	5	9	5
Nov.	G.				52	59	52	M.		2	3	1	1		6	17	9	6	7	8
	M.				30·7	43	33·8	N.	2	4	3	2		3	3	13	6	8	8	8
	L.				14	22·5	19·5	N'.	2	3	4	2	1	2	4	12	10	8	11	6
Dec.	G.				57	63	51	M.	4	1	3	1	2	3	3	14	5	5	13	8
	M.				30·3	39·5	31	N.	3		2	1	4	5	1	15	5	6	7	13
	L.				11	22·5	13	N'.	1	1	2	1	2	5	4	15	7	4	7	13
Year.	G.	30·71	30·61	30·69	64	95	82	M.	44	19	31	14	39	56	38	124	92	59	113	101
	M	30·026	29·986	30·026	44·5	56·7	45·3	N.	24	18	86	17	38	55	27	99	67	108	92	98
	L.	29·29	29·19	29·39	-2	7·5	2	N'.	18	24	72	13	41	65	29	102	187	51	114	63

* There is a chasm in the observations of the barometer, which extends to the beginning of 1805. The abstract is omitted entirely for the following year, 1804. The thermometrical observations were continued without interruption, of which an abridged view is presented in the subjoined general tables.

1805.		Barometer. 7 A. M.	2 P. M.	9 P. M.	Thermometer. 7. a.m.	2 p.m.	9 p.m.		Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair.	mostly fr.	cloudy.	mostly cl.
Jan.	G.	30·94	30·79	30·69	36	44	43	M.	4	1		2		6	8	10	6	1	17	7
	M.	30·05	29·99	30·00	18·9	26	20·6	N.	2		2		2	5	10	10	8	4	14	5
	L.	29·37	29·04	29·21	−1	6	−5	*N.*	3		1	1	1	6	12	7	9	2	16	4
Feb.	G.	30·47	30·38	30·44	38	55	39	M.	1			1		3	6	17	11	5	5	7
	M.	30·03	29·99	29·98	25·7	33·6	26·5	N.		1	2	1	1	5	4	14	9	6	5	8
	L.	29·34	29·42	29·20	4	15	5	*N.*		1	2	1		6	4	14	10	1	11	6
March.	G.	30·60	30·59	30·63	54	67	50·5	M.	3	2	3		4	6	3	10	11	2	11	7
	M.	30·29	30·22	30·24	35·8	46·8	36·1	N.	1	5	7		4	4	1	9	11	2	12	6
	L.	29·81	29·41	29·90	13	28	18	*N.*	1	5	6		2	5	4	8	11	1	14	5
April.	G.	30·43	30·32	30·25	60	78	56	M.		3	3	2		3	4	15	9	5	13	3
	M.	29·90	29·83	29·89	45·5	56·6	44	N.		3	4	2	2	2	3	14	6	10	8	6
	L.	29·53	29·54	29·54	35	37	34	*N.*	2	2	3	1	1	2	4	15	10	8	10	2
May.	G.	30·25	30·36	30·39	68	84	66	M.	2	3	2		5	4	8	7	11	4	7	9
	M.	29·99	29·92	29·99	53·2	65·6	54·7	N.	1	1	4	2	6	4	3	10	5	10	8	8
	L.	29·65	29·68	29·69	43	45	42	*N.*	1	1	4		4	6	5	10	11	6	9	5
June.	G.	30·24	30·20	30·22	80	95	80	M.		3	3	1	4	4	6	9	11	4	11	4
	M.	29·98	29·94	29·95	62·8	77	63·5	N.	1	1	14		1	4		9	5	11	6	8
	L.	29·70	29·60	29·67	48	53	49	*N.*	1	1	10	1	3	4	2	8	8	6	10	6
July.	G.	30·39	30·29	30·31	82	97	84	M.	2				3	13	1	12	14	7	3	6
	M.	30·08	30·04	30·04	69·3	86	69·2	N.	1		12		2	8	3	5	3	18		10
	L.	29·80	29·69	29·80	58	77	60	*N.*	1		8		3	10	4	5	9	10	4	8
Aug.	G.	30·29	30·29	30·25	77	92	77	M.		1	7	1	2	6	5	9	3	6	11	11
	M.	30·08	30·05	30·06	65·7	83	69·5	N.		2	10	3	1	3	3	9	6	12	2	11
	L.	29·82	29·78	29·88	58	66	60	*N.*		2	9	2	2	5	2	9	11	7	7	6
Sept.	G.	30·40	30·38	30·37	76	90	76	M	3	4	5	2	5	4	2	5	8	5	9	8
	M.	30·18	30·13	30·15	61·6	74·6	62·8	N.	1	5	13		3	7		3	5	6	7	12
	L.	29·89	29·94	29·90	45	54	48	*N.*	1	6	10	1	4	6	1	1	11	7	7	5
Oct.	G.	30·57	30·55	30·58	57	76	64	M.	3		2	2	1	4	4	14	10	7	8	6
	M.	30·04	30·98	30·01	41·5	55·7	45	N.	1	3	4	1	2	5	8	7	4	12	10	5
	L.	29·41	29·50	29·50	27	43	28	*N.*	2	2	4		1	8	8	6	13	3	10	5
Nov.	G.	30·64	30·58	30·53	54	68	57	M.	5		1	1	1	4	5	13	6	6	8	10
	M.	30·02	30·00	30·01	34·7	45·1	37·2	N.	3	1	2		2		3	14	7	8	6	9
	L.	29·45	29·59	29·44	23	33	26	*N.*	3	1	3		4	5	2	14	8	7	8	7
Dec.	G.	30·52	30·44	30·47	56	60	56	M.		1			4	3	6	16	8	5	9	9
	M.	30·03	30·02	30·02	34·5	43·3	35	N.		1			4	8	3	15	10	5	9	7
	L.	29·34	29·51	29·36	17	27	21	*N.*		1			4	8	4	14	16	2	11	2
Year	G.	30·94	30·79	30·69	82	97	84	M.	23	19	26	13	29	60	58	137	108	57	112	87
	M.	30·056	30·009	30·029	45·0	56·8	46·4	N.	11	25	72	9	30	60	41	119	79	104	87	95
	L.	29·34	29·04	29·20	−9	6	−5	*N.*	15	22	60	7	27	70	53	111	127	60	117	61

1806.		*Barometer.* 7 A. M.	2 P. M.	9 P. M.	*Thermometer.* 7 a.m	2 p.m.	9 p.m.		*Winds.* N	NE	E	SE	S	SW	W	NW	*Weather.* fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30·73	30·67	30·64	39	49	43	M.	8	1	1			4	5	12	9	2	17	3
	M.	30·15	30·10	30·13	20·1	31	23	N.	8	2	1		2	3	5	10	9	2	15	5
	L.	29·55	29·65	29·53	−6	12	0	*N.*	7	1	1			5	7	10	11	1	12	7
Feb.	G.	30·68	30·64	30·57	50	61	55	M.	3		1	4	1	5	1	13	5	1	10	12
	M.	30·08	30·04	30·04	26·	34·3	28·5	N		2	1	1	3	5	1	15	12	3	10	3
	L.	29·64	29·40	29·36	6	21	7	*N.*		2		1	1	6	5	15	13	4	9	2
March.	G.	30·39	30·38	30·40	42·5	67	52	M.	5	1	1	2		2	2	18	10	4	9	8
	M.	30·63	29·98	30·02	24	37·3	24·8	N.	4	2	4	2			2	15	8	7	9	7
	L.	29·65	29·57	29·59	11	16	13	*N.*	4		4	1		2	2	18	14	2	9	6
April.	G.	30·44	30·33	30·36	55	68	52	M.	4	3	1	1		3	2	16	8	3	11	8
	M.	29.93	29·84	29·92	36·3	47·5	40·8	N.	3	1	5	2	1	3		15	5	3	11	11
	L.	29·26	29·28	29·26	24	27	22	*N.*	3	1	6		1	3		16	13	2	9	6
May.	G.	30·37	30·37	30·32	69	86	70	M.	3	5	4	1	5	4	3	6	13	4	6	8
	M.	30·06	30·01	30·00	51·5	62·5	52·5	N	1	2	19	2		2	2	4	11	5	8	7
	L.	29·52	29·37	29·36	42	48	40	*N.*		3	11	1	1	3	7	5	12	3	8	8
June.	G.	30·54	30·54	30·47	77	92	78	M.	3	4	2	2	3	10		6	10	2	10	8
	M.	29·99	29·99	29·97	61·5	77·1	61·8	N.	1	5	8	1	1	11		3	6	6	8	10
	L.	29·23	29·26	29·27	46	59	57	*N.*	1	3	6	1	2	12	1	4	11	4	9	6
July.	G.	30·29	30·15	30·16	80	93	78	M.	4	5			3	3	9	7	8	6	10	7
	M.	29.92	29·89	29·88	63·2	81·5	64·6	N.	2	5	7		4	4	6	3	5	10	8	8
	L.	29·60	29 60	29·57	56	62	55	*N.*	3	4	6		3	4	8	2	14	2	7	8
Aug.	G.	30·29	30·20	30·23	77	93	74	M		1	3	2	6	6	4	9	11	2	7	11
	M.	29·99	29·95	29·98	63·	79	64	N.	1	1	6		6	5	4	8	5	8	6	12
	L.	29 65	29·67	29 64	50	60	58	*N.*	1		6		4	8	5	7	12	5	10	4
Sept.	G.	30·27	30·27	30·28	71	86	72	M.	5	3	1		5	3	5	8	7	2	14	7
	M.	30.00	30·00	30·03	58·1	68·7	58·1	N.	7	1	2	4	4	4	2	6	8	3	11	8
	L.	29.52	29·54	29·65	41	57	47	*N.*	7	1	1	1	5	6	5	3	10	3	14	3
Oct.	G.	30·50	30·38	30·50	61	78	65	M.	3		1		2	5	9	11	15	6	5	5
	M.	30·08	30·05	30·09	41·8	59	46·3	N.	2	2	5		6	5	6	5	14	7	3	7
	L.	29·66	29·59	29·66	30	33	33	*N.*	2	3	2		4	5	10	5	18	2	5	6
Nov.	G.	30·52	30·51	30·53	56	61	59	M.	5	1	2	2	2	4	2	12	7	5	12	6
	M.	30·08	30 02	30·04	35·7	43·7	35·3	N.	3	3	1	1	3	6	4	9	8	4	12	6
	L.	29·47	29·32	29·40	20	31	25	*N.*	3	1	3		3	6	5	9	10	4	11	5
Dec.	G.	30·69	30·65	30·64	39	51	45	M	1			1	2	11	7	8	11	6	12	2
	M.	30·04	30·02	30·05	24·7	32·1	30·5	N.	2			1	3	12	7	6	9	3	12	7
	L.	29·31	29·49	29·47	6	13	5	*N.*	1	1		1	4	6	12	6	12	3	10	6
Year.	G.	30·73	30·67	30·64	80	93	78	M.	44	24	17	15	29	60	49	126	114	43	123	85
	M.	30.029	29·991	30·012	43·0	55·4	44·6	N	34	26	59	14	33	61	39	99	100	61	113	91
	L.	29·23	29·26	29·26	6	12	0	*N.*	32	20	46	6	28	66	67	98	150	35	113	67
						$59\frac{1}{8}$														

		Barometer.			*Thermometer.*				*Winds.*								*Weather.*			
1807.		7 A. M.	2 P. M.	9 P. M.	7 a.m.	2 p.m.	9 p.m.		N	NE	E	SE	S	SW	W	NW	fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30·70	30·52	30·53	41	48	45	M.					2	14	5	10	11	3	8	9
	M.	30 06	30·01	30·02	14·6	26·8	18 8	N.	1		1		1	11	11	6	14	4	8	5
	L.	29·65	29·53	29·50	−16	−1	−9·5	*N*.	1		1	2		10	12	5	15	2	11	3
Feb.	G	30·71	30·63	30·76	43	42	43	M.	1	1	3		4	2	10	7	13	3	10	2
	M.	30·10	30·05	30 01	17·8	26·6	21·4	N.	1	2	1		5		13	6	7	8	7	5
	L.	29·15	29·06	29·24	−6	10	2	*N*.	1	1	1	2	2		15	6	14	3	10	1
March.	G.	30·35	30·33	30·29	43	46	35	M.	1	4				8	7	11	10	5	10	6
	M.	29·93	29·85	29·87	25·8	36·4	26·6	N.	2	3			1	8	10	7	11	8	7	5
	L.	29·16	29·11	29·04	11	24	14	*N*.	1	4		1		5	10	10	20	1	7	3
April.	G.	30·57	30·57	30·51	55	76	57	M.		4	3	2	3	3	6	9	9	2	12	7
	M.	29·96	29·95	29 91	40·2	49	42·1	N.	1	6	7		5	2	6	3	8	3	11	6
	L·	29·31	29·35	29·42	25	33	28	*N*.	1	5	8	1	5		4	6	8	5	13	4
May.	G.	30·18	30·12	30 20	61	80	61	M.	2	6			3	8	7	5	9	3	12	7
	M.	29·89	29·80	29·86	48 9	62 8	53·5	N.		7	4	3	3	5	4	5	2	6	11	12
	L.	29·45	29.45	29·42	38	43	36	*N*.	1	7	3	3	4	4	5	4	6	8	11	6
June.	G.	30·24	30·29	30 26	77	90	79	M.	3	2	2			7	1	5	8		8	4
	M.	29 95	29·90	29·93	58·2	71·9	60·1	N.	2	4	2	1	1	4	4	2	5	3	8	4
	L.	29·57	29 42	29·44	47	47	47	*N*.	1	2	2	1	1	5	3	5	11	4	3	2
July.	G.	30·19	30·20	30·24	76	88	79	M.												
	M.	30·00	29·94	29·98	70·3	82·2	77·1	N.												
	L.	29·81	29·81	29·80	66	74	66	*N*.												
Aug.	G.	30·21	30·13	30·18	74	89	76	M.												
	M.	30·08	30 05	30·05	66 5	78	69·6	N.												
	L.	29·92	29·90	29·92	58	68	60	*N*.												
Sept.	G.	30·49	30·46	30·52	70	78	70	M.												
	M.	30·22	30·16	30·20	55·8	69	57·6	N.												
	L.	29·87	29·88	29·90	46	60	50	*N*.												
Oct.	G.	30·45	30·47	30·50	62	78	60	M.												
	M.	30 04	30 04	30·08	46·4	59·1	47·1	N.												
	L.	29·61	29·65	29·67	26	45	26	*N*.												
Nov.	G.	30·38	30·23	30·37	37	57	51	M.												
	M	29·95	29 87	29 87	33·4	42·4	34·1	N.												
	L.	29·50	29·29	29·29	19	27	19	*N*.												
Dec.	G.	30·40	30 40	30·38	50	51	42	M.												
	M.	30 01	29 99	30·02	32·2	41 2	32·6	N.												
	L.	29·40	29·45	29 50	14	32	22	*N*.												
Year.	G.	30 71	30·63	30·76	77	90	79	M.												
	M.	30·016	29·967	29·988	41·9	52 2	44·9	N.												
	L.	29·15	29·06	29 04	−16	−1	−9 5	*N*.												

1808.		Barometer. 7 A. M.	2 P. M.	9 P. M.	Thermometer. 7 a.m.	2 p.m.	9 p.m.		Winds N	NE	E	SE	S	SW	W	NW	Weather fair.	most y fa.	cloudy.	mostly cl.
Jan.	G.	30 57	30·55	30·55	44	51	48	M.	1	1		2	3	4	11	7	9	4	10	6
	M.	30·18	30·11	30·21	19·3	30·5	21·5	N.	1	1			3	4	16	4	11	2	9	7
	L.	29·34	29·63	29·76	–6	15	3	*N.*		3			4	4	16	2	12	3	13	1
Feb.	G.	30 53	30 60	30 66	37	47	45	M.		3	2	2		3	12	5	6	1	8	12
	M	30 01	30 01	30·02	25	35·2	26·1	N.	1		2	7		3	12	2	2	5	9	11
	L.	29·62	29·21	29 35	5	21	5	*N.*		1	2	6	1	5	10	2	1	3	10	13
March.	G.	30 70	30 69	30·71	48	64	53	M.		1	3	2		2	16	7	15	4	7	5
	M.	30 19	30·09	30·13	33	43·3	34 3	N.	1		3	6		7	11	3	14	3	7	7
	L.	29·56	29·68	29 62	12	28	20	*N.*			3	4		7	16	1	16	2	7	6
April.	G.	30 55	30 50	30 54	57	71	60	M.	3	3	3	3	2	3	10	4	10	3	10	7
	M.	30 01	29 92	30 04	43 2	54·4	42 7	N.	1	2	3	7	2	3	5	6	8	8	8	6
	L.	29·61	29 22	29·57	27	43	29	*N.*	1	1	5	7	1	2	12	1	16	2	8	4
May.	G.	30·21	30 15	30·22	63	79	69	M.	3	1	2	3	1	4	12	4	9	4	12	5
	M.	29·94	29·93	29·95	50 7	61·8	50 9	N.			4	9		3	11	3	10	8	11	1
	L.	29·53	29·64	29 52	40	45	42	*N.*			8	3	1	1	15	2	13	2	11	4
June.	G.	30 27	30·27	30·30	75	90·7	82	M.			4	4	1	1	17		7	4	8	8
	M.	30 11	30·03	30·07	62·8	73·7	65·9	N.			3	6	1		17		6	6	5	10
	L.	29 75	29 73	29·78	51	48	46	*N.*			5	3	1	1	17		5	3	8	11
July.	G.	30·25	30·25	30·25	77	96·5	90	M.	1	1	2	1		6	16		9	2	6	10
	M.	30·05	30·02	30·04	65·2	81	69·9	N.		1	1	4	2	5	14		8	2	4	13
	L.	29 70	29 74	29 74	49	63	60	*N.*	2		3	1		6	15		0	3	5	10
Aug.	G.	30 36	30 33	30 36	79	90	·6	M.	1	1		2		1	21	2	13	4		11
	M.	30 04	30 04	30 07	63 2	75·7	69·8	N.				6	2	5	12	3	6	9	1	12
	L.	29 76	29·68	29·74	54	67	45	*N.*			1	2			24	1	10	2	1	15
Sept.	G.				74	88	74	M.												
	M.				54·3	70 4	55	N.												
	L.				28	44	32	*N.*												
Oct.	G.	30·63	30·55	30 56	62	76	63	M.	3		1	3	2	2	13	5	12	3	5	9
	M.	30·18	30·15	30 21	40 5	56	44	N.	2	1	2	10		2	7	5	9	5	4	11
	L.	29 82	2[illegible]·82	29·72	21	32	20	*N.*	1	2	2	4		2	18		9	2	10	8
Nov.	G.	30 42	30 39	30 34	54	66	53	M		5	1			7	11	6	7	8	9	6
	M.	30 02	29 93	29 96	34·5	45·3	37	N.		4	2	1	3	8	7	5	7	2	8	13
	L.	29·44	29·45	29·41	19	24	19	*N.*		4	4	1	1	2	12	6	9	2	12	8
Dec.	G.	30 63	30·52	30 56	55	58	57	M	2	1	1	1	5	3	14	4	7	3	10	11
	M.	30 02	30·01	30·63	28	35 5	28 6	N.	2	3	1	1	3	3	3	5	6	4	11	10
	L.	29 02	29 14	29·43	5	18	12	*N*	1	1	2	3	4		17	3	9	5	14	3
Year.	G.	30 70	30 69	30 71	79	96·5	90	M												
	M.	30·068	30 022	30·066	44·1	55·6	45·8	N												
	L.	29 34	29·21	29 35	–6	15	3	*N.*												

1809.		Barometer. 7 A. M.	2 P. M.	9 P. M.	Thermometer. 7 a.m	2 p.m	9 p.m.		Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30·38	30·34	30·30	34	40	30	M.	2	1		1		7	14	6	15	4	8	3
	M.	29·95	29·86	29·85	17	21	18·5	N.	1			1	1	7	13	8	8	5	10	7
	L.	29·08	29·10	29·36	–1	11	5	*N.*		1	1		3	3	19	4	17	2	7	4
Feb.	G.	30·64	30·59	30·58	35	45	45	M.	2				1	5	7	13	12	1	8	7
	M.	30·05	29·96	30·02	16·7	29·9	18·5	N.		2		1	2	6	6	11	9	5	5	9
	L.	29·17	29·44	29·14	–7	10	–4	*N.*	1	1	2	1	2	2	16	3	18	2	9	4
March.	G.	30·65	30·90	30·73	37	50	42	M.		1	1	2	3	7	7	10	15	1	11	4
	M.	30·08	30·10	30·15	26·7	41·9	28	N.	1		3	2	2	9	6	8	8	6	4	13
	L.	29·61	29·57	29·62	7	23	7	*N.*	2	1	4	1	4	4	12	3	12	1	8	9
April.	G.	30·51	30·41	30·49	55	76	60	M.			6		2	4	14	4	16		7	7
	M.	30·08	29·98	30·06	41·4	54·9	42·6	N.			6	1	6	3	10	4	13	1	6	10
	L.	29·58	29·40	29·64	32	36	32	*N.*			4	1	5		18	2	13	4	7	6
May.	G.	30·37	30·26	30·34	69	82	68	M.	2		1	5	4	2	15	2	10	3	10	8
	M.	29·90	29·85	29·86	51·7	66·9	50·7	N.	1		5	7	2	2	11		4	11	6	10
	L.	29·60	29·66	29·57	41	43	41	*N.*	2		2	3	11	4	13	1	13	1	8	9
June.	G.	30·40	30·34	30·36	76	87	74	M.			1	5	3	4	17		6	4	8	12
	M.	30·02	30·00	30·06	61·7	75·9	61·5	N.			2	12	6	4	6		2	10	3	15
	L.	29·81	29·69	29·66	53	60	52	*N.*		1	3	5	7	2	12		9	2	4	15
July	G.	30·30	30·21	30·19	73	92	74	M.	1	7	5		2	1	15		8	5	7	11
	M.	29·97	29·92	29·97	63·4	76·6	62·9	N.	1		6	7	2	3	12		2	13	8	13
	L.	29·68	29·63	29·73	52	55	53	*N.*		1	7	1	2	1	19		12	3	7	9
Aug.	G.	30·34	30·23	30·28	78	93	75	M.	2		2	2	4	1	19		12	3	5	10
	M.	30·03	29·96	30·00	62·6	78·2	63·2	N.			4	9	7	3	7		6	7	5	12
	L.	29·81	29·71	29·72	54	62	52	*N.*			4	2	3	2	19		15	3	4	7
Sept.	G.	30·29	30·24	30·28	68	84	69	M.			1	1		2	5	2	5	4	2	
	M.	30·09	30·04	30·07	50·[illegible]	67·8	52·2	N.			1	2	1	3	3	1	6	1	4	
	L.	29·77	29·82	29·85	36	59	42	*N.*			1	1		2	6	1	7	3		
Oct.	G.	30·40	30·39	30·48	74	88	73	M.		2	5		4	2	15	3	11	4	11	6
	M.	30·16	30·11	30·13	50·8	67·[illegible]	52·6	N.		1	7	5	3	2	12	1	11	5	5	10
	L.	29·85	29·72	29·73	30	49	34	*N.*	1		10		3	1	14	2	16	3	7	5
Nov.	G.	30·62	30·58	30·64	46	73	66	M.	2	1	1		4	1	13	8	9	1	5	15
	M.	30·02	29·96	29·99	30·2	40	31·7	N.	1	1		2	3	5	12	6	9	3	8	10
	L.	29·67	29·63	29·71	11	22	20	*N.*				2	3	2	18	5	8	5	9	8
Dec.	G.	30·63	30·58	30·55	63	66	52	M.	3		3		4	3	13	5	9	4	9	9
	M.	30·00	29·93	29·97	30·9	38·5	32·3	N.	3	1	4	5	4	4	11	2	6	6	8	11
	L.	29·35	29·54	29·00	5	9	10	*N.*	1		3	3	3	3	17	1	8	[illegible]	8	14
Year.	G.	30·65	30·90	30·73	78	93	75	M.	14	12	26	16	31	39	154	53	128	34	91	92
	M.	30·029	29·972	30·01	41·7	54.7	42·6	N.	8	5	38	54	39	51	109	44	84	[illegible]	67	120
	L.	29·03	29·04	29·00	–7	10	–4	*N.*	7	5	41	20	46	26	183	22	148	30	79	90

		Barometer.			*Thermometer.*				*Winds.*								*Weather.*			
1810.		7 A. M.	2 P. M.	9 P. M.	7 a.m.	2 p.m.	9 p.m.		N	NE	E	SE	S	SW	W	NW	fair.	mostly fa:	cloudy.	mostly cl.
	G.	30·58	30·58	30·60	39	51	48	M.	1		1		6	3	16	4	12	4	9	6
Jan.	M.	30·16	30·10	30·10	19·4	30·7	23	N.			1		5	7	13	5	9	4	5	12
	L.	29·53	29·59	29·59	−7	−2	−6·5	*N.*	1		4		5	3	16	2	12	2	7	9
	G.	30·35	30·28	30·33	50	70	55	M.			2	1	2	2	19	3	11	3	3	11
Feb.	M	30·02	29·90	30·08	22·7	42	27·4	N.	1		3	2	2	4	14	3	11	5	3	9
	L.	29·63	29·60	29·66	−6	10	3	*N.*		1	3	2	1	3	17	2	18	1	4	5
	G.	30·30	30·29	30·33	40	55	39	M.			4	1	2	2	19	3	10	4	5	12
March.	M.	29·75	29·73	29·74	29	39	30	N.	1		6	2	1	2	15	4	4	8	4	15
	L.	28·88	28·85	29·17	13	32	19	*N.*			4	3	3	2	17	2	16	2	5	8
	G.	30·42	30·41	30·45	59	79	59	M.	3	3	9	2		1	8	4	13	2	8	7
April.	M.	30·06	29·99	30·05	43	56	42·9	N.	1	2	11	4	3	1	4	4	12	2	2	14
	L.	29·44	29·55	29·70	30	34	27	*N.*	1	1	10	2	3	1	11	1	14	5	6	5
	G.	30·25	30·08	30·26	76	96	80	M.		2	6	7		3	10	3	18	7	2	4
May.	M.	29·93	29·90	29·94	55·2	64·6	52·5	N.	2	1	8	6	2	5	7		11	4	1	15
	L.	29·35	29·31	29·58	43	50	43	*N.*	2	1	6	4	1	4	13		20	3	1	7
	G.	30·19	30·20	30·20	76	85	72	M.			13	4		3	10		7	5	8	9
June.	M.	29·95	29·91	29·95	62·3	77·1	62·6	N.			11	8	1	2	8		3	10	5	12
	L.	29·65	29·61	29·66	50	55	50	*N.*			14	1	2	2	11		10	2	7	11
	G.	30·21	30·18	30·24	76	87	78	M.	1		4	1	1	1	18	1	8	5	5	9
July.	M.	30·05	30·05	30·05	68·6	76·4	63	N.			1	3	3	4	15	1	3	9	2	13
	L.	29·81	29·79	29·86	53	69	55	*N.*		1	2	3	2	3	16		8	3	4	12
	G.	30·20	30·20	30·26	78	88	76	M.	1		6	3	2	4	14	1	12	5	6	8
Aug.	M.	30·01	29·98	30·02	66·8	81	65·7	N.			7	5	3	5	10	1	7	5	4	15
	L.	29·71	29·62	29·81	56	40	55	*N.*			6	4		5	14	2	10	5	5	11
	G.	30·45	30·41	30·47	66	87	74	M.	1	2	7		1		14		9	6	7	3
Sept.	M.	30·17	30·16	30·17	57	72·7	58·5	N.	1	2	9	1		1	12	1	7	6	4	8
	L.	29·96	29·93	29·96	40	55	40	*N.*		1	11			1	13		12	1	6	6
	G.	30·60	30·53	30·56	66	85	67	M.	2		1	1	1	2	24		11	4	5	11
Oct.	M.	30·14	30·10	30·15	45·5	64·4	47·7	N.	2		1	4	3	1	19	[illegible]	9	7	2	13
	L.	29·43	29·48	29·55	19	26	24	*N.*	2		1	4	3	2	18	[illegible]	14	2	6	9
	G.	30·47	30·42	30·47	54	54	50	M.	3		7		1	2	11	6	8	3	10	9
Nov.	M.	30·14	30·09	30·13	34	46·3	35	N.	3		9	2	2	3	8	3	6	8	10	6
	L.	29·47	29·50	29·54	19	28	20	*N.*	2	1	7	2	3		14	1	10	1	9	10
	G.	30·69	30·71	30·53	51	58	43	M.	2		1		2	1	19	6	11	2	9	9
Dec.	M.	30·09	30·07	30·07	23	33	24	N.	1	4	1		4	5	12	4	9	5	8	11
	L	29·59	29·65	29·40	7	12	7	*N.*	3	1	2	2	6	1	16		7	4	8	10
	G.	30·69	30·71	30·60	78	96	80	M.	14	7	61	20	18	24	192	31	130	50	77	98
Year	M	30·040	30·000	30·029	44·7	57·4	45·1	N.	12	9	68	37	29	40	137	27	89	71	50	143
	L.	28·88	28·85	29·17	−7	−2	−6·5	*N.*	11	7	70	27	29	27	176	11	153	29	68	103

		Barometer.			*Thermometer.*				*Winds.*								*Weather.*			
1811.		7 A. M.	2 P. M.	9 P. M.	7 a.m.	2 p.m.	9 p.m.		N	NE	E	SE	S	SW	W	NW	fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30·83	30·82	30.80	50	56	52	M.	1	4				2	12	12	10	2	9	10
	M	30·18	30·15	30·19	20·3	30·6	26·1	N.	1	3				3	11	13	6	4	10	11
	L.	29·86	29·68	29·77	-1	10	3	*N.*	1	3	3			1	17	6	13	1	10	7
Feb.	G.	30·43	30·32	30·38	40	49	39	M.	4	6	3		2		10	3	7	1	12	8
	M	30·01	29·98	29·98	21·5	31·4	23·5	N	4	7	3			2	10	2	2	2	12	12
	L.	29·36	29·28	29·41	–8	12	2	*N.*	5	6	3		1	1	12		7	2	14	5
March.	G.	30·81	30·82	30·73	58	71	60	M.	1		4	5	1	4	12	4	13	1	4	13
	M	30·21	30·19	30·19	40·3	46·7	36	N.	-	2	6	8	1	2	6	6	10	4	4	13
	L.	29·53	29·57	29·72	14	32	20	*N.*		1	4	5		3	16		18	2	6	5
April.	G.	30·47	30·41	30·46	55	75	61	M.	1		4	4	1	3	10	7	13	1	3	13
	M·	30·05	30·02	30·09	41·6	54·3	41·2	N.		1	14	5		2	4	4	8	7	3	12
	L.	29·56	29·56	29·60	24	37	25	*N.*		1	8	1	3		14	3	13	4	3	10
May.	G.	30·52	30·78	30·75	65	84	65	M.		4	3	1	1	20			13	3	3	12
	M.	30·05	30·05	30·03	50·2	66·1	50·7	N			11	5	3	3	10		9	8	3	11
	L.	29·40	29·34	29·46	40	52	37	*N.*			3	1	4	1	22		13	3	4	11
June.	G.	30·42	30·36	30·35	80	95	81	M.			3	6	5	3	13		7	5	6	12
	M.	30·01	30·05	29·98	64·8	77·4	62	N.	1		4	9	3	3	10		6	8	3	13
	L.	29·64	29·65	29·25	55	60	52	*N.*			3	5	2	2	18		10		4	16
July.	G.	30·36	30·24	30·32	81·5	101	82	M.	1	3	2	5	3	3	7	7	7	4	5	15
	M.	30·05	30·02	30·02	65·3	78·8	67·2	N.		1	6	8	4	4	8	1	1	16	6	8
	L.	29·83	29·80	29·80	55	62	55	*N.*		1	7	1	6	2	15		10	8	5	8
Aug.	G.	30·39	30·30	30·35	80	97	81	M.			4		3	3	15	5	12	5	3	10
	M.	30·06	29·99	30·06	63·4	80·7	65·7	N.			8	1	4	4	11	2	10	5	3	12
	L.	29·85	29·87	29·83	51	70	55	*N.*			2			3	25		13	6	2	9
Sept.	G.	30·36	30·34	30·34	77	92	78	M.	1	2		2	1	7	14	3	15	4	2	9
	M.	30.04	30·01	30·04	56·8	70	63·2	N.	1	1	7	2	3	7	9		3	14	3	10
	L.	29.69	29·63	29·17	8	60	42	*N.*			4		1	8	16	1	14	7	3	6
Oct.	G.	30·69	30·57	30·67	70	85	74	M.	3	1	4	2	2		15	4	9	6	11	5
	M.	30·12	30·06	30·06	48·9	63·3	52	N.	3	1	5	2	2	1	15	2	7	5	9	10
	L.	29·31	29·30	29·17	18	33	33	*N.*	2	1	5	1	1	3	17	1	11	4	8	8
Nov.	G.	30·73	30·71	30·86	60	60	49	M.	1	1	2	1	1	1	14	9	9	3	8	10
	M.	80·05	30·01	30·03	36·5	47·5	37·9	N.	1	1	6	1	2		10	8	8	4	6	12
	L.	29·29	29·21	29·23	10	28	18	*N.*	1	1	4			1	23		14	4	8	4
Dec.	G.	30·58	30·52	30·67	45	56	53	M	2	2		3	1	7	11	7	11	3	8	9
	M.	29·95	29·92	29·95	27	36·5	27	N.		2		2		5	15	6	5	7	7	12
	L.	29·19	29·17	29·26	7	12	0	*N.*		1	1	1	2	2	19	5	13	4	8	6
Year.	G.	30·83	30·82	30·86	81·5	101	82	M.	15	23	29	29	21	53	133	61	126	38	74	126
	M.	30.065	30·037	30·052	44·2	56·7	45·8	N	11	19	70	43	22	36	119	44	75	34	69	134
	L.	29·19	29·17	29·17	–8	10	2	*N.*	9	15	47	15	20	27	214	16	149	45	75	95

1812.		Barometer. 7 A. M.	2 P. M.	9 P. M.	Thermometer. 7 a.m.	2 p.m.	9 p.m.		Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair.	mostly fa.	cloudy.	mostly cl.
Jan.	G.	30·62	30·51	30·71	38	42	40	M.	4			1	1	4	14	7	6		11	14
	M.	30·21	30·19	30·20	17	20	19	N.	1			1	1	[illegible]	9	11	6	2	9	14
	L.	29·35	29·27	29·10	−7	−2	−9	*N.*		1		1	3	3	17	6	11		11	9
Feb.	G.	30·60	30·76	30·48	42	44	47	M.	2	2		2	2	2	9	10	13	3	8	5
	M.	30·18	30·15	30·17	18	30	28	N.	3	1		5	3	4	8	5	8	4	8	9
	L.	29·42	29·31	29·56	−2	3	5	*N.*	2		2	3	1	6	11	4	12	2	13	2
March.	G.	30·62	30·56	30·46	39	52	40	M.	5	7		1		2	10	6	14	3	8	6
	M.	30·18	30·20	30·19	23	37	26	N.	2	5	6			3	7	8	13	2	8	8
	L.	29·58	29·69	29·69	−4	21	6	*N.*	1	5	5	1		4	14	1	15	1	8	7
April.	G.	30·57	30·49	30·48	56	76	59	M.		2	3	4	1	7	7	6	15	2	5	8
	M.	30·16	30·11	30·10	39	53	40	N.		3	8	5	3	3	4	4	8	2	3	17
	L.	29·76	29·69	29·68	25	30	25	*N.*			3	5	2	4	13	3	9	3	5	13
May.	G.	30·41	30·35	30·37	65	83	63	M.	4	2	4	2	4	5	6	4	12	3	9	7
	M.	30·03	30·01	30·03	47	56	46	N.	1	6	11	1	3	3	3	3	6	5	7	13
	L.	29·59	29·59	29·68	34	33	32	*N.*	1	5	5	3	2	3	11	1	9	3	10	9
June.	G.	30·12	30·13	30·15	70	90	76	M.	3	4	3	2	3	2	6	7	7	1	10	12
	M.	29·92	29·88	29·90	59	70	58	N.		4	5	5		7	6	3	5	8	6	11
	L.	29·59	29·70	29·60	45	55	36	*N.*		3	3	1	4	3	16		7	5	6	12
July	G.	30·20	30·18	30·19	72	88	73	M.	2	1	2	2	2	3	18	1	11	3	7	10
	M.	30·00	29·96	29·98	66	80	63	N	2		8	2	3	6	9	1	6	8	3	14
	L.	29·75	29·73	29·74	52	61	51	*N.*			9	1	1	7	12	1	14	5	4	8
Aug.	G.	30·27	30·26	30·26	68	88	72	M.		4	6	1	1	3	10	6	13	1	10	7
	M.	30·04	29·95	30·00	63	77	63	N.	2	2	7	2	3	2	13		8	7	8	8
	L.	29·77	29·55	29·76	54	61	55	*N.*	2	1	7		2	5	14		15	2	9	6
Sept.	G.	30·43	30·44	30·45	68	86	70	M.	5	4	1	1		6	10	3	14	1	6	9
	M.	30·16	30·15	30·18	50	69	54	N.	1	3	7	3	1	5	8	2	12	6	4	8
	L.	29·73	29·65	29·68	35	52	40	*N.*		1	7	1	2	3	16		17	3	3	7
Oct.	G.	30·57	30·46	30·45	65	81	72	M.			1	1	3	6	15	5	12	5	4	10
	M.	30·05	29·96	30·00	41	58	47	N.	1	1	1	1	3	5	15	4	13	4	4	10
	L.	29·43	29·38	29·38	25	40	40	*N.*	2	1	3	1	3	2	17	2	14	3	4	10
Nov.	G.	30·62	30·63	30·67	55	72	59	M.				2	5	1	19	3	15	2	3	10
	M.	30·00	29·94	30·00	32	49	34	N.	1		1		3	6	14	4	7	5	3	15
	L.	29·58	29·25	29·53	17	32	21	*N.*	1		1		1	3	23	1	14	2	5	9
Dec.	G.	30·38	30·53	30·52	37	56	42	M.	3		2	1	2	4	15	4	12	3	5	11
	M.	29·96	29·95	29·96	22	34	25	N.		1	2	1	2	5	15	5	9	3	4	15
	L.	29.43	29·40	29·49	5	22	5	*N.*		4	3	1	1	1	18	3	13	1	6	11
Year.	G.	30·62	30·76	30·71	72	90	76	M.	28	26	22	20	24	45	139	62	144	27	86	109
	M.	30·072	30·739	30·059	40·2	52·8	45·4	N.	14	26	56	26	25	57	111	50	101	56	67	142
	L.	29·35	29·27	29·19	−7	−2	−9	*N.*	9	21	48	18	22	44	182	22	150	30	84	102

The following table shews the number of mornings, evenings, and noons in each month, when there has been a fall of rain or snow, and is intended as a part of the foregoing table. The observations during several years being defective are omitted. The last column but two is the mean of the preceding columns, the last but one is the mean of the three numbers against each month, and the last is the result of a corresponding estimate of the fall of snow only.

		1791.	1792.	1793.	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1805.	1806.	1811.	1812.	mean.	do month.	Snow.
Jan.	M	4	6	6	3	6	7	5	5	4	4	8	6	7	12	6	4	6	5.8		3·3
	N.	4	5	7	3	8	6	6	6	6	4	8	4	5	13	9	2	6	6	6·3	3·3
	N.	5	8	9	8	7	10	4	10	8	4	11	7	8	5	11	2	5	7·2		4·0
Feb.	M.	9	3	7	4	8	6	11	5	6	4	8	8	7	7	7	11	6	6·9		3·8
	N.	2	2	6	8	4	8	8	5	5	6	4	9	7	7	7	8	6	6·0	6·5	3·5
	N.	5	5	8	6	3	4	11	8	6	5	8	11	11	3	6	10	4	6·7		4·3
March.	M.	1	7	5	4	7	4	7	7	6	6	11	7	4	3	9	3	2	5·5		2·6
	N.		5	6	4	2	2	8	8	4	7	14	6	6	7	8	3	3	5·5	5·8	1·4
	N.	7	8	5	5	12	7	11	5	6	9	11	7	4	4	2	2	3	6·3		2·3
April.	M.	2	2	1	3	8	2	9	4	4	8	3	4	6	8	7		2	4·3		·7
	N.	4	2	4	4	5	3	10	8	5	6	6	4	8	9	5	1	2	5·1	4·9	·5
	N.	1	5	6	4	8	2	12	5	6	12	5	4	7	6	4	1	3	5·3		·7
May.	M.	3	3	0	3	5	9	5	4	8	5	3	8	6	6	5	1	7	4·8		
	N.	4	5	1	4	8	6	7	6	9	8	9	8	4	7	1	3	7	6·1	5·3	
	N.	5	6	7	3	5	10	7	7	5	5	5	4	2	3		3	6	4·9		
June	M.	1	3	4	1	3	7	2	4	5	3	4	3	4	4	4	1	4	3·4		
	N.	3	3	4	6	7	8	5	6	8	4	6	5	6	5	9	2	2	5·2	3·8	
	N.	5	4	4	4	2	3	2	2	4	2	2	4	2	2	1		3	2·7		
July.	M	1	4	1	3	4	4	3	3	2		2	4	4	3	6	5	4	3·1		
	N.	8	2	3	6	7	11	7	8	6	6	9	4	7	2	7	3	4	5 9	4·1	
	N.	3	7	5	3	5	2		2	5	2	3	2	6	1	3	3	3	3·2		
Aug.	M.	2	4	1	3	4		5	3	4	5	4	6	2	3	7	2	6	3·6		
	N.	6	2	2	5	4	3	7	1	4	6	9	9	7	6	7	4	6	5·2	4·1	
	N	4	9	3	4	5	2	2	4	3	5	2	1	2	5	1	2	4	3·4		
Sept.	M	3	2	3	3	5	4	4	4	7	7	1	7	2	4	8	2	4	4·1		
	N.	8	3	3	5	4	5	3	4	5	3	4	4	3	6	8	4	2	4·4	4·0	
	N.	6	3	4	2	6	6	1	3	4	10	2	6	3	1	2	1	1	3·6		
Oct.	M.	2		3	5	4	3	5	4	2	5	1	5	6	7	4	5	3	3·8		
	N.	3	2	4	4	8	4	7	3	5	2	2	6	5	7	2	5	5	4·3	4·0	
	N.	5	3	5	6	2	7	8	7	2	3	1	2	2	3	1	6	4	4·0		1·0
Nov.	M.	2	7	6	1	2	2	4	4	2	8	6	3	3	3	7	6	2	4·0		1·2
	N.	2	4	8	3	3	4	5	5	2	10	4	3	4	4	8	4	4	4·5	4·5	1·2
	N.	8	7	3	11	3	6	10	10	4	4	4	4	3	3	1	3	3	5·1		1·3
Dec.	M.	3	3	4	4	8	2	4	4	7	6	4	7	5	5	7	3	4	4·7		2·0
	N.	8	2	7	6	6	4	4	7	12	6	3	6	4	6	8	4	4	5·7	5·6	2·6
	N.	10	2	9	3	7	9	6	8	9	10	6	2	10	6	1	6	4	6·3		3·0
Year.	M.	33	44	40	37	64	50	64	51	57	61	55	68	56	65	77	43	50	54·0		13·6
	N.	52	37	57	54	66	64	77	67	71	68	78	68	66	79	86	43	51	63·8		12·5
	N.	64	67	68	58	65	65	74	71	62	72	60	54	60	42	33	39	43	58·7		15·7
Mean.		50	49	55	49	65	60	72	63	63	67	64	63	61	57	65	45	48	58·8		13·9

Hygrometrical table, the result of six years observation, with De Luc's hygrometur.

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1800	G.	73	75	70	74	75	61	58	63	75	77	90	86
	M.	56·9	55	50·6	52·7	53·7	50·3	48·5	51·1	54·6	57·6	60·3	63·1
	L.	49	45	41	33	42	39	38	41	46	47	48	43
1801	G.	88	89	90	86	89	77	76	73	78	79	84	90
	M	63·8	64·5	70·1	62·1	62·3	57·9	56·6	59 4	61·4	57·2	63·6	62·3
	L.	43	48	43	38	42	41	39	47	49	42	45	44
1802	G.	86	91	88	85	90	82	72	88	82	85	84	91
	M	62	66·2	63·4	53·3	61·1	56·6	62·6	62·5	62·9	66·7	65·9	67·1
	L.	49	45	43	36	34	44	43	48	46	50	50	48
1804	G.	91	89	92	84	75	85	72	78	83	86	82	86
	M.	63·4	61·7	59·5	60·2	54·5	59·3	53·8	55·9	58	62	61·8	64·3
	L.	51	50	42	41	36	43	42	41	40	45	43	54
1805	G.	84	85	86.8	83	85	81	63	68	85	84	87	82
	M.	65·1	59·8	61·3	56·4	54·4	55·6	49·5	54·8	57·9	61·3	61·6	59·1
	L.	47	48	45	35	39	41	40	43	42	45	46	48
1806	G.	87	81	81	84	82	75	75	85	85	79	84	90
	M.	67·1	59.6	57·3	58·7	54·8	56·2	55·5	58·1	63·9	57	65·8	68·1
	L.	43	44	44	41	42	40	40	41	49	45	47	52
	G.	91	91	92	86	90	85	76	88	85	86	90	91
	M.	63	61·1	60·4	57·2	56·8	56	54·4	57	59·8	60·3	63·2	64
	L.	43	44	41	33	34	39	38	41	41	42	43	43

Difference between morning and noon, and noon and night.

1800	M.	3	4·3	4·6	4·6	6·7	2·8	5·1	4·9	4·5	5·2	4·7	3·5
	N.	1·3	2·8	·5	1	1·5	·5	2·9	2·9	2·7	3·2	3	2·5
1801	M.	6·1	10·1	9·2	8·2	11·2	10·4	11·1	11·1	10·8	10·8	6·6	6
	N.	4·6	4·8	7·2	6·2	8·2	7·6	7·3	6·5	5·8	5·9	5·9	3·3
1802	M.	7·6	6·3	10·3	8·2	10	10·7	10·3	12·6	14·4	12	10·2	6
	N.	4·6	4·1	6	4	8·3	6·2	5·4	6·6	7·4	8	7·5	3·9
1804	M.	5·7	8·4	9·2	6·3	8·6	8·7	8·7	11	13	10	9·4	7
	N.	5·3	5·7	5·9	4·1	5	8·3	5·6	6·6	9·5	8	5	3
1805	M.	5·9	6·8	8	6	9	9	9·5	10	8·8	5·9	9	4·9
	N.	4·3	1·5	4·8	5·9	4·3	5·6	5·7	5·3	4·5	4·5	4·7	2·3
1806	M.	5·7	6 7	4·7	8·2	5·4	7·7	9 2	11·3	8·4	7·4	4	6
	N.	3·7	3·1	3·8	4·2	3	3·9	5	5·5	3·9	1·5	3·4	3·8

ABRIDGED TABLES DEDUCED FROM THE PRECEDING.

Table I. shewing the *mean height* of the barometer for each month, included in the period before mentioned.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1790	29·957	29·913	30·020	29·843	29·980	29·970	29·880	30·030	30·123	29·917	29·897	29·917	29·954
1791	29·887	29·927	30·037	29·887	30·003	29·957	29·997	30·017	30·040	29·920	29·963	29·867	29·958
1792	29·840	29·873	29·883	30·057	30·000	30·033	30·010	29·937	30·073	29·987	29·900	29·857	29·954
1793	29·843	30·023	30·053	30·033	30·143	29·970	29·990	30·123	30·053	30·050	29·963	29·697	29·995
1794	29·880	29·877	30·050	30·127	30·050	29·957	30·080	30·067	30·017	30·033	29·990	29·940	30·005
1795	29·950	29·780	29·863	29·883	30·040	30·033	29·993	30·040	30·040	30·020	29·943	29·830	29·951
1796	29·970	30·003	29·983	29·940	29·930	30·050	30·023	30·133	29·930	30·187	29·977	29·700	29·985
1797	30·007	29·900	29·957	29·970	29·920	30·030	29·993	30·013	29·997	29·897	29·887	30·007	29·965
1798	29·963	29·990	29·867	30·010	29·990	29·980	29·973	30·040	30·027	30·033	29·980	29·830	29·974
1799	30·117	29·940	29·880	29·797	29·923	29·967	30·010	30·013	30·060	30·043	29·867	29·883	29·958
1800	29·797	29·867	29·823	29·943	30·030	29·910	30·100	30·037	30·100	30·093	29·887	30·003	29·966
1801	29·923	30·037	29·897	30·030	29·863	29·950	29·943	29.890	30·093	30·050	30·127	29·860	29·972
1802	30·080	30·133	30·053	30·053	29·867	30·010	30·083	30·097	30·010	30·160	30·070	30·123	30·062
1803	29·907	30·150	30·107	30·087	30·097	29·947	29·927	29·903					30·014
1805	30·013	30·000	30·250	29·873	29·967	29·957	30·053	30·063	30·153	30·010	30·010	30·023	30·031
1806	30·127	30·053	30·010	29·897	30·023	29·983	29·897	29·973	30·010	30·073	30·047	30·037	30·0 1
1807	30·030	30·053	29·883	29·940	29·850	29·927	29·973	30·060	30·193	30·053	29·917	30·007	29·990
1808	30·167	30·013	30·137	29·990	29·940	30·077	30·037	30·050		30·180	29·970	30·020	30·053
1809	29·887	30·010	30·110	30·040	29·870	30·027	29·953	29·997	30·067	30·133	29·990	29· 67	30·004
1810	30·120	29·967	29·740	30·033	29·923	29·937	30·050	30·003	30·167	30·130	30·120	30·077	30·022
1811	30·173	29·990	30·197	30·053	30·048	30·013	30·030	30·037	30·030	30·080	30·030	29·940	30·051
1812	30·200	30·170	30·190	30·123	30·023	29·900	29·980	30·000	30·163	30·003	29·980	29·957	30·057
mean.	29·993	29·989	30·000	29·982	29·976	29·981	29·999	30·021	30·064	30·050	29·978	29·931	29·997

Table II. shewing the *greatest variation* in each month, the several numbers being the means of the differences between the greatest and least height at the several hours of observation.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug	Sept.	Oct.	Nov.	Dec.
1790	1·030	1·243	1·347	1·347	·993	·440	·563	·470	·763	·823	·710	1·320
1791	1·180	1·413	1·090	1·030	·650	·930	·740	·830	·650	1·243	1·137	1·517
1792	1·317	·930	1·253	·930	·510	·550	·770	·640	·890	1·023	·850	1·040
1793	1·080	1·347	1·243	·930	·673	·573	·573	·487	·823	1·063	1·147	1·017
1794	1·563	1·307	1·273	1·137	·673	·533	·537	·570	·677	1·070	·990	·933
1795	1·293	1·120	1·393	1·010	·550	·833	·587	·657	·723	1·303	1·433	1·207
1796	1·100	1·287	1·857	·793	1·037	·680	·570	·583	1·060	1·083	1·287	1·180
1797	1·193	·937	1·193	·887	·730	·590	·440	·550	·873	1·190	1·257	1·070
1798	·910	1·160	1·303	1·080	1·030	·493	·420	·557	·727	1·163	1·270	1·297
1799	1·173	1·250	1·453	1·103	·793	1·050	·530	·707	·453	·907	1·063	1·107
1800	1·613	1·110	1·200	·897	·707	·630	·703	·650	·847	1·297	1·100	1·193
1801	1·397	1·210	1·200	·970	·673	·570	·630	·653	·700	·800	·877	1·033
1802	1·640	1·350	1·227	·813	·983	·737	·787	·530	·670	·670	·930	1·097
1803	1·050	1·217	1·137	1·080	·890	·897	·517	·670				
1804	1·270	1·110	·903	·850	·660	·563	·557	·420	·473	1·073	1·007	·933
1805	1·600	1·107	·910	·830	·660	·563	·570	·450	·473	1·077	1·110	1·073
1806	1·103	1·163	·787	1·110	·908	1·263	·610	·553	·803	·857	1·123	1·237
1807	1·023	1·550	1·220	1·190	·730	·787	·400	·260	·570	·830	·970	·940
1808	·983	1·203	1·080	1·063	·633	·527	·520	·623		·793	·950	1·373
1809	1·190	1·353	1·160	·930	·713	·650	·553	·537	·457	·657	·943	1·283
1810	1·010	·690	1·320	·873	·783	·557	·370	·507	·493	1·077	·950	1·097
1811	1·053	1·027	1·187	·873	1·283	·863	·530	·530	·850	1·383	1·523	1·383
1812	1·370	1·183	·893	·803	·757	·503	·450	·573	·753	1·097	1·187	1·037
mean.	1·224	1·181	1·201	·944	·786	·686	·563	·567	·693	1·021	1·082	1·152

Ttable III. containing the means of all the morning, of the noon, and of the evening obs. arranged in three distinct columns, and exhibiting the mean *diurnal* variation of the barometer.

	Morn.	Noon.	Even.
1790	29·968	29·950	29·946
1791	29·972	29·931	29·972
1792	29·968	29·931	29·963
1793	29·997	29·987	30·000
1794	30·017	29·997	30·002
1795	29·959	29·934	29·961
1796	29·991	29·974	29·992
1797	29·975	29·947	29·970
1798	29·984	29·959	29·978
1299	29·970	29·945	29 960
1800	29·972	29·956	29·970
1801	29·993	29 950	29·972
1802	30·086	30·031	30·068
1803	30 026	29 986	30·026
1805	30·056	30·009	30·029
1896	30·029	29·991	30·012
1807	30·016	29·967	29·988
1808	30·068	30·022	30·066
1809	30·029	29·972	30·011
1810	30·040	30 000	30·029
1811	30·065	30 037	30·052
1812	30 072	30·039	30·059
mean.	30·011	29·978	30·001

Table IV. shewing the greatest and least heights of the barometer for each year, together with he times, when they occurred, and the direction and force of the wind, face of the sky, and state of the weather at each time. The last column of this table contains also the greatest *annual* variation.

Greatest height.	Direc'n wind at gr. h't.	*	Least height.	Direct'n of wind at least h't.		Diff. extr.
30·71 Mar. 20	N	fa.	28·83 Apr. 5	NE	cl.&r.	1·88
30·58 Mar. 27	E 2*	fa.	28·83 Feb. 16	W 2	cl.&r.	1·75
30·56 Apr. 8	NW 1	fa.	28·85 Jan. 13	NE 3	cl.&r.	1·71
30·64 Sep. 27	NW 2	cl.	28·93 Dec. 18	E 3	cl.&r.	1·71
30·74 Apr. 14	S 1	fa.	29·02 Jan. 23	SW 3	cl.&r.	1·72
30·67 Oct. 2	E 2	cl.	28·97 Jan. 30	S 3	cl.&r.	1·70
30·73 May 9	N 1	fa.	28·59 Mar. 16	NW 3	cl.&r.	2·14
30·66 Jan. 9	W 1	fa.	29·08 Oct. 4	W 3	cl.&r.	1·58
30·65 Feb. 18	N 3	fa.	29·04 Mar. 12	NNW 3	cl.&r.	1·61
30·68 Jan. 5	NW 1	fa.	28·89 Mar. 27	NE 3	cl.&r.	1·79
30·74 Oct. 15	N 1	fa.	28·73 Jan. 18	NW 3	cl.&r.	2·01
30·71 Jan. 3	N 1	fa.	28·87 Dec. 23	W 3	cl.&r.	1·84
30·78 Feb. 6	NW 1	fa.	28·97 Jan. 10	SW 3	cl.	1·81
30·71 Feb. 16	N 2	cl.	29·19 Mar. 6	NW 1	few cl	1·52
30·94 Jan. 12	W 1	fa.	29·04 Jan. 27	N 2	cl.&r.	1·90
30·73 Jan. 19	NW 1	cl.	29·23 June 21	SW 3	few cl	1·57
30·76 Feb. 10	W 1	fa.	29·04 Mar. 31	NE 2	cl.&r.	1·72
30·71 Mar. 2	W	fa.	29·21 Feb. 9	W 2	cl.&r.	1·50
30·90 Mar. 25	W 3	fa.	29·00 Dec. 27	NW 2	cl.	1·90
30·71 Dec. 26	W	fa.	28·85 Mar. 6	W 3	cl.&r.	1·86
30·86 Nov. 30	W	fa.	29·17 Dec. 19	W 1	cl.	1·69
30·76 Feb. 1	W	fa.	29·10 Jan. 20	NW	cl.	1·66
G.30·94			29·23			2·14
M30·724			28·974			1·753
L.30·56			28·73			1·50

It is apparent, that the greatest and least heights of the barometer occur generally at the same season, viz. in the colder months, when the fluctuations are greatest, and often with the wind in the same quarter. Of the above twenty-two observations, there happened

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Of the greatest	5	5	4	2	1	0	0	0	1	2	1	1
Of the least	7	2	6	1	0	1	0	0	0	1	0	4

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
Greatest with the wind	6	0	2	0	1	0	8	5
Least do.	0	3	0	1	1	3	6	6

* 1, 2, 3, denote the different degrees of force of the wind; fa. fair weather, cl. cloudy, r. rain.

THERMOMETRICAL TABLES.

TABLE I.

Monthly mean state of the Thermometer.

	Jan.	Feb.	March	April	May	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1790	33·3	29·5	37·2	46·5	58·2	68·3	70·7	70·7	63·7	53·2	40·0	18·3
1791	27	20·7	40·3	50·8	61·2	70·7	74·3	73·2	63·0	48·0	41·0	31·3
1792	17·5	26·7	41·0	49·7	61·3	66·5	72·7	61·0	61·2	53·5	43·5	26·5
1793	28·3	30·3	40·3	51·3	49·0	72.2	75·0	75·3	65·3	53·7	41·3	31·0
1794	26·3	26·3	41·0	51·0	61·8	68·0	74·5	73·2	66·7	50·0	42·2	42·3
1795	27	26·1	37·0	47·7	59·5	68·5	72·5	72·4	64·4	53·1	40·5	33·7
1796	28·1	26·7	33·3	47·7	56·3	66·6	72.3	69·8	60·8	47·8	36·3	23·3
1797	21·8	33·8	35·7	45·6	54·2	67.0	73·1	67·7	59·5	47·5	36·0	24·8
1798	27·5	25·0	35·5	46·3	59·2	66·5	71·2	74·7	64·0	50·3	35·7	23·2
1799	25·7	24·8	28·5	44·0	55·2	66·0	72·3	71·3	61·0	48·3	41·0	28·0
1800	26·5	27·2	33·7	50·3	55·7	66·7	73·8	69·7	62·0	51·0	36·8	33·7
1801	26·2	28·8	38·5	45·4	59·9	66·7	74·0	70·2	64·7	51·7	39·6	31·0
1802	33·5	26 6	36·5	46·4	53·7	68·3	72·4	72·7	64·7	54·2	40·3	31·8
1803	26·6	31·9	36 1	46·5	53·3	70·2	73·8	71·8	57·7	50·5	35·8	33·6
1804	21·6	26·0	32·2	42·7	9·5	68·1	74·0	72·7	56·0	47·0	41·0	28·2
1805	21·8	28·6	39·5	48·7	57·8	67·7	74·8	72.7	66·3	47·4	35·7	37·6
1806	24·7	29·7	28·7	41·5	58·8	66·8	69·7	68·7	61·6	49·0	38·2	29·1
1807	20·1	21·9	29·6	43·4	55·1	63·4	76·5	71·3	60·8	50·8	36·6	35·3
1808	23·7	28·7	36·5	46·7	54·4	7·4	72·0	69·5	59·9	46·8	38·9	30·7
1809	18·8	21·7	32.2	46·3	56·4	56·3	67·6	68·0	56·9	56·9	33·6	33·9
1810	24·3	30·7	32·7	47 3	57·4	67·3	69·0	71·2	62·7	52·5	8·4	26·7
1811	25·7	25·4	41·0	45 7	55·7	68·1	70·4	69·9	63·3	54·5	40·6	30·2
1812	18·6	25·3	28·7	44·0	49·7	62·3	69·7	67·7	57·7	48·7	38·3	27·0
mean.	24·97	27·01	35 46	46·76	56·66	67·36	72·44	70 66	62·43	50·71	38·75	30·05
*	28·99	31·18	37·09	47·99	58·66	67·26	72·9	70·91	62·01	51·57	41·12	31·91
†	22·5	23·9	32·9	45·1	54·4	66·1	69·6	69·4	60·0	50·1	40·2	29·4
‡	45·4	48·6	57·8	60	55·4	58·4	69·7	69·7	67·3	57·4	53·4	51·4

* Monthly mean state of the thermometer, according to observations of Dr. Winthrop with Hawkesbee's thermometer, from 1742 to 1774, reduced to Fah.

† Monthly mean state of the thermometer, according to the observations of Dr. Williams, from 1783 to 1788.

‡ Monthly mean temperature according to the theoretical tables of Kirwan, for lat. 42 20.

TABLE II.

Mean temperature of the seasons from 1790 to 1812, inclusive.

	Winter. 7 A. M.	2 P. M.	9 P. M.	*Spring.* 7 A. M.	2 P. M.	9 P. M.	*Summer.* 7 A. M.	2 P. M.	9 P. M.	*Autumn.* 7 A. M.	2 P. M.	9 P. M.	Mean temp. wint.	Mean temp. spring	Mean temp. sum'r	Mean temp. aut'n.	Mean for year.
1790	29·5	33	32	44	51	47	66	75	69	49	56	52	31·5	47·3	70	52·3	50·3
1791	18·3	28	23	46	56·3	50	68·3	78·3	71·5	46.3	55·3	50·3	23·1	50·7	72·7	50·6	49·3
1792	21	29·5	25	46	56·3	49·7	57·5	76·3	69	48	58·2	42	25·2	50·7	67·6	49·4	48·2
1793	24·1	32·3	28·5	43	52	46	69	80	73	49	59	52·3	28·3	47	74	53·4	50·7
1794	24·7	30·7	28·7	46	57	50·8	67·2	76·8	71·7	48	57·8	51·8	28	51·3	71·9	52·5	50·9
1795	27·6	35·7	32	44·8	52·7	47·6	66	76·3	71·2	48	59	51	31·8	48·4	71·2	52·7	51
1796	25	35·6	28·3	40·3	52·6	44·2	64·6	77·2	67·3	43	55	47·2	29·6	45·7	69·7	48·4	48·3
1797	21·6	31·2	26	41	52·5	42	63·6	75	67·2	42·2	55	45·7	26·2	45·1	68·6	47·6	46·9
1798	22·6	30·2	24·7	43	52·2	45·8	65·8	77·8	69	45·8	56·5	47·6	25·8	47	70·9	49·9	48·4
1799	20·6	29·7	23·3	37·6	49·8	40	64·3	78·3	67	45·8	55·8	49	24·5	42·5	69·9	50·2	46·8
1800	23	32	26·3	42	53	44·6	65·5	77·8	66·8	45·8	55·6	48·3	27·1	46·5	70	49·9	48·4
1801	25·3	35	27·2	46	53·6	44·4	66·6	80·2	64·6	47·9	60·9	47·5	29·1	48·1	70·4	52·1	49·9
1802	26·5	36·5	28·2	42·3	53·1	41·1	67·8	80	65·5	48·6	62·1	48·8	30	45·6	71·1	53·1	50
1803	25·8	36·5	28·2	42·8	52·4	40·7	68·4	81	66·5	41·2	56·9	45·8	30·2	45·3	72	48	48·9
1804	22·7	33·5	25	41·1	48·6	41·6	66·9	77·9	70	47·7	57·7	48·7	27·1	43·8	71·6	51·3	48·4
1805	23·5	30·4	24·7	44·8	56·3	44·9	65·9	82	67·4	45·9	58·5	48·3	26·2	48·7	71·8	50·9	49·4
1806	26·9	36·2	28·8	37·3	49·1	39·4	62·7	79·2	63·5	45·2	57·1	46·6	30·6	41·9	68·5	49·6	47·6
1807	19	28·5	23·6	38·3	49·4	40·7	65	74	68·9	45·2	56·8	46·3	23·7	42·8	69·3	49·4	46.3
1808	25·5	35·6	26·7	42·3	53·5	42·6	63·7	76·8	68·5	43·1	57·2	45·3	29·3	46·1	69·7	48·5	48·4
1809	20·5	28·8	21·9	40	54·6	40·4	62·6	76·9	62·5	43·7	58·4	45·5	23·7	45	67·3	49·2	46·3
1810	24·3	37·1	27·6	42·4	53·2	41·8	65·9	78·2	63·8	45·5	61·1	47·1	29·7	45·8	69·3	51·2	49
1811	21·6	31·7	24·5	44	55·7	42·6	64·5	79	65	46·9	60·3	51	25·9	47·4	69·5	52·7	48·8
1812	21	28·6	25·3	36·3	48·6	37·3	62·6	75·6	61·3	41	58·6	45	24·8	40·7	66·5	48·2	45·1
Gen. mean	23·7	32·4	26·5	42·2	52·8	43·7	65·3	77·8	67·4	45·7	57·8	47·5	27·5	46·2	70·2	50·3	48·6

TABLE III.

Extremes of heat and cold for the several seasons and for the year from 1790 to 1812 inclusive. Against each year the upper number signifies the greatest and the lower the least elevation of the thermometer.

	Winter. 7 A. M.	2 P. M.	9 P. M.	*Spring.* 7 A.M.	2 P. M.	9 P.M.	*Summer.* 7 A.M.	2 P. M.	9 P. M.	*Autumn.* 7 A.M	2 P. M	9 P. M	Lowest.	Highest.	Range.
1790	47	53	47	60	75	71	77	88	84	71	79	77	5	88	83
	6·5	8	5	12	15	17	57	58	58	18	25	23			
1791	47	49	47	74	88	80	89	92	86	72	78	76	−11·5	92	103·5
	−11·5	3	−2	36	46	39	54	67	46	17	31	25			
1792	59	50	48	77	88	80·5	79	91	81·5	73	83·5	75	−11	91	102
	−11	−2	−5	28·5	34·5	32	50·5	55	52	25	30	27			
1793	59	54	52	75	90	78	81·5	92	86	77	87	80	−2	92	94
	−2	12	8	16	22	22	53	57	55	25	32	28			
1794	51	56	47	73	84	78	79·5	90	84	76	84	78	2	90	88
	2	10	2	0	12	6·5	53	63	58	22	25	25·5			
1795	53	64	60	68	82	71	76·5	91	88	74	89	79	−1	91	92
	−1	9	5	20	27	23	51	60	58	23·5	38	26			
1796	45	51	51	66	78	67	78·5	90	79	70	81	77	−1·5	90	91·5
	−1·5	14	4·5	12	29·5	14·5	47	54	53	11	24	17			
1797	46	54	45	63	81·5	65	75	89	78·5	67	83	74	−12·5	89	101·5
	−12·5	6	−3·5	13	22	16	51	56	51	16	25	19			
1798	50·5	57	44	68	84	71	80	93·5	83	75	88	61	−2	93·5	95·5
	−2	3	3·5	11	29	23	53·5	57·5	53	18	30	20			
1799	48	51	44	66	86	71	76	90	79	71	80	72	−6	90	96
	−6	2	−5	−6·5	14	4	46	46	44	22	33	25			
1800	43	48·5	43	60	82	65	80	95	83	69	83	70	−2	95	97
	−2	10	3·5	6·5	23	12	50	62	54	8	31	19			
1801	56	62	53	71	88	67	82	97	81	80	93·5	79	−1	97	98
	−1	11·5	3	21	32·5	23	48	48·5	44	17	30	23			
1802	52·5	60	53	63	82	60	80	92·5	79	76	87	74	−3	92·5	95·5
	−3	10	1	13	26	15·5	55	58	51	25	36	27			
1803	54	60	56	65	85	66	84	95	82	71	82	70	−2	95	97
	−2	7·5	0	6	19	9	51	60	51	14	22·5	19·5			
1804	57	63	51	69	85	70	83	91	85	79	93	85	−2	93	95
	−2	10	4	3	24	6	51	72	55	18	30	26			
1805	45	55	43	68	84	66	82	97	84	76	90	76	−9	97	106
	−9	6	−5	3	28	18	48	53	49	23	33	26			
1806	56	61	56	69	86	70	80	93	78	71	86	72	−6	93	99
	−6	12	0	11	16	13	46	59	55	20	31	25			
1807	43	51	45	61	80	61	77	90	79	70	78	70	−16	90	106
	−16	−1	−9·5	11	24	14	47	47	47	19	27	19			
1808	51	51	48	60	79	69	79	96·5	90	74	88	74	−6	96·5	102·5
	−6	15	3	12	28	20	49	48	45	19	24	19			
1809	55	58	57	69	82	68	78	93	75	74	88	73	−7	93	100
	−7	10	−4	7	23	7	52	55	52	11	22	20			
1810	63	70	62	76	96	80	78	88	78	66	87	74	−7	96	103
	−7	−2	−6·5	13	32	19	50	58	50	19	26	20			
1811	51	58	52	65	84	65	81·5	101	82	77	92	78	−8	101	109
	−8	10	2	14	32	20	51	60	52	10	28	18			
1812	45	56	53	65	83	63	72	90	76	68	86	72	−9	90	99
	−7	−2	−9	−4	21	6	45	55	36	17	32	21			

TABLE IV. *Greatest monthly variation of the thermometer.*

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Ang.	Sept.	Oct.	Nov.	Dec.
1790	40	42	43	29	28	28	23	31	33	39	39	50·5
1791	47	51	60	49·5	49	42	33	30	32	46	51	51
1792	58·5	35	31·5	36	43·5	38·5	28	39	44	38	46	45
1793	35	56	55	36	45	38	31	34	42	49	42	43
1794	54	40	68	46	47	33	32	30	37	36·5	48	39
1795	43	48	45	45	42	31	23	40	45	45	46	44
1796	52	49	48	49	36	34	30	42	41	44	45	50
1797	57	41	[illegible]	54	45	38	25	28	41	43	53	56
1798	46	41	61	51	39	30	38	36	48	43	40	41
1799	55	47	60	46	51	44	30	39	36	39	45	35
1800	51	42	52	49	33	30	40	34	37	37	42	44
1801	51	59	35	39	41	53	42	44	56	49	62	45
1802	53	60	61	47	46	40	36	33	50	53	38	62
1803	56	54	68	49	53	43	39	40	45	49	45	52
1804	38	49	52	44	42	35	33	39	52	36	43	59
1805	49	51	54	44	42	47	39	34	45	49	45	43
1806	55	55	56	46	46	46	38	43	45	48	41	45
1807	64	49	35	51	42	42	22	31	32	52	38	35
1808	57	42	52	44	39	45	48	35	60	56	47	53
1809	41	52	57	44	41	35	39	41	42	58	62	52
1810	58	76	42	49	53	35	34	32	47	66	35	51
1811	57	57	57	51	44	43	46	46	54	67	50	49
1812	49	49	56	51	49	45	37	34	51	56	55	51
mean.	50·7	50	52·3	43·3	45	38·9	34	36·3	44·1	47·7	46	47·6

TABLE V. *Mean daily variation of the thermometer.*

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1790	3	4	7	5	8·5	7	7	13	8	7·5	5	11
1791	6	10	10	11	10	8	12	10	7	10	10	7
1792	9	9	9	10	12	10	10	13	11·5	11·5	9·5	9
1793	6	9	9	9	10	8	13	13	7	16	7	6
1794	3	9	11·5	13	10·5	10	9·5	10·5	9	10·5	10·5	9
1795	7	7·6	5	9	9·5	11	10	10	11·4	12	11·4	8
1796	11·8	11·7	11	15	11	11·5	10·5	15·5	15	11	10·5	9·5
1797	11	7·5	10	10·7	13·8	11·3	14·2	9	15	13·5	10	9
1798	6	9	10	6	11·5	11·5	12	12·5	14	9	9	7
1799	8·5	11·5	10·5	12·5	14·5	12·5	12·5	12·5	8	12·5	9·5	7·5
1800	9	9·5	11	11	11	13	13·5	11·5	11	12	10	8·5
1801	10	10·5	6·6	10	11	16·8	15·3	14	14	17·4	8·8	10
1802	8·9	11·5	11·5	14	11·5	6	13	14	15·5	12	13	9·5
1803	10·5	12·4	12	9·4	13·8	17	11	15·2	18·7	16	9·2	9·2
1804	10·8	12·5	13·6	8	11·6	13·2	8	12	11	14	9	5·5
1805	7	8	11	12·6	12·4	14·2	16·8	17·3	13	14	10·4	8·8
1806	11	8	13·3	11·2	11	15·6	17·3	15·7	10·6	17·2	8	7·4
1807	12·2	8·8	11	9	13	13·7	12	11·5	13·2	12·7	9	9
1808	11	10	12	1	11	11	15·8	12·2	16	15·5	10·8	7·5
1809	4	13	15	13·5	15·2	14·2	13·7	15·6	17	16·5	9·8	7·6
1810	11·3	19·2	10	13	12	15	12·4	15·3	15·7	19	12	10
1811	10·3	10	6·4	12·7	16	15·4	13·5	17·3	13·2	15	11	11·5
1812	3	12	14	14	9	11	17	4	19	17	17	12
mean.	8·3	10	10·5	10·8	11·7	12·8	12·6	13·3	12·8	13·6	10	8·7

TABLE VI. Mean temperature of the coldest day and warmest day of each year, obtained by taking the mean of the three observations on each of the said days, together with the time of their occurring, the direction and force of the wind, face of the sky, and state of the barometer. The figures 1, 2, 3, express the different degrees of force of the wind. *Clear* is used to denote very few clouds, and *cloudy* more clouds than clear sky. At the bottom of this table are subjoined the most remarkable periods of extreme cold and heat. Mean height of the mercury in the Bar. during the cold days 30·165, ditto during the warm days 29·935, difference 0·23.

	Times	M. tem.	Wind	Weather	Bar.		Times	M. temp.	Wind	Weather	Bar.
1790	Feb. 9	4·3	NW	clear	30·15		Aug.14	82	SW	cloudy	30·13
91	Dec.19	—1	W1 SW1	clear	30·21		July 13	82	SW 2	cloudy	30·11
92	Jan. 23	—8	NW 2	clear	30·03		Aug.19	81	SW 2	clear	29·87
93	Feb. 1	5	NW 1	few cl.	30·56		July 5	83	SW2 W3 E1	cloudy	29·87
94	Dec.27	4	W 3	cloudy	29·81		July 18	81	SW 2	few cl.	30·02
95	Feb.26	3	NW3 W2	clear	29·68		Aug. 7	84·2	W NW	cloudy	30·06
96	Jan. 31	7·2	NW 1	clear	29·88		July 12	80·7	SW 2	cloudy	29·85
97	Jan. 8	—7·5	NW 2	no cl.	30·34		July 22	80·8	W 1 SW 2	cloudy	30·05
98	Feb. 8	5	NW 2	no cl.	30·38		Aug. 9	85·2	W 2 SW 2	cloudy	29·85
99	Jan. 5	—3	NW 2	no cl.	30·62		Aug. 1	80·3	W 1 S 2	few cl.	29·90
1800	Jan. 29	4·7	NW2 W2	no cl.	30·37		July 6	80·3	W 2 NW 2	few cl.	30·20
01	Jan. 3	4·7	NW2 N1	clear	30·67		July 2	85·7	SW 1	few cl.	29·76
02	Feb.23	3·3	NW 3	clear	29·76		July 23	84·2	SW 1	few cl.	29·94
03	Dec.17	2·3	NW 2	clear	30·65		July 10	84·3	W2	few cl.	29·91
04	Jan. 21	4·2	NW1 W1	no cl.			July 10	83	SW 1 W 1	cloudy	
05	Dec.14	5	NW 1	few cl.			July 13	85	SW 1 W 1	few cl.	29·93
06	Jan. 16	3·3	W1 SW2	no cl.	29·90		July 27	81	W 1 SW 1	cloudy	29·83
07	Jan. 26	—6·5	NW1 W1	no cl.	30·35		Jun. 10	81·3			
08	Jan. 16	6·3	W 1	clear	30·38		July 17	82·8	N W	few cl.	30·01
09	Feb. 4	4·7	NW 2 W	clear	30·48		July 10	79·3	W 1	few cl.	29·90
10	Jan. 19	—4·3	W 3	clear	29·48		Aug.29	78·3	SW	cloudy	29·88
11	Feb.22	4·7	W NW	cloudy	30·31		July 4	88·2	W E	few cl.	29·81
12	Jan. 18	—5·7	NW 1	no cl.	30·35		July 4	75·3	W 1 SW	few cl.	29·89
1792	Jan. 22	3	NW 3	cloudy	29·80	1795	Aug. 5	80	NW 1	few cl.	29·95
	23	—8	NW 2	clear	30·12		6	82	SW 1 W	few cl.	30·00
	24	4	NW 2	cloudy	29·90		7	84·2	W 1 NW 1	cloudy	29·97
1797	Jan. 7	6·5	NW 1	few cl.	29·99		10	80	SW 1 W 1	cloudy	29·88
	8	—7·5	NW 2	no cl.	30·34	1801	July 1	82·7	SW 1	cloudy	29·99
	9	1·2	NW 1	no cl.	30·65		2	85·7	SW 1	few cl.	29·73
	10	9·5	NW W	few cl.	30·46		3	80·3	SW 2	cloudy	29·63
1807	Jan. 19	7·3	NW1 W1	no cl.	30·24		7	81·7	NW 1 SW	few cl.	30·00
	20	11·3	W1 SW1	no cl.	30·28	1803	July 7	80·3	SW 1	few cl.	30·16
	21	17	W 1	no cl.	30·29		8	81·7	S 1 SW 1	cloudy	30·15
	22	0	NW1 W1	few cl.	30·44		9	83·5	W 2	clear	30·05
	23	7	NW 1	cloudy	30·38		10	84·3	W 3	clear	29·93
	26	—6·5	NW1 W1	no cl.	30·35	1805	July 12	83·7	SW 2	cloudy	30·00
	27	7	NW1 N1	cloudy	30·39		13	87	SW 2	few cl.	29·93
1810	Jan. 19	—4·4	W 3	clear	29·48		15	84	S 1 W 1	few cl.	30·04
	20	—3	W 3	clear	29·86		16	86	SW 1	few cl.	29·91
	21	—0·7	W 2	clear	29·99		17	80	SW 2	few cl.	29·77
	22	7·3	N NW	cloudy	30·28	1811	July 3	84	SW W	cloudy	29·85
1812	Jan. 16	4·7	NW W	cloudy	30·04		†4	88·2	W E	few cl.	29·82
	17	4	N NW	cloudy	30·04		‡5	86·3	W	few cl.	29·82
	*18	—5·7	NW 1	no cl.	30·35		6	86·2	W	clear	29·85
	19	0·7	NW 2	cl.&sn.	30·07		Aug.19	82·7	SW S	few cl.	29·94
	20	7·7	NW 1	cl.&sn.	29·38		20	86	W	no cl.	29·89
	21	2	W 2½	few cl.	29·82		21	82	SW E	few cl.	29·93
	22	—2·7	W	clear	30·88		22	81	E SW	cloudy	29·91

GENERAL TABLES OF WINDS AND WEATHER.

TABLE I. *Relative direction of the wind and state of the weather at the several hours of observation.*

		Winds. N	NE	E	SE	S	SW	W	NW	*Weather.* fair	mostly fa.	cloudy	mostly cl.
1791	M.	40	24	8	14	40	89	44	106	144	42	121	56
	N.	36	30	41	18	47	92	37	64	116	68	98	80
	E.	29	34	31	17	42	85	40	87	167	35	103	61
1792	M.	54	28	15	11	27	68	49	114	133	47	111	75
	N.	35	39	66	10	26	74	36	80	113	84	82	87
	E.	32	32	51	9	29	80	39	94	157	50	105	54
1793	M.	54	25	20	10	42	96	31	87	116	43	111	95
	N.	30	27	62	11	33	87	30	85	84	78	100	92
	E.	26	31	51	8	37	92	28	92	140	61	106	59
1794	M.	27	42	15	14	32	83	43	110	100	66	92	107
	N.	18	44	61	15	26	79	28	95	88	95	87	99
	E.	14	42	58	6	30	93	23	102	130	79	99	57
1795	M.	57	28	23	11	31	70	36	103	96	62	116	85
	N.	42	24	74	12	30	56	48	79	55	108	103	100
	E.	33	27	63	9	35	61	46	91	129	55	109	72
1796	M.	53	16	20	9	36	80	43	109	76	75	109	104
	N.	24	18	72	19	44	57	42	91	68	98	92	101
	E.	19	21	61	17	46	60	38	104	134	57	113	57
1797	M.	35	22	25	19	37	62	61	107	94	78	112	81
	N.	20	21	64	17	40	58	60	85	63	104	97	100
	E.	20	23	60	14	40	52	58	98	133	70	115	46
1798	M.	54	29	25	13	27	69	40	108	106	63	123	71
	N.	36	31	67	17	28	66	31	89	67	116	95	87
	E.	26	34	59	11	33	79	17	93	168	42	109	46
1799	M.	54	15	22	8	27	70	44	126	85	61	125	93
	N.	27	24	63	15	36	46	37	114	63	110	102	89
	E.	21	25	61	9	40	50	40	119	135	61	111	58
1800	M.	51	26	22	7	32	56	38	132	123	53	115	74
	N.	23	23	80	9	28	50	34	118	73	91	100	100
	E.	15	21	69	6	29	54	45	126	135	53	124	54
1801	M.	38	33	27	19	36	59	24	129	97	52	117	99
	N.	19	27	88	17	34	49	20	112	76	89	90	110
	F.	20	25	76	12	34	63	23	112	134	44	127	63
1802	M.	47	24	23	12	39	62	31	126	85	60	128	91
	N.	28	29	67	14	33	62	33	98	55	91	98	121
	E.	28	22	63	9	42	64	28	108	123	58	128	56
1803	M.	44	19	31	14	39	56	38	124	92	59	113	101
	N.	24	18	86	17	38	55	27	99	67	108	92	98
	E.	18	24	72	13	41	65	29	102	137	51	114	63

		N	NE	E	SE	S	SW	W	NW	fair.	m. fa.	cl.	m. cl.
1805	M.	23	19	26	13	29	60	58	137	108	57	112	87
	N.	11	25	72	9	30	60	41	119	79	104	87	95
	E.	15	22	60	7	27	70	53	111	127	60	117	61
1806	M.	44	24	17	15	29	60	49	126	114	43	123	85
	N.	34	26	59	14	33	61	39	99	100	61	113	91
	E.	32	20	46	6	28	66	67	98	150	35	113	67
1809	M.	14	12	26	16	31	39	154†	53	128	34	91	92
	N.	8	5	38	54	39	51	106	44	84	73	67	120
	E.	7	5	41	20	46	26	183	22	148	30	79	90
1810	M.	14	7	61	20	18	24	192	31	130	50	77	98
	N.	12	9	68	37	29	40	137	27	89	71	50	143
	E.	11	7	70	27	29	27	176	11	153	29	68	103
1811	M.	15	23	29	29	21	53	133	61	129	38	74	126
	N.	11	19	70	43	22	36	119	44	75	84	69	134
	E.	9	15	47	15	20	27	214	16	149	45	75	95
1812	M.	28	26	22	20	24	45	139	62	144	27	86	109
	N.	14	26	56	26	25	57	111	50	101	56	67	142
	E.	9	21	48	18	22	44	182	22	150	30	84	102
mean*	M.	39	23	24	14	31	63	66	103	110	53	108	91
	N.	24	24	66	19	33	60	54	84	80	89	89	104
	E.	20	24	57	12	34	61	69	84	142	50	106	67

TABLE II. *Annual mean number of winds at each of the points used, and annual mean state of the weather.*

	N	NE	E	SE	S	SW	W	NW	fair	m. fa.	cl.	m. cl.
1791	35	29	26·6	16	43	88·6	40	85·6	142	48	107	65·6
1792	40	33	44	10	27	74	41	96	134	60	99	71
1793	36·6	27·6	44	9·6	37	91·6	29·6	88	113	61	105	82
1794	19·6	42·6	44·6	11·6	29	85	31	102	104	80	92·6	87·6
1795	44	26	53	10·6	32	62	40	91	93	75	109	85·6
1796	32	18	31	15	42	65·6	41	101	92·6	76·6	105	87
1797	25	22	49·6	16·6	39	57	59·6	96·6	96·6	84	108	75·6
1798	38·6	31	50	13·6	29	71	29	96·6	113·6	73·6	109	68
1799	34	21	48·6	10·6	34	55	40	119·6	94	77	112·6	80
1800	29·6	23	57	7	29·6	53	39	125	110	65·6	113	76
1801	25·6	28·3	63·6	16	34·6	53·6	23·3	117·6	102·3	60·6	111·3	90·6
1802	34·3	25	51	11·6	38	62·6	30·6	110·6	87·6	69·6	118	89·3
1803	28·6	20·3	63	14·6	39·3	58·6	31·3	108·3	98·6	72	106	87
1805	16	22	52·6	9·6	28·6	63	50·6	122	104·6	73	105	81
1806	36·6	23	40·6	11·6	30	62	51·6	104·6	121	46	116	80·6
1809	9·6	7	35	30	38·6	38·6	148·6	39·6	120	45·6	79	100·6
1810	12	7·6	66	28	25	30	168	23	127	50	65	114·6
1811	11·6	19	48·6	29	21	38·6	155	40	117·6	55·6	72·6	118
1812	17	24	42	21	23·6	48·6	144	44·6	131·6	37·6	79	117·6

* This is the mean of nineteen years observation.

† It will be perceived that from this time the number of west winds has increased, and that of the north west diminished. It is to be considered merely as a transfering from one to the other, when the wind was near the middle point between them, owing probably to a different apprehension of the points of the compass in Dr. Webber and myself. I have used for about five years past a vane made expressly for the purpose, with the points of the compass carefully fixed under it.

TABLE III. *Monthly mean state of the winds and weather at the several hours of observation; to which is subjoined the mean of the morning, noon, and evening observations for each month.*

		Winds.								*Weather.*			
		N	NE	E	SE	S	SW	W	NW	fa.	m.f.	cl.	m.c.
Jan.	M.	4	·73	·57	1	2	5	6	12	9	3	12	7
	N.	3	1	1	1	2	5	6	12	7	6	10	7
	E.	2	1	1	·42	2	5	8	11	13	3	11	4
Feb.	M.	3	1	1	1	1	4	5	11	8	4	9	7
	N.	3	2	1	1	1	5	5	9	8	5	9	6
	E.	3	2	1	1	2	4	6	9	11	3	11	3
March	M.	4	2	2	1	2	5	5	10	10	4	11	6
	N.	2	3	4	1	3	5	4	9	8	6	9	7
	E.	2	3	4	1	3	5	5	8	13	3	10	5
April	M.	4	3	3	1	2	4	4	8	11	3	10	6
	N.	2	3	7	2	3	3	3	7	8	5	8	9
	E.	1	3	6	2	3	3	5	7	13	4	9	4
May	M.	3	4	2	2	3	7	3	7	10	3	9	9
	N.	1	3	9	3	3	4	3	5	6	7	8	10
	E.	1	3	7	1	4	5	5	5	11	4	10	6
June	M.	2	2	3	2	4	7	4	6	8	5	8	9
	N.	·63	2	8	2	3	7	3	4	4	10	6	10
	E.	·67	2	7	1	4	7	4	4	10	5	7	8
July	M.	3	2	3	1	4	7	6	5	9	6	7	8
	N.	·58	1	10	2	3	6	4	4	4	12	4	11
	E.	·42	1	8	1	4	7	5	4	11	5	6	8
Aug.	M.	2	2	3	1	4	6	6	6	9	5	8	9
	N.	·53	2	9	2	3	6	3	5	5	10	5	11
	E.	·7	2	7	·7	3	6	6	5	13	5	7	6
Sept.	M.	4	2	2	2	2	5	5	7	9	6	6	7
	N.	2	2	7	1	2	5	4	5	5	9	6	8
	E.	2	2	7	·9	2	6	5	5	11	6	7	5
Oct.	M.	3	1	2	·84	2	5	8	9	10	5	9	7
	N.	2	2	4	2	3	5	7	6	8	7	7	8
	E.	3	2	4	1	3	5	7	5	13	4	8	5
Nov.	M.	4	·84	1	1	3	4	7	9	8	5	9	8
	N.	3·3	1	3	1	3	4·4	5	9·3	7	7	8	8
	E.	2	1	3	·9	3	4	7	9	11	4	9	6
Dec.	M.	3	·63	1	1	2	5	7	11	9	4	10	8
	N.	3	1	1·3	1	2·7	5	6	11	7	7	9	8
	E.	2	1	1·4	1	2·5	5	7	11	11	4	11	5

Jan.	3	·91	·86	·81	2	5	6·7	11·7	9·7	4	11	6
Feb.	3	1·7	1	1	1·3	4·3	5·3	9·7	9	4	9·7	5·3
March	2·7	2·7	3·3	1	2·7	5	4·7	9	10·3	4·3	10	6
April	2·3	3	5·3	1·7	2·7	3·3	4	7·3	10·7	4	9	6·3
May	1·7	3·3	6	2	3·3	5·3	3·7	5·7	9	4·7	9	8·3
June	1·1	2	6	1·7	3·7	7	3·7	4·7	7·3	6·7	7	9
July	1·3	1·3	7	1·3	3·7	6·7	5	4·3	8	7·7	5·7	9
Aug.	1·08	2	6·3	1·23	3·3	6	5	5·3	9	6·7	6·7	8·7
Sept.	2·7	2	5·3	1·3	2	5·3	4·7	5·7	8·3	7	6·3	6·7
Oct.	2·7	1·7	3·3	1·29	2·7	5	7·3	6·7	10·3	5·3	8	6·7
Nov.	3·1	·95	2·3	·97	3	4·13	6·3	9·1	8·7	5·3	8·7	7·3
Dec.	2·7	·88	1·23	1	2·4	5	6·7	11	9	5	10	7

		Fair								Cloudy							
		*N	NE	E	SE	S	SW	W	NW	N	NE	E	SE	S	SW	W	NW
Dec.	M.	25°		36°	36°	25°	33·5°	26°	19°	31°	35·3°	36°	35·7°	34·2°	32°	26·3°	24°
	N.	33		38	42	38·6	36·8	34·2	27	34	35·3	40	45·3	36	37	35·5	30
	E.	80		33	36	40	29·3	28	22	32	29	38	34	33·4	35	34·5	29
Jan.	M	18·5		14	24	30	24·6	9·3	13·5	23	30·5	32	39	41	25·4	12·5	18
	N.	27·5		36	36	39	25·8	25·2	26·5	28	32	35	42	42	37·6	29	29·1
	E.	22		28	26	30	23·8	15·8	17·8	26	25·5	35	40	39	32·5	28·5	27·7
Feb.	M.	18	26	35	29	24·4	27	12·3	17·1	28	33	32	30	31·3	28·5	24·8	25·2
	N.	27	35	37	30	36·4	43·6	31·5	30·3	33	35·5	36	34	38·4	39·7	31·8	35·7
	E.	21	32	39	21	33·3	28·5	26·8	22·5	29	34	34	30	36·9	36·5	25·6	32·6
Mean	M.	20·5	26	28·3	29·7	26·4	28·2	15·9	16·5	27·3	32·9	33·3	34·9	35·5	28·6	21·2	22·4
	N.	29·1	35	37	32·7	38	35·3	30·3	27·9	31·7	34·3	37	40·3	38·8	38·1	32·1	31·6
	E.	24·3	32	33·3	27·6	35·1	27·4	23·5	20·8	29	29·5	35·7	34·7	36·4	34·7	29·2	29·8
Gen. m.		24·7	31	37	31·1	33·1	30·3	23·2	21·7	29·3	34·1	35·3	36·7	36·9	33·9	27·5	27·9
June	M	59	54·5	56·7	62·4	55·6	64·6	64·6	62·4	62·4	59	60·1	64·6	64·6	68	64·7	58
	N.	73·6	64·6	68	73·6	75·9	79·2	79	73·6	64·6	62·3	66·9	66	73	75·8	71	66·9
	E.		57·9	62·4	64·6	64·6	72	64·6	62·4	55·6	55·5	62·4	64·6	67	71·3	70·2	64·6
July	M.	68	64·6	64·6	65·7	68·7	68	67·1	62·2	61·5	63·9	66·8	69·1	67·6	71	69·5	65·5
	N.	70·2	71·5	76·4	75·8	83·1	83·1	80·7	80·8	74	66·9	77·5	75·8	79·2	87	80·1	72·7
	E.	64·2	56	57·5	71·3	70·6	72·5	70·6	62·5	65	64	67·7	72·5	70·3	71·3	69·3	68
Aug.	M.	60·1	71·3	56·7	63·6	66·8	69·1	68	62·3	64·8	64·8	65·7	66·8	71	70·2	66·8	65·7
	N.	77	52·2	73·6		80·3	78	73·6	74·7	70·2	68·2	73·6	73·6	71·5	77·2	82·6	77·2
	E			66·8	71·3	72	72	69·1	66·8	65·7	64·8	66·8	71·3	69	72	73·6	71·3
Mean	M.	62·3	63·57	59·3	63·9	63·7	67·2	66·6	62·3	62·9	62·6	64·2	66·8	67·7	69·7	67	63
	N.	73·6	65	72·7	74·7	79·8	80·1	77·8	76·3	69·6	65·8	72·7	71·8	74·6	80	77·9	72·3
	E.	64·2	61	62·2	69·1	69·1	72·2	68·1	63·9	62·1	61·4	65·6	69·5	68·8	71·5	71	67·9
Gen. m.		66·7		64·7	69·2	70·9	73·2	70·8	67·5	64·8	63·3	67·5	69·3	70·3	73·7	71·9	67·7
Dec.	M.	27·3		37	30	23·5	32	14·6	22·1	30·7	36·5	38·4	37·1	34	38·5	30	25·3
	N.	32·7	31	41	37	39	43·5	23·5	32	33·7	40·7	41·1	44·7	39·7	40·5	37	32·7
	E.	29·5	40	33·5	37·5	32·5	33·7	20·2	29	33·7	34·1	37·5	34·7	39·3	37·3	35	31·8
Jan.	M.	20	40			29·5	33·1	27·3	17·3	28	31·3	30	19·5	31·4	37	28	26·2
	N.	30·3		40	36	37·7	40	33·3	22·3	31·3	32	33	36·8	40·3	46	33	28·7
	E	20			33	33·7	28·3	27	17·3	28·8	32·3	32	36	38	41	29·5	22·3
Feb.	M.	10·3	31·7		33	37	23·5	8·5	15	21·5	24·3	29·5	34·5	41·5	37	12·2	22·5
	N	25·7		35	35·7	42·3	39·2	17	29·2	26·1	34·3	34·3	40·5	43·8	40·5	26	29·4
	E.	15	40		21·8	38·5	31·2	8	16·3	24·7	30·5	31·1	30·7	38·3	39	17	24·7
Mean.	M	19·2	35·8	37	31·5	30	29·5	16·8	18·1	26·7	30·7	32·6	30·4	35·6	37·5	23·4	24·7
	N.	29·6	31	38·7	36·2	39·7	40·9	24·6	27·8	30·4	35·3	36·1	40·7	41·3	42·3	32	30·3
	E.	21·5	35·6	33·5	30·8	31·6	31	18·4	20·9	29	32·3	33·5	33·8	38·5	39·1	27·2	26·3
Gen. m.		23·4	60	36·4	32·8	33·8	33·8	19·9	22·3	28·7	32·8	34·1	35	38·5	39·6	27·5	27·1
June	M.	58		53·5	61·5	60·2	62·5	55	55·7	60·7	63·5	60·3	62·5	66·3	65	68·7	63
	N.	73·5	59	70·5	81·5	77·8	83·7	77	72·3	69·7	67	68·7	70·5	71	89·5	73	72·8
	E.	51	60	59	61·5	62	72·5	67	54·5	71	56·3	55·5	66·5	64·5	66·5	65·7	65·8
July	M.	63·3	72	64	69	67·5	71·7	70·7	57·7	63	68	72·3	68·7	68·3	74·5	71	63
	N.	74		75·7	80	81·2	88	84·2	77·5	75	70·5	72·3	74·2	80·3	89	73	74·5
	F..		63	65·7	72	62	74	73	63·3	67·5	64·3	68·7	65·5	70·3	79	70	70
Aug.	M.	60	78	54	62	64	68	70·5	69·3	67	66	65·7	65	73	72·3	76	71·5
	N.	78	63	76·7	75.2	87·7	87	82·5	82	76·5	66·3	73·5	77	88	80·5	88	84
	E.	61	61	61·5	65	73·3	74·2	74·3	66	70	66·7	68	70	72·5	73	71	76
Mean	M.	60·4	75	57·2	64·2	63·8	67·4	65·4	60·9	63·6	65·8	66·1	65·4	69·2	70·6	71·9	65·8
	N.	75·2	60·7	74	78·9	82·2	86·2	81·2	77·3	73·7	67·9	71·5	73·9	79·8	86·3	78	77·1
	E.	56	65·6	62·1	66·2	68·8	73·6	71·4	61·3	69·5	62·4	64·1	67·3	69·1	72·8	68·9	70·6
Gen. m.		63·9		64·4	69·8	71·6	75·7	74	66·5	68·9	65·3	67·2	68·9	72·7	76·6	72·9	71·2

* For explanation of this table see next page.

The table on the preceding page is intended to show the influence which the winds, blowing from different points of the compass, have upon our climate. The several-numbers are the means of a large number of observations, continued for twenty years. The observations are taken for fair weather and foul, for morning, noon and night, during the winter and summer months; and they are so selected and detached from all other circumstances affecting the thermometer, as to exhibit as fairly as possible the simple effect of the direction of the wind upon the temperature of the air. The first part of the table is made from observations taken with an internal thermometer; the second from observations with a thermometer exposed to the external air. Below the observations for the months in each part of the table, are subjoined the means of the summer and winter observations, for morning, noon, and night, and the mean of these means. It will be observed that there are several blank places in this table, there being no thermometrical observations corresponding to the state of the wind and weather, to which they belong. Also some of the numbers in the columns N E and E are single observations, instead of being the means of several, the wind being very rarely at either of these points in fair weather in the winter months.

It ought to have been mentioned, that the monthly mean state of the thermometer, according to the observations of Dr. Winthrop, given page 389, was the result of only two observations each day, namely, at 7 o'clock A. M. and at 3 P. M. The mean of the morning observations for fifteen years, beginning with 1743, is 46·42°; the mean of the morning observations for the winter months only 28·10°. Mean temperature at the same hour, according to the foregoing tables, 44·22° for the year, 23·7° for the winter months.

An abstract of meteorological observations, taken in the south parish in Andover, Mass. in latitude 42° 38′ N. by the late Rev. Jonathan French. The thermometer used in these observations appears upon examination to be a good one. It was placed upon the north west side of a building about ten feet from the ground, exposed to a free air, and protected from the direct rays of the sun. The place of observation is about eighteen miles from the sea, and elevated above it about one hundred and ninety feet.

1798		sunrise.	warmest pt. of day.	sundown.						Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair	cl.	wet
Jan.	G.	45	61	46	Winter.	45	51	46	M.	3	3		4	6	3	4	8	18	7	6
	M.	21	34·2	26		18·5	30·6	24·9	N.	2			5	2	7	5	10	20	6	5
	L.	−1	14	7		−7	6	−2	E.	2			5	5	2	7	10	20	5	6
Feb.	G.	36	46	42					M.	4	3			3	2	2	14	19	4	5
	M.	18·2	29·7	25·1					N.	3	3	1	2	1	4	5	7	16	4	8
	L.	−7	11	5					E.	5	4	1	3		2	6	7	16	5	7
March	G.	50	76	66					M.	4	1	1	2	8	5	3	7	20	5	6
	M.	27·2	42·9	35·4					N.	3	1	1	3	6	9	3	5	17	3	11
	L.	4	26	24					E.		3	1	5	6	3	4	7	19	3	9
April	G.	57	83	73	Spring.	64	86	75	M.	1	8	1	4	6	3	3	4	15	9	6
	M.	39·6	54·4	47·4		39·3	55·1	46·8	N.	1	6	6	4	3	4	2	4	13	6	11
	L.	24	33	29		4	26	24	E.		8	4	5	3	2	3	5	15	5	10
May	G.	64	86	75					M.	1	3	1	5	12	5	[illegible]	2	18	7	6
	M.	51·2	68·1	57·7					N.		4		5	9	5	2	6	16	6	9
	L.	42	48	43					E.		4		7	8	4	2	5	17	4	10
June	G.	71	89	78					M.	2	3	2	4	10	4		4	19	4	7
	M.	60·7	75	67					N.		5	1	5	8	7	2	2	16	5	9
	L.	49	56	50					E.		4	1	5	8	7	2	3	18	5	7
July	G.	76	94·5	85	Summer.	76	945	87	M.	2		1	4	9	5	5	5	22	3	6
	M.	62	80·7	71·2		62·7	79·8	70·5	N.	2			3	4	10	6	6	19	3	9
	L.	50	66	59·5		49	56	50	E.	2	1	1	4	5	10	4	4	20	1	10
Aug.	G.	75	94	87					M.	1	1	1	10	4	10	3	1	21	5	5
	M.	65·6	83·9	73·4					N.		1	1	8	3	14	2	2	21	5	5
	L.	51	72	59					E.				9	4	13	2	3	25	3	3
Sept.	G.	68	90	81·5					M.	1	1	6	8	3	4	3	4	18	7	5
	M.	54·7	72·4	64·4					N.	1	2	4	10	2	5	2	4	16	10	4
	L.	34·5	45	42					E.	2	2	3	9	4	4	2	4	20	5	5
Oct.	G.	58	70	62·5	Autumn.	68	90	815	M.	8	3	4	3	2	4	1	6	19	7	5
	M.	44·5	58·7	53·3		42·2	57·4	41·4	N.	3	10	3	3	3	2	3	4	21	7	5
	L.	24	38	35		11·5	27	26	E.	1	10	5	4	1	2	3	5	20	4	7
Nov.	G.	47	58	54					M.	8			3		10	2	8	20	6	5
	M.	27·6	41·1	36·6					N.	9			3	0	8	3	8	16	8	7
	L.	11·5	27	26·5					E.	6	1	1	2	1	8	2	10	18	7	6
Dec.	G.	37	45·5	41					M.	5	2	1	1	1	4	2	15	18	9	4
	M.	15·8	27·3	23·1					N.	5		2			3	4	17	1[illegible]	9	7
	L.	−2·5	11	12					E.	5	1	1		1	3	4	16	18	6	7
Year	G.					63·2	80·4	72·4	M.	40	28	18	48	64	59	30	78	227	72	66
	M.					40·7	55·7	45·9	N.	31	32	23	51	47	78	39	75	206	72	90
	L.					14·4	27·5	24·5	E.	23	38	18	58	46	60	41	79	226	53	87

1799		sunrise.	warmest pt. of day.	sundown.						Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair	clou.	wet
Jan.	G.	40·5	56.5	45		45	56·5	46	M.	8	·2	3		3	3	6	6	16	12	3
	M.	19·3	31·3	26·4	Winter.	17·1	29·3	24·8	N·	8	1	4	1	2	5	5	5	13	11	7
	L.	–12	0	–3		–12	0	–3	E·	8	4	1	2	3	3	5	5	17	8	6
Feb.	G.	45	50	46					M·	4				5	6	4	9	15	7	6
	M.	16·3	29·3	25·1					N·	1	3		1	4	4	6	8	16	6	6
	L.	–3	14·5	11					E·	2	3		1	3	6	4	9	19	3	6
March	G.	39	56	45					M·	6		1		5	5	2	12	15	12	4
	M.	20·9	37·6	28·7					N·	4		2		5	8	3	10	12	11	8
	L.	–9	12	8					E·	3	3	2	1	6	6	5	5	16	4	11
April	G.	56	83	64		70	88	77	M·	3	2		2	5	4	8	8	21	4	5
	M.	34	53	43·4	Spring.	34·4	52·1	42·6	N·	4		1	3	3	4	6	9	21	2	6
	L.	24	32	25		–9	12	8	E·	3	1		4	3	4	5	10	24	2	4
May	G.	70	88	77					M·	3	1	1	3	8	4	4	7	17	8	6
	M.	48·3	65·7	55·7					N·	3	1	4	3	6	3	5	7	13	8	10
	L.	32	50	39					E·	2	4		5	4	2	8	6	16	6	9
June	G.	76	92	83					M·	1	1	1	4	6	10	4	3	22	4	4
	M.	62	76·5	65·4					N·			3	5	5	11	1	6	18	4	8
	L.	44	44	43					E·	1	2	2	6	6	7	2	4	18	5	7
July	G.	73	92	80		78	92	83	M	5	3	1	4	9	3	4	2	17	5	9
	M.	65.9	77·7	69·4	Summer.	63·6	77·9	69·3	N	1	6	1	6	7	3	5	2	17	9	5
	L.	51	65·5	56		44	44	43	E·		5	1	7	6	6	3	3	18	7	6
Aug.	G.	78	89	80					M·	3	3	1	2	5	10	6	1	18	10	3
	M.	62·9	79·5	73·2					N		5	2	3	4	11	4	2	18	5	8
	L.	45	60	57					E·		4	2	6	2	9	7	1	25	3	5
Sept.	G.	68	84	74					M·	2	2	3	8	1	2	3	9	11	12	7
	M.	54·5	67·4	59·8					N·	2	4	3	5	1	3	2	9	11	9	10
	L.	40	55	50					E·	1	7	3	6	1	4	1	7	16	7	7
Oct.	G.	58	72	58		68	84	74	M·	5	2	1	4	4	5	3	7	18	10	3
	M.	40·7	55·9	49	Autumn.	42·2	56·4	49·8	N·	1	5		8	4	1	4	8	12	9	10
	L.	21	42	34		15	30	26	E·	1	6		9	4	1	5	5	12	8	11
Nov.	G.	50	66·5	64					M	1	1	1	1	1	16	4	5	16	10	4
	M.	31·5	46·1	40·7					N·		2	1	2	1	11	5	8	13	12	5
	L.	15	30	26					E·		2	1	2	1	12	3	9	16	8	6
Dec.	G.	41	49	38					M	7	1		2	2	7	4	8	17	9	5
	M.	22	32·2	27·5					N·	6	1		3	1	6	8	6	13	7	11
	L.	1	15	12					E·	6	1	1	2	2	6	6	7	15	4	12
Year	G.					65·2	80·1	70	M·	48	18	13	30	54	75	52	77	201	103	59
	M.					39·8	53·9	46·6	N·	30	28	21	40	43	70	54	80	174	95	94
	L.					9·5	21·5	18·5	E·	27	42	13	51	41	66	54	71	210	65	90

1800		sunrise.	warmest pt. of day.	sunset.					Winds.								Weather.		
									N	NE	E	SE	S	SW	W	NW	fair	clou.	wet
Jan.	G.	38	48	41	Winter. 41	57	47	M.	2	2			2	8	3	14	20	7	4
	M.	20·2	30·1	25·7	20·5	31·6	26·4	N.	5	1			2	6	5	12	22	6	3
	L.	−6	10	5	−6	10	5	E.	3	2			1	8	5	12	22	6	3
Feb.	G.	37	57	47				M.	4	2		1		5	1	15	17	5	6
	M·	19·3	32·7	27·1				N.	6	4				1	7	10	21	4	3
	L.	3	17	13				E.	6	4				1	6	11	21	4	3
March	G.	38	60	50				M.	5	2	1	2	1	4	4	12	17	10	4
	M·	24·5	42·1	34·4				N.	2	4	1	4	1	4	4	11	17	9	5
	L.	0	20	13				E.	2	2	1	6	1	5	4	10	18	8	5
April	G.	58	84	74	Spring. 65	89	74	M.	2	2	3	8	7	6	2	6	17	5	8
	M·	42·3	57·5	50·3	38·1	54·8	46·4	N.	1	5	1	1	4	6	3	9	17	4	9
	L.	28	38	36	0	20	13	E.	2	5		3	5	4	3	8	17	3	10
May	G.	65	89	67				M.	5	7	2	5	7		3	2	15	8	8
	M·	47·6	64·8	54·6				N.	2	5	3	7	8		4	2	19	7	5
	L.	32	39	39				E.	2	4	4	8	7		2	3	19	7	5
June	G.	72	94	77				M.	1		1	5	6	7	2	8	24	2	4
	M·	59·4	78·4	67·4				N.		2		8	3	7	3	7	22	5	3
	L.	46	62	56				E.		2		7	3	6	5	7	22	5	3
July	G.	79	100	86	Summer. 79	100	86	M.	1	1	3	6	4	12	3	1	23	4	4
	M·	64	84·6	72·3	61·2	80·2	69·5	N.		6	1	6	4	11	2	1	19	7	5
	L.	48	69	53	44·5	60	53	E.		4	1	8	5	12	1		18	8	5
Aug.	G.	74	89	81				M.	4	1	1	4	9	7	2	3	19	5	7
	M.	62·2	77·7	68·9				N.	2	2	1	4	6	9	2	5	20	4	7
	L.	44·5	60	61				E.	1	2	2	5	6	9	2	4	17	6	8
Sept.	G.	67	89	75				M.	5	3	3	3	7	2	2	5	15	7	8
	M·	52·8	69·2	61·6				N.	4	4	1	8	2	5	3	3	18	6	6
	L.	40	54	49				E.	4	3	1	8	3	5	4	2	20	5	5
Oct.	G.	62	71	63	Autumn. 67	89	75	M.	6		3	2	5	5	5	5	21	4	6
	M·	42·9	57·4	50·7	41·9	55·9	49·6	N.	3	3	4	1	5	2	8	5	19	5	7
	L.	28	45	40	11	31	21	E.	3	5	3	1	5	2	8	4	20	4	7
Nov.	G.	46	61	55				M.	5	1	2	3	1	10	4	4	14	11	5
	M·	30	41·1	36·7				N.	5	1	1	1	3	8	4	7	13	7	10
	L.	12	31	21				E.	5	1	1	1	4	2	6	10	14	8	8
Dec.	G.	56	66	56				M.	4		1	2	8	6	2	8	19	9	3
	M·	28	37·9	33·4				N.	3	1		4	5	7	3	8	20	5	6
	L.	11	27	23				E.	3			4	5	6	3	10	19	5	7
Year	G.				63	83·7	70·5	M.	44	21	20	35	57	72	33	83	221	77	67
	M·				40·9	55·6	48	N.	33	38	13	44	43	66	48	80	227	69	69
	L.				12·4	30·2	23	E.	31	34	13	51	45	60	49	81	227	69	69

65½

1801		sunrise.	warmest pt. of day	sunset.						Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair	clou.	wet
Jan.	G.	83	42	48	Winter.	56	66	56	M.	3	1	2		1	7	5	12	20	4	7
	M.	18·7	29·2	25·4		22·4	33·8	28·7	N.	3	2		1	2	4	5	14	18	4	9
	L.	−4	8	5		−7	8	5	E.	3	2	1	1	2	4	5	13	16	5	10
Feb.	G.	46·5	61	51					M.	4	2		3	2	5	5	7	15	8	5
	M.	20·4	34·5	27·4					N.	2			3	4	4	6	9	18	2	8
	L.	−7	14	10					E.	3			2	3	5	4	11	19	2	7
March	G.	43	55	46					M.	6	10	2	1	3	2	1	6	10	11	10
	M.	32·6	42·9	39·3					N.	4	14	1	2	2	1		7	13	6	12
	L.	12	33	27					E.	4	12	4	3				8	11	6	14
April	G.	58	76	60	Spring.	68	85	74	M.	7	6	4	2	3	3	2	3	17	6	7
	M.	39	53·8	46·1		41·4	55·4	47·9	N.	4	10	6	2	1	3	2	2	18	7	5
	L.	28	33	35		12	33	27	E.	4	9	4	4	3	1	2	3	16	7	7
May	G.	68	85	74					M.	3	4	3	4	10	5	1	1	14	12	5
	M.	52·7	69·6	58·5					N.	1	10	1	3	7	2	3	4	16	6	9
	L.	46	52	47					E.		11	1	6	7	3	1	2	16	7	8
June	G.	74	92	81					M.		5	1	5	12	3	1	3	20	4	6
	M.	58·6	77·6	65·7					N.		5	3	4	9	5	1	3	18	2	10
	L.	42	48	48					E.		4	2	6	8	6	1	3	22	1	7
July	G.	76	96	84	Summer.	76	96	85	M.			3	4	10	7	2	5	22	5	4
	M.	64·2	81·6	70·2		61·1	79·4	68·3	N.	1	2	1	8	5	8	2	4	21	4	6
	L.	47	68	59		42	48	48	E.	1	2		9	4	11		4	19	1	11
Aug.	G.	75	93	85					M.		2	3	8	9	7	2	5	20	8	3
	M.	60·5	79·1	69·2					N.		1	3	4	4	7	3	9	20	5	6
	L.	43	66	55					E.	1		4	3	5	9	2	7	17	5	9
Sept.	G.	75	90	83					M.	7	4	1	2	4	6	1	6	20	4	6
	M.	56·5	73·4	61·7					N.	7	5	2	3	4	4	1	5	23	3	4
	L.	36	50	44					E.	4	6	3	3	4	4		5	22	4	4
Oct.	G.	61	72	65	Autumn.	75	90	83	M.	1		2	3	4	10	1	10	23	3	5
	M.	42·6	59·5	52·4		43·7	58·7	50·3	N.	1	2	1	4	2	9	2	10	23	4	4
	L.	19	43	38		9	26	24	E.		1	1	6	3	8	1	11	24	2	5
Nov.	G.	60	64	60					M.	2	2		2	7	4	4	9	17	8	5
	M.	31·9	43·2	36·8					N.		1		4	3	6	2	14	20	6	4
	L.	9	26	24·5					E.		1		3	4	6	2	14	18	6	6
Dec.	G.	47	54	48					M.	2	1		2	2	5	5	14	20	6	5
	M.	25	37·7	31·4					N.	3			3	2	4	4	15	18	8	5
	L.	7·5	16	14					E.	3			3	2	6	3	14	17	8	6
Year	G.					68·7	84·2	74.5	M.	35	37	21	31	67	64	30	78	218	79	68
	M.					42·1	56·8	48·8	N.	26	92	18	41	45	57	31	96	226	57	82
	L.					14	28·7	26	E.	23	48	20	51	45	63	21	95	217	54	94

1802		sunrise.	warmest pt. of day.	sunset.						Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair	clou.	wet
Jan.	G.	58	61	55	Winter.	58	61	55	M.	1	2	1	1	6	11	2	7	18	8	5
	M.	27·8	38	33·1		23·4	35·2	29·9	N.	1	1	1	1	3	14	3	7	20	5	6
	L.	3·5	13	9		−6	8	4	E.	1		1	2	2	14	4	7	21	5	5
Feb.	G.	37	51	49					M.	3	3	1	1	4	4	2	10	14	7	7
	M.	17·6	29·9	25·3					N.	4	3		2	3	5	3	8	17	1	10
	L.	−6	8	4					E.	4	1		3	3	4	3	10	17	1	10
March	G.	49	66	54					M.	4	1	1	1	2	11	4	7	16	9	6
	M.	27·9	44 3	35·3					N.	3	2	1	1	2	13	3	6	15	6	10
	L.	7	23	15					E.	4	1	2	2	3	10	3	6	20	6	5
April	G.	51	71	60	Spring	58	82	68	M.	2		1	1	8	2	2	14	23	2	5
	M.	38·9	54·6	46		38·1	53·1	44·5	N.	2	4	2	1	5	3	1	12	21	4	5
	L.	24	35	31		7	23	15	E.	2	2	2	4	1	5	1	13	21	6	3
May	G.	58	82	68					M.	7	4	6		6	2	2	4	13	10	8
	M.	47·7	60·3	52·2					N.	3	8	5	3	5	2	2	3	11	7	13
	L.	35	45	43					E.	5	6	5	4	2	5		4	12	10	9
June	G.	73	89	78					M.	4	1	1	2	10	7	3	2	16	6	8
	M.	61·1	77·4	66·6					N.	1	3	1	2	7	10	3	3	14	5	11
	L.	51	62	56					E.	1	2	1	4	9	7	4	2	17	3	10
July	G.	75	90	81	Summer.	75	91	81	M.	1	5		1	13	6	1	4	16	9	6
	M.	63·2	80·6	69·2		62·6	79·1	67·2	N.		6	1	3	7	7	1	6	16	5	9
	L.	50	66	57		50	62	56	E.		3	2	7	3	10	2	4	19	4	7
Aug.	G.	71	91	78					M.	2	2	3	2	10	8		4	15	7	9
	M.	63·5	79·2	65·9					N.	1	5	3	4	7	8		3	15	8	8
	L.	52	65	68					E.	1	6	5	5	5	5	2	2	14	7	10
Sept.	G.	74	85	79					M.	2	4		1	6	7	3	7	18	9	3
	M.	56·9	70	60·3					N.	2	2	2		4	8	3	9	16	8	6
	L.	34	56	49					E.	1	1	2	2	2	9	4	9	19	6	5
Oct.	G.	63	79	73	Autumn	74	85	79	M.	7	2	2	4	5	5		6	18	10	3
	M.	46·7	59·1	54·7		45·9	59	52·4	N.	6	3	1	4	6	5	6		16	8	7
	L.	27	37	34		22	34	29	E.	4	7	1	1	5	7		6	18	9	4
Nov.	G.	57	60	57·5					M.	4	1	2	1	4	5	3	10	19	8	3
	M.	34·2	48	42·2					N.	4	1	2	2	5	4	2	10	17	8	5
	L.	22	34	29					E.	4	3	2	1	4	4	2	10	20	4	6
Dec.	G.	49	59	53					M.	2	3	2		2	10	2	10	14	10	7
	M.	26·5	35·2	32·1					N.	2	3	1			11	3	11	13	8	10
	L.	1	10	5					E.	4	2	1	1	3	9	3	8	16	8	7
Year	G.					66·2	79·7	70·7	M.	39	28	20	15	76	78	24	85	200	95	70
	M.					42·5	56·6	48·5	N.	29	41	20	23	54	90	30	78	191	73	100
	L.					18·2	41.7	26	E.	31	34	24	36	42	89	28	81	214	69	81

1803		sunrise.	warmest pt of day.	sunset.						Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair	clou.	wet
Jan.	G.	54	58	51	Winter.	54	59	53	M	3	1	1		5	12	6	3	17	10	4
	M.	19·0	32·0	28·3		22·8	35·1	31	N·	2	2		1	4	8	7	7	19	7	5
	L.	-7·5	8	7		-7·5	8	5	E·	3	1	1	1	2	9	9	5	15	9	7
Feb.	G.	50	59	53					M·	5	1		1	7	7	2	5	15	6	7
	M.	23·0	38·2	32·6					N·	3	2			6	8	2	7	14	6	8
	L.	2	12	10					E·	4	2			6	7	3	6	14	5	9
March	G.	52	74	64					M·	3	3	3	2	5	4	3	8	16	9	6
	M.	27·9	43	36·1					N·	2	3		4	4	8	2	8	15	10	6
	L.	0	14·5	12					E·	1	5	1	5	2	8	1	8	16	8	7
April	G.	57	79	67	Spring.	67	86	71	M·	8	3	3		9	2		5	10	14	6
	M.	40·5	56·1	46·7		39·2	55·6	46·1	N·	4	8	1	1	7	3		6	16	7	7
	L.	26	30	22		0	14·5	12	E·	2	11		2	7	3		5	14	8	8
May	G.	67	86	71					M·	4	7	1	4	10	1	1	3	21	8	2
	M.	49	65·7	55·7					N·	3	5	3	7	7	2	1	3	20	7	4
	L.	31	33	34					E·	4	2	4	9	8	1		3	17	10	4
June	G.	73	93	84					M·	1	3	3	3	7	7		6	16	10	4
	M.	57·9	77·4	67·3					N·		2	4	4	5	8		7	17	8	5
	L.	48	62	53					E·		1	4	6	5	6		5	14	9	7
July	G.	71	91	82	Summer.	73	93	48	M·		3	1	3	11	5	1	7	16	8	7
	M.	67·6	77·1	72·3		62·4	77·9	67·8	N.		5	4	3	4	9	2	4	14	7	10
	L.	49	59	54		41·5	59	53	E·		5	2	5	6	6	1	6	14	1	13
Aug.	G.	72	88	82					M.		1	3		8	7	4	8	20	4	4
	M.	61·9	79·2	69·9					N·		4	3		4	5	5	10	22	4	5
	L.	41·5	69	56					E·		3	3	2	2	6	4	11	21	4	6
Sept.	G.	66	78	68					M·		2		2	8	9		7	20	7	3
	M.	49·9	68·6	59·7					N·		3	2	3	2	10	1	9	22	4	2
	L.	34	60	51					E·		3	1	4	2	9		11	21	7	2
Oct.	G.	63	77	67	Autumn.	66	78	67	M·	5			1	10	8	2	4	18	11	2
	M	43·7	59·1	53·1		40·9	56·6	50·2	N·	6		2	3	7	5	1	7	20	5	6
	L.	28	42	39		18	20	20	E·	6	2	1	3	8	5	1	5	18	6	7
Nov.	G.	51	61	54					M·	3	3	2	1	4	7	6	4	20	7	3
	M.	29·2	42·2	38					N·	2	3	2	3	1	7	2	10	16	11	3
	L.	18	20	20					E·	2	3	3	1	3	5	2	11	17	8	5
Dec.	G.	57	62	59					M·	4	5	1	1	7	7		6	17	8	6
	M.	29·1	39·2	34·7					N·	4	5	1		8	6	2	5	17	7	7
	L.	9·5	22	18					E·	3	4		1	6	7	2	8	17	10	4
Year	G.					65	79	68·7	M·	26	32	18	18	91	76	25	66	206	105	54
	M.					41.3	56·3	48·8	N·	26	42	22	29	59	79	25	83	212	83	68
	L.					13	25·4	22·5	E·	25	42	20	39	57	72	26	84	198	88	79

1804.		sunrise.	warmest pt. of day.	sunset.						*Weather.*								*Winds.*		
										N	NE	E	SE	S	SW	W	NW	fair	clou.	wet
Jan.	G.	35	46	41	Winter.	57	62	59	M.	10		2		1	3	3	12	15	10	6
	M.	15.1	26·6	22·4		21·1	32·7	28·3	N.	8		3	1	1	3	2	13	18	7	6
	L.	−5	10	9		−5	10	9	E.	7	2	2	1	2	3	2	12	14	10	7
Feb.	G.	39	46·5	41					M.	4	2		1	2	5	6	9	20	5	4
	M.	19·3	32·3	27·8					N.	6	2	1	1	1	5	6	7	21	2	6
	L.	−2	12	9					E.	3	3	1	1	1	6	6	8	23	3	3
March	G.	36	57	45					M.	5	3	31	1	4	6	3	8	16	10	5
	M.	24·1	41·4	32·9					N.	3	7	1		1	5	3	11	16	9	6
	L.	1	21	13					F..	4	6	1		2	6	2	10	19	7	5
April	G.	47	66	53	Spring.	67	86	75	M.	9	3	4		2	4		8	12	10	8
	M.	36.6	49·8	43·4		37·3	53·8	45·3	N.	3	7	3	2	1	3	2	9	14	5	11
	L.	17	35	29		1	21	13	E.	2	8	3	2	1	4	1	9	12	10	8
May	G.	67	86	75					M.	5	3	7	3	9	2		2	19	11	1
	M·	51·4	70·3	59·7					N.	4	3	8	5	4	6		1	19	8	4
	L.	40	51	44					E.		3	7	6	6	7		2	17	8	6
June	G·	72	90·5	80					M.	5	7		1	9	4	2	2	13	10	7
	M.	61·5	74·1	65·4					N.	3	11		2	5	3	2	4	13	6	11
	L.	53	55	54					E.	2	7		5	6	4	1	5	16	5	9
July	M·	78	89	82	Summer.	78	90·5	82	M.	1			1	10	9	3	7	19	10	2
	L.	60·6	77·8	68·8		60·3	76.2	67	N.	1	3		4	6	10	1	6	22	2	7
	G.	44	62	59		44	55	54	E.	1			5	7	9	3	6	19	6	6
Aug.	G.	71	87	78					M.	3	5	2	2	7	6		6	18	7	6
	M.	59·2	76·9	66·9					N.	1	6	2	2	7	7		6	20	8	3
	L.	44	67	59					E.	1	6	2	4	5	7		6	19	10	2
Sept.	G.	74	91	81					M.	2	2		1	6	6	3	10	20	3	7
	M.	53·9	69·4	61·5					N.	3	2	3		3	9	2	8	19	4	7
	L.	31	48	43					E.	5	3	2		4	7	2	7	21	3	6
Oct.	G	55	68	61	Autumn.	74	91	81	M.	5	2	2		4	10	1	7	15	11	5
	L.	39·3	52·9	47·3		41·9	55·9	50	N.	4	3	1		4	10	2	7	17	8	6
	M.	29	38	33		14	1	27	E.	3	3		1	5	10	1	8	18	5	8
Nov.	G.	57	66	58					M.	3	2	1		2	10		12	18	7	5
	L.	32·5	45·4	41·4					N.	4	2				11	4	9	19	6	5
	M.	14	31	27					E.	3	3	1			12	2	9	19	7	4
Dec.	G.	40	45	40					M.	3	2	1	2	1	10	4	8	16	10	5
	M.	21·1	31	27					N.	4	1		2		9	4	10	16	7	8
	L.	10·2	14	12					E.	4	1		4		10	3	9	15	8	8
Year	G.					69	82·4	74	M.	55	31	20	12	57	75	25	91	201	104	61
	M.					40·1	54·6	47·6	N.	44	47	22	20	33	81	28	91	214	72	80
	L.					13·5	26·7	24·2	E.	35	44	19	29	39	85	23	91	212	82	72

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1805.		sunrise.	warmest pt. of day.	sunset.						*Winds.* N	NE	E	SE	S	SW	W	NW	*Weather.* fair	clou.	wet
Jan.	G.	37	41	38	Winter.	40	58	43	M.	5	2			3	11		10	11	12	8
	M.	16·2	25	21·4		19·6	30·2	25·7	N.	6	1	1		3	7	1	12	11	10	10
	L.	-9	4	0		-10·5	4	0	E.	8	1			2	6	1	13	9	12	10
Feb.	G.	36·5	58	43					M.	1	1		1	3	10	1	11	18	7	4
	M·	21·7	34·6	28·7					N.	1	2		2	1	8	1	13	18	5	5
	L.	4	14	12					E.	2	1		2	2	6	1	14	13	9	6
March	G.	52	65	58					M.	5	3	2		7	6	2	6	14	14	3
	M·	31·3	45·9	39·5					N.	4	6		4	3	8	1	5	15	12	4
	L.	11	25	21					E.	3	5		4	4	8	2	5	15	11	5
April	G.	51	75	68	Spring.	64	80	71	M.	2	4	1	1	5	10	2	5	15	11	4
	M·	42	56·6	48·4		41·1	55·7	48·4	N.		4		1	5	8	2	10	13	8	9
	L.	34	39	32		11	25	21	E.		4		1	5	7	2	11	16	7	7
May	G.	64	80	71					M.		3			10	15	1	2	20	5	6
	M·	50·1	64·7	57·5					N.	1	1	1		5	15	3	5	18	6	7
	L.	38	45	42					E.		1	1		5	14	4	6	17	7	7
June	G.	75	95	80					M.	3	4	3	2	7	4	2	5	17	8	5
	M·	59·5	75·2	65·9					N.	3	5	3	4	5	2	2	6	21	6	3
	L.	46	48	48					E.	2	4	4	4	7	2	2	5	17	8	5
July	G.	78	95	85	Summer.	78	95	85	M.	1	1	1		9	11		8	25	4	2
	M·	64·1	85	73·4		62·5	80.7	70·3	N.				4	7	14	1	5	26	4	1
	L.	52	72	62		46	48	48	E.		1	1	7	3	13	1	5	25	5	1
Aug.	G.	74	92	77					M.			4	8	4	7	4	4	14	12	5
	M.	63·9	82·1	71·8					N.			3	9	3	12		4	15	9	7
	L.	54	72	66					E.			4	9	3	9	2	4	16	9	6
Sept.	G.	69	89	78					M.	2	5	1	2	8	7	1	4	11	9	10
	M·	57·9	71·9	63·6					N.	1	11	2	2	3	8		3	11	5	15
	L.	41	51	47					E.	1	11	1	2	4	8		3	21	3	6
Oct.	G.	56	78	70	Autumn.	69	89	78	M.	6	1	5		2	10	1	6	18	10	3
	M·	39·2	54·9	48·8		43·6	57·6	51·6	N.	1	2	4	4	1	9	2	8	17	6	8
	L.	28	40	36		22	32	31	E.	1	2	4	3	2	9	3	7	17	8	6
Nov.	G.	53	72	64					M.	3	3		1	2	9	3	9	19	8	3
	M·	33·8	46·2	42·6					N.	3	3				8	3	13	21	4	5
	L.	22	32	31					E.	3	5		1		7	3	11	17	8	5
Dec.	G.	55	69	58					M.	1			1	6	8	6	9	17	11	3
	M·	33·8	43.8	38·8					N.		1	1	1	5	7	2	14	16	11	4
	L.	14	25	23					E.		1	1		4	8	3	14	18	7	6
Year	G.					62·7	80·5	69·2	M.	29	27	17	16	66	108	23	79	199	111	55
	M·					41·7	56	49	N.	20	36	15	31	41	106	19	98	202	86	78
	L.					17·1	27·2	25	E.	20	36	16	33	41	97	24	98	201	94	70

1806.		sunrise.	warmest pt. of day.	sunset.						*Winds.* N	NE	E	SE	S	SW	W	NW	*Weather.* fair	clou.	wet
Jan.	M.	40	49	37	Winter.	55	69	58	G.	7		1	1	5	4	3	10	14	8	9
	N.	20·8	29·6	25·1		26·1	36·1	31·4	M.	1	1	2	2	2	5	4	10	14	8	9
	E.	−6	12	6		−6	12	6	L.	4	3	2	2		4	7	9	12	10	9
Feb.	M.	55	58	54					G.	1	3	1	2	4	7	1	9	12	11	5
	N.	23·7	35·1	30·3					M.		5	2	2	2	6	2	9	13	10	5
	E.	−5	19	14					L.		6	2		2	8	1	9	13	9	6
March	M.	40	71	59					G.	3	4	1	1	1	6	1	14	18	10	3
	N.	24·1	34·6	30·8					M.	4	4	1	2		5	1	14	17	8	6
	E.	10	15	13					L.	3	4	1	2	1	3	2	14	17	6	8
April	M.	57	66	63	Spring.	68	90	75	G.	3	5	1	1	2	5	5	8	14	12	4
	N.	34·8	46·5	41·6		36·1	49·5	43·1	M.	3	5	2	2	2	3	5	8	14	11	5
	E.	19	29	27		10	15	13	L.	1	7	1	3	2	2	8	6	13	12	5
May	M.	68	90	75					G.	3	9	1	2	9	2	2	2	20	8	3
	N.	49·6	67·4	57					M.	1	7	4	6	5	7	1	1	22	4	5
	E.	36	50	45					L.		7	4	6	6	6	1	1	10	8	4
June	M.	75	92	82					G.	2	4		1	11	6	2	4	19	8	3
	N.	59·5	76·5	65·1					M.		3	1	2	10	9	2	3	22	5	3
	E.	47	61	52					L.		3	2	2	10	8	3	2	21	7	2
July	M.	75	92	80	Summer.	75	92	82	G.	2	9	1	1	1	11	1	5	18	4	9
	N.	60·7	77·8	65·1		61·7	76·9	65·7	M.	2	10	1		1	13		4	15	4	12
	E.	54	61	56		47	61	52	L.	2	10	2			13		4	17	6	8
Aug.	M.	72	91	81					G.	2	2	1	3	9	7	1	6	11	12	8
	N.	64	76·5	67·9					M.	2	4	2	4	5	8	2	4	13	7	11
	E.	48	65	58					L.	2	4	2	4	4	8	3	4	14	5	12
Sept.	M.	69	83	76					G.	5	5		3	9	2	1	6	10	11	9
	N.	53·8	68·7	61·4					M.	5	9		2	6	4		7	15	5	10
	E.	37	57	50					L.	3	8		3	6	5		7	15	5	10
Oct.	M.	65	76	69	Autumn.	69	83	76	G.	10				4	8	4	5	24	4	3
	N.	40·6	58·6	51.1		42·6	57·5	51·2	M.	2	6	2	1	2	9	4	5	26	4	1
	E.	28	38	34		24	32	30	L.	2	4	4	2	2	7	4	6	25	5	1
Nov.	M.	55	62	57					G.	4	5	2	1	5	5	3	5	14	8	8
	N.	33·5	45·4	41·1					M.	4	6	1	1	3	4	6	5	14	7	9
	E.	24	32	30					L.	4	7	1	2	3	3	6	5	14	7	9
Dec.	M.	39	48	45					G.	1	2		1	2	15	2	8	18	7	6
	N.	23·4	34·3	30·1					M.	3	1		1	2	9	5	10	14	10	7
	E.	2	13	11					L.	3	1			2	12	5	8	18	6	7
Year	M.					66·7	83·5	72·7	G.	43	48	9	17	61	79	26	81	192	103	70
	N.					41·6	55	47·8	M.	27	58	18	25	39	82	32	81	199	83	83
	E.					18·7	30	25·2	L.	24	64	21	26	38	79	39	75	198	86	81

1807		sunrise.	warmest pt. of day.	sunset.						Winds. N	NE	E	SE	S	SW	W	NW	Weather. fair	clou.	wet
Jan.	G.	33	51	37	Winter.	40	51	45	M.					3	11	1	16	20	9	2
	M.	11	23	18·5		15·8	27·6	23·2	N.			1	1	2	10	2	15	22	3	6
	L.	–18	–6	–9		–18	–6	–9	E.	2	1	1	1	1	9	4	12	21	5	5
Feb.	G.	40	42	38					M.	1	1		2		6		18	18	4	6
	M.	13·1	25·6	21					N.		2	1	3	1	4	1	16	19	4	5
	L.	–11	0	–2					E.		3		3	2	4	1	15	18	6	4
March	G.	33	44	34					M.	3	3		2		10	3	10	22	5	4
	M.	20·8	31·3	26·9					N.	2	4			1	7	2	15	18	6	7
	L.	3	19	16					E.	2	3		1		6	2	16	19	7	5
April	G.	50	72	61	Spring.	73	76	63	M.	4	4	3	2	3	8	1	5	13	9	8
	M.	33·5	48·2	39		32·9	45·9	38·4	N.	3	6	1	7	1	6	2	4	12	11	7
	L.	20	33	28		3	19	16	E.	1	6	1	7	4	4	1	6	9	16	5
May	G.	73	76	63					M.	3	6	2		4	10	3	3	15	6	10
	M.	44·4	58·2	49·5					N.	2	8	1	2	2	10	1	5	14	7	10
	L.	32	41	35					E.	2	8		3	2	8		8	16	6	9
June	G.	72	89·5	78					M.	2	6	1	1	6	7	1	6	15	11	4
	M.	54·1	68·6	59·2					N.	1	3	1	4	5	6	5	5	15	7	8
	L.	42	42	40					E.	1	3	1	6	4	4	5	6	14	8	8
July	G.	69	85	73	Summer.	72	89·5	78	M.		1	2	3	6	16	2	1	19	7	7
	M.	60·6	75·7	63·8		58·7	73·7	63·6	N.		2	1	9		12	4	3	16	9	6
	L.	50	61	57		42	42	40	E.		2	2	9	1	13	3	1	19	4	8
Aug.	G.	67	82	76					M.	1	3	1	3	7	11	2	3	12	12	7
	M.	61·6	77	67·9					N.		5	3	1	7	12		3	14	3	14
	L.	47	65	57					E.	1	5	3	2	8	8	2	2	14	1	16
Sept.	G.	64	75	65					M.		2		2	5	9	2	10	19	5	6
	M.	47·1	63	54·6					N.	1	2		4	1	10	2	10	25	2	3
	L.	38	51	43					E.	1	1		5	1	11	2	9	21	5	4
Oct.	G.	57	71	68	Autumn.	64	75	68	M.	1	3			3	6	5	13	15	10	6
	M.	38·8	50·3	48·8		37·7	50	45·5	N.		3			3	7	1	17	17	6	8
	L.	21	35	30		11	23	24	E.		3			3	8	2	15	16	6	9
Nov.	G.	52	53	54					M.	5	2	1		1	8	7	6	18	6	6
	M	27·3	36·8	33·3					N.	6	2	1		1	5	6	9	11	9	10
	L.	11	23	24					E.	6	2	1		1	6	6	8	11	10	9
Dec.	G.	38	53	40					M.	6	3			7	12		3	13	14	4
	L.	24·2	34·2	31·1					N.	3	3	1	1	4	10	3	5	16	3	12
	M.	7	15	16					E.	2	2	1	2	5	10	3	6	16	8	7
Year	G.					62·2	72·9	63	M.	26	34	10	15	45	114	27	94	197	98	70
	L.					36·3	49·3	42·7	N.	18	40	11	32	28	99	29	107	201	70	96
	M.					9·5	19·5	17·7	E.	18	39	10	39	32	91	31	104	194	82	89

1808		sunrise	warmest pt. of day.	sundown.						N	NE	E	SE	S	SW	W	NW	fair	clou.	wet
										Winds.								*Weather.*		
Jan.	G.	38	44	43	Winter.	38	53	43	M.	3	1	1	2	5	9	2	8	17	10	4
	M.	12·6	23·7	21		15·3	29·1	25·7	N.	2	1		2	5	8	1	12	16	7	8
	L.	-9	4	1		-9	4	1	E.	2	1		1	5	7	3	12	16	5	10
Feb.	G.	36	47	43					M.	4	3		3	4	10	3	3	12	7	10
	M.	19·1	29·4	25					N.	2	5			4	10	3	5	12	7	10
	L.	-4	13	7					E.	3	3	1		5	8	5	4	15	8	6
March	G.	48	56	51					M.	3	1	2		4	8	3	10	20	8	3
	M.	26·6	37·3	33·6					N.		5			3	10	2	11	17	6	8
	L.	6	18	15					E.		4	1		4	8	3	11	17	8	6
April	G.	54	72	63	Spring.	54	75	63	M.	5	5	1	3	4	3	1	8	18	6	6
	M.	37·2	50 8	42·5		35·8	48·3	41	N.	2	6	1	4	5	3	1	8	20	4	6
	L.	19	35	32		6	18	15	E.	3	7		5	5	3	1	6	17	6	7
May	G.	52	75	63					M.	7	5	1	2	5	4	2	5	13	8	10
	M.	43·7	56·8	48					N.	3	7	1	4	4	3	3	6	15	6	10
	L.	33	40	39					E.	4	5	3	3	4	5	2	5	15	6	10
June	G.	66	86	77					M.	2	4	5	1	8	7		3	13	11	6
	M.	54·4	69·2	60·8					N.		5	2		11	6		6	19	5	6
	L.	40	41	42					E.		6	2	1	11	6		5	19	5	6
July	G.	71	89	80	Summer.	71	89	80	M.	1	3	3	1	12	6	2	3	16	6	9
	M.	58·3	74·5	62·8		55·8	71·4	62·1	N.		3	2	2	10	10	2	2	16	5	10
	L.	45	55	54		38	41	42	E.		4	1	2	8	11	3	2	19	3	9
Aug.	G.	70	87	73					M.	4	3		1	9	6	1	7	22	5	4
	M.	54·9	70·7	62·9					N.	2	4	1	2	4	10		8	24	4	3
	L.	38	56	51					E.	1	3	1	4	5	8		9	22	8	1
Sept.	G.	63	85	72					M.	1	2			9	14	1	3	15	9	6
	M.	55·7	67·8	58·4					N.	2	2		1	5	14	1	5	20	5	5
	L.	34	46	39					E.	2	2	1	1	3	15	1	5	19	7	4
Oct.	G.	70	71	61	Autumn.	70	85	72	M.	8	1		1	8	2	1	10	13	14	4
	M.	37·5	49·1	43·4		40·8	52·1	46·1	N.	3	5		1	7	5	2	8	14	9	8
	L.	18	37	23		13	19	19	E.	3	4	1	1	8	4	2	8	15	9	7
Nov.	G.	48	62	57					M.	3	5			5	9	4	4	15	10	5
	M.	29·2	39·4	36·6					N.	2	5	1	1	2	10	5	4	14	10	6
	L.	13	19	19					E.	3	8	1	2	2	7	4	3	14	11	5
Dec.	G.	50	55	53					M.	2	4	1	2	4	9	1	8	14	12	5
	M.	21·3	28·6	27·7					N.	2	5	1	3	2	8	3	7	16	4	11
	L.	-2	11	9					E.	2	5	1	2	3	9	2	7	16	3	12
Year	G.					58·2	75·5	54·5	M.	43	37	14	16	77	87	21	72	188	106	72
	M.					36·9	50·2	43·7	N.	20	53	9	20	62	97	23	82	203	72	91
	L.					12	20·5	19·2	E.	23	52	13	22	63	91	26	77	204	79	83

The following table shows the greatest, mean, and least elevation of the thermometer for each month and year of the foregoing period.

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year*
1798	G.	51	46	76	83	86	89	94·5	94	90	70	58	45·5	94·5
	M.	27·1	24.3	35·2	47·1	59	69·6	71·3	74·3	63·8	52·2	35.1	22·1	50·6
	L.	−1	−7	4	24	42	49	50	51	34·5	24	11·5	−2·5	−7
1799	G.	56·5	50	56	83	88	92	92	69	84	72	66·5	49	92
	M.	26	23·6	29·1	43·5	56·6	68·3	75	71·9	60·6	48·5	39·5	27·2	46·7
	L.	−12	−3	−9	24	32	43	51	45	40	21	15	1	−12
1800	G.	48	57	60	84	89	94	100	89	89	71	60	66	100
	M.	25·3	26·4	33·7	50	55·7	68·4	73·6	69·6	61·2	50·3	33·9	33·1	48
	L.	−6	3	0	78	32	46	48	44·5	40	28	12	11	−6
1801	G.	42	61	55	26	85	92	96	93	90	72	64	54	96
	M.	27·8	27·4	38·2	46·3	60·3	67·3	72	69·6	63·8	51.5	37·9	31·3	49·6
	L.	−4	−7	12	28	46	42	47	43	36	19	9	7·5	−7
1802	G.	61	51	66	71	82	89	90	91	85	79	60	59	91
	M.	32·9	24·3	35·8	46·5	53·4	68·3	70	72·9	62·4	53·5	41·5	31·3	49·5
	L.	3·5	−6	7	24	31	51	50	52	34	27	22	1	−6
1803	G.	58	59	74	79	86	93	91	88	78	77	61	62	93
	M.	26·4	31	55·7	47·8	56·8	67·5	72·3	70	59·4	51·9	36·4	34·3	48·5
	L.	7·5	2	0	22	31	48	49	41·5	34	28	18	9·5	0
1804	G.	46	46·5	57	66	85	90·5	89	87	91	68	66	45	90·5
	M.	21·3	26·4	32·8	43.2	61·4	67	69·1	67·7	61·6	46·5	39·7	26·3	47·5
	L.	−5	−2	1	17	40	53	44	44	31	29	14	−10·5	−5
1805	G.	41	58	65	75	80	95	95	92	89	78	72	69	95
	M.	20·9	28·3	38·9	49	57·4	66·9	74·2	72·6	64·5	47·6	40·2	38·8	49·7
	L.	−9	4	11	32	38	46	52	54	41	28	22	14	−10·5
1806	G.	49	58	71	66	90	92	92	91	83	76	62	48	92
	M.	25·6	29·9	27·8	40·9	54·7	67	67·9	69·5	61·3	50·1	40	29·2	48
	L.	−6	−6	10	19	36	47	54	48	37	28	24	2	−6
1807	G.	51	42	44	72	76	89·5	85	82	75	71	53	53	89.5
	M.	17·5	19·9	26·3	40·2	50·7	60·6	66·7	68·8	54·9	45·9	32·5	29·8	42·9
	L.	−18	−11	3	20	32	42	50	47	38	21	11	7	−18
1808	G.	44	47	56	72	75	86	89	87	85	71	62	55	89
	M.	19·1	24·5	32·5	43·5	49·5	61·4	65·2	62·8	60·6	43·3	35·1	25·9	43·9
	L.	−9	−4	6	19	33	40	45	38	34	18	13	−2	·9
Great'st		61	61	76	84	90	95	100	94	91	79	72	69	100
Gen. M.		24·5	26·0	33·4	45·3	56·1	66·6	70·4	70	61·3	49·2	37·4	29·9	47·6
Least		−18	−11	0	17	31	40	45	38	31	18	9	−2·5	−18

Mean state of the thermometer at the several hours of observation. It will be observed, that the mean temperature at sundown is nearly the same, as the mean for the year, or as the mean of the other two.

	1778	1779	1800	1801	1802	1803	1804	1805	1806	1807	1808	Mean
Sunrise.	40·7	39·3	40·9	42·1	42·5	41·3	40·1	41·7	41·6	36·3	39·6	40·55
Warmest pt. d.	55·7	53·9	55·6	56·8	56·6	56·3	54·6	56	55	49·3	50·2	55·55
Sundown.	45·9	46·6	48	48·8	48·5	48·8	47·6	49	47·8	42·7	43·7	47·04

* The numbers in this column are the extremes and means for the year of the seasons.

Annual mean state of the winds and weather.

		Wind								Weather.		
		N	NE	E	SE	S	SSW	W	NW	fair	clou.	wet
1798	M.	40	28	18	48	64	59	30	78	227	72	66
	N.	31	32	23	51	47	78	39	75	206	72	90
	E.	23	38	18	58	46	60	41	79	226	53	87
1799	M.	44	21	20	35	57	72	33	83	221	77	67
	N.	33	38	13	44	43	66	48	80	227	69	69
	E.	31	34	13	51	45	60	49	81	227	69	69
1800	M.	48	18	13	30	54	75	52	77	201	103	59
	N.	30	28	21	40	43	70	54	80	174	93	94
	E.	27	42	13	51	41	66	54	71	210	65	90
1801	M.	35	37	21	31	67	64	30	78	218	79	68
	N.	26	52	18	41	45	57	31	96	226	57	82
	E.	23	48	20	51	45	63	21	95	217	54	94
1802	M.	39	28	20	15	76	78	24	85	200	95	70
	N.	29	41	20	23	54	90	30	78	190	73	100
	E.	31	34	24	36	42	89	28	81	214	69	81
1803	M.	36	32	18	18	91	76	25	66	206	105	54
	N.	26	42	22	29	56	79	25	83	212	83	68
	E.	25	42	20	39	57	72	26	84	198	88	79
1804	M.	55	31	20	12	57	75	25	91	201	104	61
	N.	44	47	22	20	33	81	28	91	214	72	80
	E.	35	44	19	29	39	85	23	91	214	82	72
1805	M.	29	27	17	16	66	108	23	79	199	111	55
	N.	20	36	15	31	41	106	18	98	202	86	78
	E.	20	36	16	33	41	97	24	98	201	94	70
1806	M.	43	48	9	17	61	79	26	81	192	103	70
	N.	27	58	18	25	39	82	32	81	199	83	83
	E.	24	64	21	26	38	79	39	75	198	86	81
1807	M.	26	34	10	15	45	114	27	94	197	98	70
	N.	18	40	11	32	28	99	29	107	201	70	96
	E.	18	39	10	39	32	91	31	104	194	82	89
1[illegible]	M.	43	37	14	16	77	87	21	72	188	106	72
	N.	20	53	9	20	62	97	23	82	203	72	91
	E.	23	52	13	22	63	91	26	77	204	79	83
Mean.	M.	40	31	16	23	65	81	29	80	204	96	65
	N.	27	42	18	32	45	82	33	86	205	75	85
	E.	25	43	17	39	44	78	33	85	209	75	81

General table, deduced from the preceding, shewing the mean state of the winds and weather at the several hours of observation; to which is subjoined the mean of the morning, noon and evening observations for each month and for the year.

		Winds.								Weather.		
		N	NE	E	SE	S	SW	W	NW	fair	clou.	wet
Jan.	M.	4·1	1·3	1	·7	3·6	7·5	3·2	9·6	16.9	8·8	5·3
	N.	3·5	·9	1·1	1·4	2·5	7	3·6	10·6	17·5	6·7	6·7
	E.	3·9	1·5	·8	1·5	2·3	6·3	4·7	10	16·6	7·3	7·1
Feb.	M.	3·2	1·9	·3	1·4	3·1	6·1	2·5	10	15·9	6·5	5·8
	N.	2·7	2.8	·5	1·5	2·5	5·4	3·8	9	16·8	4·6	6·7
	E.	2·9	2·7	·5	1·4	2·5	5·2	3·6	9·4	17·1	5	6·1
March	M.	4·3	2·8	1·4	1·1	3·6	6·1	2·6	9·1	16·7	9·4	4·9
	N.	2·8	4·5	·7	1·8	2·5	7·1	2·2	9·4	15·6	7·8	7·5
	E.	2·4	4·2	1·3	2·6	2·6	5·9	2·5	9·1	17	6·7	7·2
April	M.	4·1	3·8	2	1·6	4·9	4·5	2·4	6·7	15·9	8	6·1
	N.	2·5	5·5	2.2	2·5	3·4	4·2	2·4	7·4	16·3	6·3	7·4
	E.	1·8	6·2	1·4	3	3·5	3·6	2·5	7·5	15·8	7·5	6·7
May	M.	3·7	4·7	2·3	2·6	8·2	4·6	1·9	3	16·8	8·3	5·9
	N.	2·1	5·4	2·8	4·1	5·6	5	2·3	3·7	16·6	6·6	7·8
	E.	1·7	5	2·7	5·2	5·4	5	1·9	4·1	16·5	7·2	7·4
June	M.	2·1	3·5	1·6	2·6	8·4	6	1·5	4·2	17·6	7·1	5·1
	N.	·7	4	1·7	3·5	6·6	6·7	1·9	4·7	17·7	5·3	7
	E.	·6	3·5	1·7	4·7	7	5·7	2·3	4·3	18	5·5	6·5
July	M.	1·3	2·4	1·5	2·5	8·5	8·3	2·2	4·4	19·9	5.9	5·9
	N.	·6	3·9	1·1	4·4	5	9·7	2·4	3·9	18·3	5·4	7·3
	E.	·5	4·3	1·2	5·7	4·4	10·4	1·9	3·5	18·8	4·5	7·6
Aug.	M.	1·8	2·1	1·8	3·5	7·4	7·8	2·3	4·4	17·3	8·1	5·5
	N.	·7	3·4	2·2	3·7	4·9	9·4	1·6	5·1	18·4	5·6	7
	E.	·7	3	2·5	4·8	4·5	8·3	2·4	4·8	18·4	5·5	7·1
Sept.	M.	2·5	2·9	1·3	2·9	6	6·2	1·8	6·4	16·1	7·5	6·4
	N.	2·5	3·9	1·7	3·5	3	7·3	1·5	6·5	17·9	5·5	6·5
	E.	2·2	4·3	1·5	4·1	3·1	7·4	1·5	6·3	19·5	5·2	5·3
Oct.	M.	5·6	1·3	1·7	1·6	4·6	6·6	2·2	7·2	18·4	8·5	4·1
	N.	2·7	3·8	1·6	2·6	4	5·8	3·2	7·2	18·4	6·5	6·4
	E.	2·2	4·3	1·8	2·8	4·2	5·7	2·7	7·3	18·5	6	6·5
Nov.	M.	3·7	2·3	1	1·2	2·9	8·5	3·6	6·9	17·3	8·1	4·7
	N.	3·5	2·4	·8	1·5	1·7	7·5	3·8	8·8	15·3	8	6·3
	E.	3·3	3·3	1·1	1·5	2·1	6·5	3·4	9·1	16·2	7·6	6·3
Dec.	M.	3·4	2·1	·6	1·3	3·8	8·5	2·5	8·8	16·6	9·5	4·8
	N.	3·2	1·9	·6	1·6	2.6	7·3	3·7	9·8	15·8	7·2	8
	F..	3·2	1·6	·5	1	3	7·8	3·4	9·7	16·8	6·6	7·5
Year	M.	3·3	2·6	1·4	1·9	5·4	6·7	2·3	6·7	17·1	8	5·4
	N.	2·3	3·5	1·4	2·7	3·7	6·8	2·7	7·2	17·1	6·3	7
	E.	2.1	3·6	1·4	3·2	3·7	6·5	2·7	7·1	17·4	6·2	6·9
Jan.		3·8	1·2	1	1·2	2·8	6·9	3·8	10·1	17	7·6	6·4
Feb.		2·9	2·5	·4	1·4	2·7	5·6	3·3	9·5	16·6	5·4	6·2
March		3·2	3·8	1·1	1·8	2·9	6·4	2·4	9·2	16·4	8	6·5
April		2·8	5·2	1·9	2·4	3·9	4·1	2·4	7·2	16	7·3	6·7
May		2·5	5	2·6	4	6·4	4·9	2	3·6	16·6	7·4	7
June		1·1	3·7	1·7	3·6	7·3	6·1	3·9	4·4	17·8	5·9	6·2
July.		·8	3·5	1·3	4·2	5·9	9·5	2·2	3·9	19	5·3	6·9
Aug.		1·1	2·8	2·2	4	4	8·5	2·1	4·8	18	6·4	6·5
Sept		2·4	3·7	1·5	3·5	4	7	1·6	6·4	17·8	6·1	6·1
Oct.		3·5	3·1	1.7	2·3	4·3	6	2·7	7·2	18·4	7	5·7
Nov.		3·5	2·7	1	1·4	2·3	7·5	3·6	8·3	16·4	7·9	5·8
Dec.		3·3	1·9	·6	1·5	3·1	7·9	3·2	9·4	16·4	7·8	6·8
mean		2·6	3·3	1·4	2·6	4·1	6·7	2·8	7	17·2	6·8	6·4

LII.

ON THE MOTION OF A PENDULUM SUSPENDED FROM TWO POINTS.

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1. THE remarkable variety of motions in a pendulum suspended from two points, in the curious experiment in Professor Dean's paper on the apparent motion of the earth, as viewed from the moon, induced me to examine the theory of such motions, and I have found the fluents of the fundamental equations, where the arcs of oscillation are small, which is the case usually considered in simple pendulums. Some of the most important results of this calculation are contained in the following articles.

2. Let A, B, (Pl. III. Fig. 1.) be the points of suspension of the line ACB, to which the ball D is attached, by the vertical line CD, the line AB being supposed horizontal. Continue DC to meet AB in G, which point being taken as the origin of the rectangular co-ordinates, we shall call GD the axis of z; GB that of x; and GH, perpendicular to the plane of the figure, the axis of y. If the pendulum be supposed to vibrate in the plane of xz, the point D of the body will describe an arch of a circle EDF, whose centre is C, and radius CD; and if this arch be made to revolve about the axis AB (or chord EF) it will generate a *curve superficies* which will be the locus of that point of the pendulous body in all its successive revolutions. It must however be observed, that the arcs of vibration must never be so great as to bring the pendulum in the direction of the line AC or BC, which would reduce the double, to a single, point of suspension.

3. In calculating the motion of the pendulum, we shall neglect the resistance of the air, and shall consider the whole pendulum as a

point D suspended by the line ABCD void of gravity. Suppose that at the end of the time t the pendulous body is at L, and the centre C at c; the co-ordinates of the point L being $GM=x$, $MK=z$, $KL=y$. Continue MK to meet the arch EDF in I, and on MK let fall the perpendicular CS. Draw Lca, ICa, which will evidently meet in the point a of the line AB, making Ia=La and IM=LM. Put $CD=r$, $CG=r'$, the force of gravity=g, and the tension of the thread Lc at the point L equal to $\frac{\lambda r}{\sqrt{rr-xx}}$. This compound quantity is taken rather than a simple one, in order to render the equations found by this method identical with those investigated in a different manner in the next article. This tension being multiplied by $\frac{Ma}{La}, \frac{LK}{La}, \frac{KM}{La}$ will give the corresponding forces in directions of the axes x, y, z, respectively. Now by the similar triangles ICS, IaM we have Ia (=La)= $\frac{IM.IC}{IS}=\frac{LM.IC}{IS}=\frac{r\sqrt{zz+yy}}{\sqrt{rr-xx}}$, because $LM=\sqrt{MK^2+KL^2}=\sqrt{zz+yy}$ & $IS=\sqrt{CI^2-CS^2}=\sqrt{rr-xx}$, also $Ma=\frac{IM.CS}{IS}=\frac{LM.CS}{IS}=\frac{x\sqrt{zz+yy}}{\sqrt{rr-xx}}$, which substituted give the forces in directions of these axes $-\frac{\lambda x}{\sqrt{rr-xx}}, \frac{-\lambda y}{\sqrt{zz+yy}}, \frac{-\lambda z}{\sqrt{zz+yy}}$, the negative sign being prefixed because these forces tend to decrease the co-ordinates. This last force is to be increased by g, because gravity acts in direction of the axis z, and the force in direction of that axis becomes $\frac{-\lambda z}{\sqrt{zz+yy}}+g$. Now (by the usual rules for variable motions) these forces being multiplied by the fluxion of the time dt will give the fluxions of the velocities in direction of those axes, namely, $d.\frac{dx}{dt}, d.\frac{dy}{dt}, d.\frac{dz}{dt}$; hence by the transposition we have the following system of equations, the integrals of which, combined with the equation of the curve surface, will give the values of x, y, z, corresponding to the time t.

$$
\left.\begin{aligned}
0&=d.\frac{dx}{dt}+\frac{\lambda x dt}{\sqrt{rr-xx}}\\
0&=d.\frac{dy}{dt}+\frac{\lambda y dt}{\sqrt{zz+yy}}\\
0&=d.\frac{dz}{dt}+\frac{\lambda z dt}{\sqrt{zz+yy}}-gdt.
\end{aligned}\right\} \quad (A)
$$

4. These equations may be investigated by the same method that La Place has used for a single pendulum in vol. i. page 28 of his "Mecanique Celeste," by substituting in the equations $0=d.\frac{dx}{dt}-\lambda dt\left(\frac{du}{dx}\right)$ $0=d.\frac{dy}{dt}-\lambda dt\left(\frac{du}{dy}\right)$; $0=d.\frac{dz}{dt}-\lambda dt\left(\frac{du}{dz}\right)-gdt$, the value of $u=o$ representing the equation of the curve surface on which the pendulous body moves. This equation is easily investigated by observing that $MI=MS+SI=r'+\sqrt{rr-xx}$; $ML=\sqrt{zz+yy}$, and $MI=ML$ gives $r'+\sqrt{rr-xx}=\sqrt{zz+yy}$; or $0=r'+\sqrt{rr-xx}-\sqrt{zz+yy}=u$. This value of u, substituted in the preceding equations of La Place, gives the system (A) of the preceding article.

If AB were inclined to the horizon, and GD to the vertical, by the angle I, the force of gravity in direction x would be g sine I, and in direction z would be g cosine I; which would produce, in the first equation, the term $-gdt$ sine I, and in the last $-gdt$ cosine I, instead of $-gdt$, which when I is very small and x, y, small in comparison of r, (which, as in § 5 following, give $\lambda=g$ nearly) may be reduced to the same form as the equations (A), by writing $x+r$ sine I for x, which is the same as changing the origin of the co-ordinates, consequently the values of x, y, z, given in the following articles for the case of AB horizontal may be easily reduced to that, where the axis is inclined to the horizon by a very small angle.

It is worthy of remark, that the *distance of the points of suspension* AB *does not enter into these equations, consequently that distance may be varied at pleasure, without affecting the motion,* provided r and r' remain unaltered, and the condition at the end of § 2 be observed.

It may be observed that these equations would remain the same, even if the term r' were to become negative, or the point C were to fall above G, provided that by any light mechanical contrivance, whose weight might be neglected in the calculation, the ball D could be retained constantly in the moveable plane ABC, while vibrating about this axis AB, the ball at the same time vibrating in that plane about the centre C.

5. If we suppose the arcs of vibration to be small, the vertical ascent or descent of the body, denoted by the change in the value of z would be very small in comparison of x or y, consequently in the last of the equations (A) we may neglect $d.\frac{dz}{dt}$; and, as y is very small in comparison of z, we may, in neglecting terms of the order $\frac{yy}{zz}$, put $\frac{z}{\sqrt{zz+yy}}=1$, then this equation divided by dt gives $\lambda=g$. This being substituted in the other two equations (neglecting quantities like those before mentioned, by putting r for $\sqrt{rr-xx}$, and $r+r'$ for $\sqrt{zz+yy}$) they become $0=d.\frac{dx}{dt}+\frac{gxdt}{r}$, $0=d.\frac{dy}{dt}+\frac{gydt}{r+r'}$, which integrated, putting for brevity $\frac{g}{r}=aa$, $\frac{g}{r+r'}=a'a'$, give

$$\left.\begin{aligned} x&=b \text{ cosine } (at+c) \\ y&=b' \text{ cosine } (a't+c') \end{aligned}\right\} \quad (B)$$

as may be easily proved by substituting these values in the proposed equations; b, b', c, c', being constant quantities, to be determined by the initial values of x and y, and the velocities of projection in directions of those axes. The general expressions of the velocities are $\frac{dx}{dt}$, $\frac{dy}{dt}$, which by means of the equations (B) become

$$\left.\begin{aligned} \frac{dx}{dt} &= -ab \text{ sine } (at+c) \\ \frac{dy}{dt} &= -a'b' \text{ sine } (a't+c') \end{aligned}\right\} \quad (C)$$

If we therefore suppose the value of x, y at the commencement of the motion to be e, e', we shall from the equations (B) have $e=b$ cosine c, $e'=b'$ cosine c'; and if the velocities in directions x, y, be at that time v, and v', the equations (C) will become $v=-ab$ sine c, and $v'=-a'b'$ sine c'. From these we deduce

$$\left.\begin{aligned} b &= \sqrt{ee+\frac{vv}{aa}} \\ b' &= \sqrt{e'e'+\frac{v'v'}{a'a'}} \\ \text{Tang. } c &= -\frac{v}{ae} \\ \text{Tang. } c' &= -\frac{v'}{a'e'} \end{aligned}\right\} \quad (D)$$

which determine the constant quantities.

The commencement of the time t being arbitrary, we may, by taking it at that point of any revolution where $y=b'$, reduce the constant c' to o. For in this case the second of the equations (B) becomes $b'=b'$ cosine $(a't+c')$, or $1=$ cosine $(a't+c')$, and, as $t=0$, we may take $c'=0$, and then the expressions of x, y will become.

$$\left.\begin{aligned} x &= b \text{ cosine } (at+c) \\ y &= b' \text{ cosine } a't \end{aligned}\right\} \quad (E)$$

which may be considered equally general as the equations (B).

If the body fall from a point at rest, we shall have $v=o$, $v'=o$, whence, by the equations (D) $b=\pm e$, $b'=\pm e'$, $c=o$, $c'=o$, consequently

$$\left.\begin{array}{l} x=b \text{ cosine } at \\ y=b' \text{ cosine } a't \end{array}\right\} \quad (F)$$

These last equations may *always* be used when a, a', are incommensurable, which includes by far the greatest number of cases. For if the arch $a't$ be decreased by any whole number p of circles represented by $p.\,360^\circ$ the arch at would be decreased by $p.\,360^\circ + p.\,360^\circ.\frac{a-a'}{a'}$, hence the expression of x in the equations (E) would become b cosine $\left(at+c-p.\,360^\circ.\frac{a-a'}{a'}\right)$ and if a & a' were incommensurable, we might take p such that $p.360^\circ.\frac{a-a'}{a'}$ would (in neglecting multiples of 360°) be equal to c, or differ from it by a quantity less than any assignable, which would reduce the expression of x to b cosine at, taking for epoch the time corresponding to this value of p. But when a and a' are commensurable, this reduction can take place but for particular values of c, which it will not be necessary to note, since they may be easily discovered.

6. The equation $o=r'+\sqrt{rr-xx}-\sqrt{zz+yy}$ of § 4, developed in series, neglecting the fourth powers of x and y gives $z=r'+r-\frac{xx}{2r}-\frac{yy}{2z}$ which by substituting the values of x, y, given in the equations (B) becomes $z=r+r'-\frac{bb}{2r}.\text{ cosine } \overline{at+c}\,^2-\frac{b'b'}{2(r+r')}\text{ cosine } \overline{a't+c'}\,^2$

Thus we have obtained approximate values of x, y, z, corresponding to the time t, which will enable us to trace nearly the course of the pendulous body; and if greater accuracy were required, we might substitute the values of z, y, in the third equation (A) and thus obtain a more correct value of λ which substituted in the other two equations would give exacter values of x, y, and in this way, by successive operations, we might obtain the co-ordinates to any required degree of accuracy.

7. The equations (B) give $\pm b$ for the greatest value of x, and $\pm b'$ for the greatest value of y. Hence if on GS the axis of x (Plate 3. Fib. 2.) we take, on each side of the point G, the lines GS=GN= b; and in like manner on the axis of y, the lines GE=GW=b', and through these points draw lines parallel to the axes, to complete the parallelogram ACKD, *the projection of the path of the pendulum on the plane of* xy *will always be contained within this figure.*

8. The tangent of the curve must be *parallel* to the axis of x, when $\frac{dx}{dy}$ or $\frac{ab \text{ sine}(at+c)}{a'b' \text{ sine}(a't+c')}$ is infinite, and *perpendicular* to that axis when that expression is 0. The first condition takes place when $b'=o$, or sine $(a't+c')=o$; the second when $b=o$ or sine $(at+c)=o$. When $b'=o$, the second equation (B) gives $y=o$, consequently the pendulum must vibrate in the plane of zx: when $b=o$, the first of the equations (B) gives $x=o$, and the body must then vibrate constantly in the plane of zy. When sine $(a't+c')=o$, $y=b'$ cosine $(a't+c')$ must be $\pm b'$, consequently the line AD or CK must then be tangent to the curve. When sine $(at+c)=o$, $x=b$ cosine $(at+c)$ must be $\pm b$ and the line AC or DK must be tangent to the curve. Hence in general we may conclude that the *sides of the parallelogram* ADKC *become tangents to the curve in every vibration.* There is one exception to this, namely, when sine $(at+c)$ and sine $(a't+c')$ are both $=o$, which correspond to $x=\pm b$ and $y=\pm b'$, when the body is at one of the corners A, C, K, D, of the parallelogram. In this case the preceding expression of $\frac{dx}{dy}$ becomes of the form $\frac{o}{o}$, and we must, according to the usual rule, take the fluxions of the numerator and denominator, which gives

$\frac{dx}{dy} = \frac{aab \text{ cosine } (at+c)}{a'a'b' \text{ cosine } (a't+c')}$ or $\frac{aab}{a'a'b'}$, which by § 5 is equal to $\frac{r+r'}{r} \cdot \frac{b}{b'}$, hence the subtangent $\frac{ydx}{dy}$ becomes $\frac{r+r'}{r} \cdot b$, which affords this construction. Take on the axis NS (Plate 3, Fig. 2 or 4) GI=GL= $\frac{r'}{r}$. GS, and join KI, AL, DI, CL, these will be respectively the tangents of the curve at the points K, A, D, C. If we substitute the values, sine $(at+c) = o$, sine $(a't+c') = o$, in the equations (C) we shall find the velocities in the directions of the axes x, y, are equal to o, consequently the pendulum must be at rest when it is at either of the points A, D, K or C.

9. In the case of the last article where $b'=o$, the vibrations must be performed in the plane zx, exactly like those of a pendulum of the length r suspended from a *fixed* point C. (Plate 3. Fig. 1.) Because the values $x=b$ cosine $(at+c)$ given by the first of the equations (B) is not altered by supposing AB and r' to be decreased till they become o, and this value of x shows that one vibration is performed while x changes from b to $-b$, consequently the arch at must vary 180° in one vibration.

In like manner when $b=o$, the body must move in the plane yz, and one vibration will be performed while $y=b'$ cosine $(a't+c')$ changes from b' to $-b'$; consequently, in the time of one vibration, the arch $a't$ will increase 180°, and the body will vibrate like a simple pendulum of the length $r+r'$, suspended from the point G. For $a'a'$ being $= \frac{g}{r+r'}$. the value $a't$ would not be changed by decreasing r' till it became o, provided r were increased by an equal quantity. The same would take place if r were decreased till it became o, r' being increased by an equal quantity, so as to preserve the same value to $r+r'$ and a'.

Hence the vibrations of the pendulum ADB, (Plate III. Fig. 8) about the axis AB would be performed in the same time as those of a simple pendulum of the length GD$=r+r'$.

10. From the preceding articles it follows, that if at the moment the compound pendulum is set in motion, from a point whose ordinates are e, e', and velocities v, v', in the directions of the axes x, y, as mentioned in § 5, two simple pendulums are also projected—One of the length r, suspended from the point C, and projected in the plane zx with the velocity v, from a point where $x=e$: The other of the length $r+r'$, suspended from the point G, and projected in the plane zy with the velocity v', *the distances of these simple pendulums from the axis of* z *at any time will be respectively equal to the values of* x, y, *in the motion of the compound pendulum.* For in all these pendulums the values of x, y, will be given by the same equations (B), since the constant quantities a, b, c, a', b', c', will be the same in the compound pendulum as in the simple ones. It being always understood that the arcs of vibration are small in comparison of the lengths of the pendulums, and the bodies are supposed not to interfere with each other in their different motions.

The same result might also be obtained in the following manner. Suppose the pendulum were projected from the point D (Plate III. Fig. 1.) in a direction corresponding to the diagonal GA, (Fig. 2) with a force represented by GA, that would make it ascend to the point corresponding to A. This force might be decomposed into two, GN, GE. If the first of these only acted on the body it would vibrate in the plane of zx about the centre C, (Fig. 1) and if the last only acted, the vibrations would be in the plane zy about the centre G, and when these forces are very small, they may be considered as acting at the same time *independently of each other*, as is well known by mathematicians, consequently the motion of the compound pendulum may in this case be investigated, as if it were two simple ones, agreeably to the former part of this article.

11. For illustration we shall here compare the path of a simple pendulum on a spherical surface with that of the compound pendulum on the surface DILN, supposing the body to fall from rest, from a point N. In the first case when the surface DILN is supposed spherical, (the point C coinciding with G) the body in falling from rest from the point N, would, by the force of gravity in the first instant, describe the small arch Nr, situated in the *vertical* plane, perpendicular to the spherical surface at the point N, which plane *would pass through the lowest point* D of the spherical surface, and the action of gravity upon the body, in the successive moments of time, continuing to operate in the same plane, the paths described would be an arch NrD of a great circle, whose projection on the plane of xy would be a right line. In a similar way, if the surface DILN were not spherical, the line NR passed over in the first moment of the fall would be in the *vertical* plane perpendicular to that surface at the point N, and this plane *would not pass through the lowest point* D, except b or $b'=o$; and the force of gravity would act in like manner at the successive points of the path described by the body, consequently that path would be represented by a curve, as NRP, meeting the arch DEP in P, the points N and P being on different sides of the point D (or rather on different sides of the plane yz), when a does not much exceed a'. For at the point P the value of $y=b'$ cosine $a't$ is o, $a't$ being $=90°$, and as a is greater than a', at would exceed $90°$, and its cosine would become negative, consequently $x=b$ cosine at would have a different sign from b.

12. That we may more fully understand the nature of the path

described by the pendulum, we shall endeavour to give an idea of it for various values of a, a', by tracing its projection on the plane of xy, and for brevity we shall speak of the motion of the body as if it were actually made on that plane. Denoting therefore by $\mathrm{A}\frac{x}{b}$ the arch, whose cosine is $\frac{x}{b}$, we shall have from the equations (E) $at+c=\mathrm{A}\frac{x}{b}$ and $a't=\mathrm{A}\frac{y}{b'}$, whence, by exterminating t, we shall obtain the equation of the curve projected on the plane of xy.

$$\mathrm{A}\frac{x}{b}=c+\frac{a}{a'}\mathrm{A}\frac{y}{b'} \qquad \text{(G)}$$

and taking the cosine of each side of the equation

$$\frac{x}{b}=\text{cosine } c\,.\,\text{cosine}\left(\frac{a}{a'}\,\mathrm{A}\frac{y}{b'}\right)-\text{sine } c\,.\,\text{sine}\left(\frac{a}{a'}\,\mathrm{A}\frac{y}{b'}\right) \qquad \text{(H)}$$

This equation is generally transcendental, but may be easily reduced to an algebraical form when $\frac{a}{a'}$ is a whole number. To illustrate this, we shall develop a few simple cases where $\frac{a}{a'}$ is an integer, or differs from an integer by a very small quantity.

13. When $\frac{a}{a'}=1$, or $r'=o$, the points C and G (Fig. 1) coincide, and the pendulum is of the common simple form, suspended from the point G. In this case, the equation (H) becomes $\frac{x}{b}=\text{cos. } c\,.\,\text{cos.}\left(\mathrm{A}\frac{y}{b'}\right)$ $-\text{sine } c\,.\,\text{sine}\left(\mathrm{A}\frac{y}{b'}\right)$, or by reduction

$$\frac{x}{b}=\frac{y}{b'}\,.\,\text{cosine } c-\sqrt{1-\frac{yy}{bb'}}\,.\,\text{sine } c.$$

When sine $c=o$, this becomes $\frac{x}{b}=\pm\frac{y}{b'}$, and if b & b' are both finite the equation is that of a right line, corresponding to the diagonal KA, or CD. If b or $b'=o$, x or y must be respectively o, and we shall obtain the same results a in § 9. If c is finite, we must transpose the term $\frac{y}{b'}$ cosine c, and square both sides, which by reduction will give

$$\frac{x^2}{bb} - \frac{2xy}{bb'} \text{ cosine } c + \frac{yy}{b'b'} = \overline{\text{sine } c}\,|^2$$

the equation of an ellipsis or circle, when b and b' are finite. When $c=90^\circ$ the equation is reduced to $\frac{xx}{bb}+\frac{yy}{b'b'}=1$, corresponding to an ellipsis, which becomes a circle, whose radius is b, when $b=b'$.

14. When a' is nearly equal to a, we shall put $\frac{a'}{a}=1-\frac{1}{m}$, m being a large number; then, since by § 5, $\frac{aa}{a'a'}=\frac{r+r'}{r}$, we shall have $m=\frac{2r}{r'}$ nearly, and r' will be very small in comparison of r. This is the only case mention in Professor Dean's paper, and the motion may be compared to that of a body in a variable ellipsis. For let P (Pl. III. Fig. 7.) be the place of the pendulum at any moment, when, by the equations (B), $x=b\,.$ cosine $(at+c)$ and $y=b'\,.$ cosine $(a't+c')$. This last expression, in putting $h=\overline{a-a'}\,.\,t+c-c'$, becomes $y=b'\,.$ cosine $(at+c-h)=b'\,.$ cosine $h\,.$ cosine $(at+c)+b'\,.$ sine $h\,.$ sine $(at+c)$. If in this we substitute for $b'\,.$ cosine $(at+c)$ its value $\frac{b'x}{b}$, and for $b'\,.$ sine $(at+c)$ its value $b'\,.\,\frac{\sqrt{bb-xx}}{b}$, it will become $y=\frac{b'x}{b}\,.$ cos. $h+b'\frac{\sqrt{bb-xx}}{b}$ sine h. Therefore, if we take on SK, the line $\text{SL}=b'\,.$ cosine h, and draw the line GL to cut the ordinate PM in T, we shall have, from the similar triangles GMT, GSL, $\text{MT}=\frac{b'x}{b}\,.$ cosine h, and $\frac{\sqrt{bb-xx}}{b}=\frac{\sqrt{\text{GL}^2-\text{GT}^2}}{\text{GL}}$, whence $y=\text{MP}=\text{MT}+b'\,.\text{sine } h\,.\,\frac{\sqrt{\text{GL}^2-\text{GT}^2}}{\text{GL}}$, consequently $\text{TP}=b'\,.\text{sine } h\,.\,\frac{\sqrt{\text{GL}^2-\text{GT}^2}}{\text{GL}}$. Hence, if we take on GW, the line $\text{GR}=b'\,.$ sine h, we shall have $\text{TP}=\text{GR}\,.\,\frac{\sqrt{\text{GL}^2-\text{GT}^2}}{\text{GL}}$, which is

evidently the equation of an ellipsis, whose conjugate semidiameters are GL, GR. *Hence the place of the body may be found upon the supposition that the curve described is an ellipsis, one of whose semidiameters* GL *is found by making* SL$=b'$ *cosine* $(\overline{a-a'}\,.\,t+c-c')$, *the other* GR *being taken on the axis of* y, *and made equal to* b' *sine* $(\overline{a-a'}\,.\,t+c-c')$. *The corresponding point* P *of the curve being found by taking, on the axis of* x, GM$=b$ *cosine* $(at+c)$ *and drawing the ordinate* MTP, *perpendicular to that axis.*

A second method of computing this ellipsis may be found by putting $x=b\,.\,\text{cosine}\,(a't+c'+h)=b\,.\,\text{cosine}\,h\,.\,\text{cosine}\,(a't+c')-b\,.\,\text{sine}\,h\,.\,\text{sine}\,(a't+c')$, and if in this we substitute $b\,.\,\text{cosine}\,(a't+c')=\frac{by}{b'}$ and b sine $(a't+c')=b\frac{\sqrt{b'b'-yy}}{b'}$, it will become $x=\frac{by}{b'}\,.\,\text{cosine}\,h-b\,.\,\text{sine}\,h\,.\,\frac{\sqrt{b'b'-yy}}{b'}=\text{PM}'$, in drawing M′T′P parallel to GS. Now if on WK we take WL′$=b\,.$ cosine h, and draw the line GL′ to cut M′P in T′, we shall have by the similar triangles GM′T′, GWL′, M′T′$=\frac{by}{b'}\,.$ cosine h, T′P$=-b\,.\,\text{sine}\,h\,.\,\frac{\sqrt{\text{GL}'^2-\text{GT}'^2}}{\text{GL}'}$. By taking therefore on the axis GS the line GR′$=b\,.$ sine h, we shall have T′P$=-\text{GR}'.\,\frac{\sqrt{\text{GL}'^2-\text{GT}'^2}}{\text{GL}'}$, which is evidently the equation of an ellipsis whose conjugate semidiameters are GL′, GR′,* consequently the *place of the body may be found by making* WL′$=b\,.$ *cosine* $(\overline{a-a'}\,.\,t+c-c')$ *the other* GR′ *being taken on the axis of* x *equal to* $b\,.$ *sine* $(\overline{a-a'}\,.\,t+c-c')$. *The corresponding point* P *of the curve being found by taking on the axis of* y, GM′$=b'\,.$ *cosine* $(a't+c')$ *and drawing the ordinate* M′T′P′ *perpendicular to that axis.*

* In the present figure the point P is supposed to correspond to a *negative* value of the ordinate T′P.

The *first* of these methods is best to be used when b exceeds b', the second when b' exceeds b. It is evident that in both methods the sum of the squares of the conjugate semidiameters will be equal to $bb+b'b'$, and the area of the parallelogram included by the tangents drawn through the extremities of the diameters will be $4bb'$ sine $(\overline{a-a'}.t+c-c')$.

The greatest value of the semidiameter GL or GL$'$ corresponds to the case where $SL=\pm b'$ or $WL'=\pm b$, or $\overline{a-a'}.t+c-c'=0°$ or $180°$. For then GL, GL$'$ fall on one of the diagonals AK, CD, of the parallelogram; the conjugate semidiameter GR becomes o, and the ellipsis changes into one of these diagonals. The semidiameter GL of the first method cannot be less than GS, that of GL$'$ in the second method not less than GW.

15. In the time of one vibration of a simple pendulum of the length r the arch at will increase 180°, by § 9, and the arch $h=\overline{a-a'}.t+c-c'$ will increase in the same time $180°.\frac{a-a'}{a}=\frac{180°}{m}$ by § 14: the *arch* h *will therefore increase* 360° *in* 2m *vibrations (or* m *revolutions) of the same pendulum, (or* 2 m—2 *vibrations of a simple pendulum of the length* r+r$'$*) and in that time the conjugate diameters of the abovementioned ellipsis will go through all their changes of magnitude; and, if* m *be a whole number, the compound pendulum will be at the same place as at the beginning of the time, consequently the whole cycle of motions will be complete, and the body will again begin to describe the same curves as in the former period.* The same thing takes place nearly when m is large, but not a whole number, in taking m' for the nearest whole number to m: for, in this case the curves described after m' revolutions of the simple pendulum r, will be nearly like those in the preceding period, as when m is a whole number.

16. From what has been said in the last article, we can easily trace the curve described when $\frac{a-a'}{a}$ is small, and for illustration we shall take the case when the body falls from rest from the point K (Fig. 2). The arch h becomes $(a-a')\,t$, because by the equations (F) c and c' are then $=o$; and in using the first method (Fig. 7), we have $SL=b'$ cosine $(a-a)\,t$, and $GR=b'$ sine $\overline{a-a'}\,.\,t$. At the commencement of the motion when $t=o$, the direction of the body will be in the right line KI (Fig. 2), which is tangent to the curve in K, as was observed in § 8, and this line nearly coincides with the diagonal KA, the semidiameter GR (Fig. 7) is o, and it rapidly increases in the successive revolutions. After $\frac{1}{2}m$ vibrations of the pendulum of the length r, the arch $(a-a)\,t$ becomes 90°, then $GL=b$ and $GR=b'$, and the ellipsis becomes as in Fig. 3, the motion being in the direction ESWN. The semidiameter GR (Fig. 7) will then decrease, and after m revolutions the arch $\overline{a-a'}\,.\,t$ will become 180°, GR will be o, $SL=-b'$, and the point L will fall in D, the motion being then in the straight line DI (Fig. 4), corresponding nearly with the other diagonal DC. The body when at D will be at rest, as appears by the equations (C), c and c' being o, $at=a't+180°$, and m being supposed a whole number. From this point the body will begin to fall in direction of the line DI, the expression of GR (Fig. 7) will become negative, and independent of its sign will rapidly increase, and the motion will become elliptical. After $\frac{3}{2}\,m$ vibrations the arch $\overline{a-a'}\,.\,t$ will become 270°, $GL=b$ and $SL=-b'$, and the ellipsis will become as in Fig. 5, the motion being in the direction SENW, contrary to what it was when the number of vibrations was $\frac{m}{2}$, which is conformable to the equations (C), which show that at the point W, (where the curve touches the line CK) $\frac{dy}{t}=o$, and that $\frac{dx}{dt}$ changes its sign in

consequence of the increase of the arch $\overline{a-a'}\,.\,t$ by 180°. After this the value of GR (Fig. 7) independent of its sign decreases, and finally becomes 0, at the end of $2m$ vibrations, when the body will proceed towards the point K (Fig. 2), nearly in the right line IK, and when arrived at K the arch $\overline{a-a'}\,.\,t$ will be 360°, and the pendulum will be at rest, as at the commencement of the motion, and it will begin again to describe the same curves as in the former period. In Fig. 6, the curve described in a quarter of a cycle of revolutions when $m=12$ is marked. What has been said for the case $c=o$, $c'=o$ and m a whole number, will apply, with but little modification, to other values of those terms, so it will not be nesessary to examine this class of motions more particularly.

17. When $\frac{a}{a'}=2$, or $3r=r'$, the equation (H) becomes $\frac{a}{b}=$ cosine $c\,.$ cosine $(2\,.\,\mathrm{A}\frac{y}{b'})$ — sine $c\,.$ sine $(2\,\mathrm{A}\,\frac{y}{b'})$, which by substituting the values of cosine $(2\mathrm{A}\,.\,\frac{y}{b'})$ and sine $(2\mathrm{A}\,.\,\frac{y}{b'})$ becomes

$$\frac{x}{b}=(\frac{2yy}{b'b'}-1),\ \text{cosine}\ c-2\,.\,\frac{y}{b'}\sqrt{1-\frac{yy}{b'b'}}\,.\ \text{sine}\ c. \qquad \text{(I)}$$

which is in general a curve of the fourth order, but becomes of the second when sine $c=o$; that is, when $c=o$, or 180° &c.

When $c=o$ the equation (I) becomes $\frac{x}{b}=\frac{2yy}{b'b'}-1$ or $(b+x)\,.\,\frac{b'b'}{2b}=yy$, which is the equation of a parabola, whose axis is $b+x$, ordinate y, and parameter $\frac{b'b'}{2b}$. Hence if we take $r'=3r$, and let the pendulum fall from rest from the point K (Pl. 3, Fig. 9) of the parallelogram, it will describe the parabolic arc KND, whose axis is NS, vertex N; the parts KN, DN, being exactly similar and equal. When the arch at is 180°, $a't$ will be 90° and the body will be at N, as is evident by the equations (F). When $at=360°$, $a't=180°$, and the body will be at D, and will then be at rest, by the equations (C.) When $at=540°$, the body will be again at N, and when $at=720°$, it will be at K. Hence the pendulum will keep vibrating backwards and forwards in the parabolic arc KND.

When $c=45°$ the equation (I) becomes $\frac{x}{b\sqrt{2}}=\frac{2yy}{b'b'}-1-\frac{2y}{b'}\sqrt{1-\frac{yy}{b'b'}}$, of the fourth order. The body will then describe a curve of the form *abcdefga* (Pl. III. Fig. 10,) according to the order of the letters. This curve is easily traced by means of the equations $x=b$ cosine $(2a't+45°)$ and $y=b'$. cosine $a't$, deduced from the equations (E). The velocity of the pendulum at the point e in the line CK is, by the first of the equations (C) $-ab$. sine $45°$, or $\sqrt{\tfrac{1}{2}}$ multiplied by the velocity acquired by a simple pendulum of the length r in falling from the point corresponding to S towards the lowest point G. The points a, e, are found by putting $y=b'$ and $y=-b'$, corresponding to $a't=o$ and $a't=180°$; which give in both cases $x=b$. cosine $45°=b\sqrt{\tfrac{1}{2}}$. The points g, d, where the curve touches the line DK are found by putting $x=b$, which gives $at=315°$ or $675°$, and the points b, f, where it touches AC, by putting $x=-b$, which gives $at=135°$ or $495°$.

When $c=90°$, the equation (I) becomes $\frac{x}{b}=-\frac{2y}{b'}\sqrt{1-\frac{yy}{b'b'}}$, of the fourth order. In this case the body will describe the curve EcGdWfGgE (Pl. III. Fig. 11) according to the order of those letters. This curve will be described if the pendulum be projected from E in the direction EA, or from W in the direction WC, with a velocity equal to that which a simple pendulum of the length r would acquire, in falling through the arch whose projection is SG. The curve is easily traced by means of the values $x=-b$ sine $2a't$, $y=b'$ cosine $a't$, deduced from the equations (E). By taking $x=\pm b$ we obtain $y=\pm b'\sqrt{\tfrac{1}{2}}$ which is equal to the lines Sg, Sd, Nc, Nf. The parts of the path in the four quarters of the parallelogram are exactly similar and equal. The pendulum will return to its point of projection E, in a time equal to four vibrations of the pendulum r, after which it will recommence its former course. The same may be observed in other values of c.

When $c=135°$ the equation (I) becomes $\frac{x}{b\sqrt{2}}=1-\frac{2yy}{b'b'}-\frac{2y}{b'}\sqrt{1-\frac{yy}{b'b'}}$ of the fourth order. The body will then describe a curve of the form *abcdefga* (Pl. III. Fig. 12) according to the order of the letters. This curve is easily described by means of the equations $x=b$ cosine $(2a't+135°)$ and $y=b'$ cosine $a't$, and is exactly like that in Fig. 10, corresponding to $c=45°$, except in being placed in an opposite position.

When $c=180°$, the equation (I) becomes $\frac{x}{b}=1-\frac{2yy}{b'b'}$, or $(b-x).\frac{b'b'}{2b}=yy$, which is the equation of a parabola ASC (Pl. III. Fig. 13) whose axis is NS, vertex S, absciss $b-x$, ordinate y; being exactly similar and equal to that in Fig. 9, (corresponding to $c=o$) but placed in an opposite situation.

By taking c greater than 180° and less than 360°, we obtain no new curves; the form being precisely the same, whether we use the value c or its supplement to 360°; but there is this essential difference, that the curves are described in a contrary order. Because when $t=o$, this change in the value of c produces a change of sign in the value of dx in the equation (C), the value of dy remaining in both cases $=o$. Thus when $c=225°$, the curve is as in Fig. 12, described according to the order of the letters *gfedcbag*. When $c=270°$, the curve is as in Fig. 11, described in the order E*g*G*f*W*d*G*c*E. When $c=315°$, the curve is as in Fig. 10, described in the order *gfedcbag*.

Hence it appears, that when $c=o$ the curve has but one vertex N (Fig. 9); as c increases, this opens into two vertices, which gradually separate, till they come to the points C, A, Fig. 13. In like manner the points D, K of the curve (Fig. 9) form the vertices g, d, as c increases; and these points gradually approach till they meet in S, when $c=180°$. While c increases from 180° to 360°, these points go back in the same order as they advanced, and when $c=360°$, the curve becomes as in Fig. 9, where $c=o$.

18. When $2a'$ is nearly equal to a, we may put $\frac{a}{a'}=2+\frac{1}{m}$, m being a large number, and since (by § 5) $\frac{aa}{a'a'}=\frac{r+r'}{r}$, we shall have nearly $m=\frac{4r}{r'-3r}$, consequently r' must exceed $3r$, by a very small quantity to render m positive. If we suppose the pendulum to be let fall from rest from the point K (Pl. III. Fig. 9) the equations (F) will give $y=b'$ cosine $a't$ and $x=b$. cosine $at=b$. cosine $(2a't+\frac{a't}{m}.)$ Hence if we put $C=\frac{180°}{m}$, and take $a't$ successively $=0°$, $2\times180°$, $4\times180°$, $6\times180°$, &c. the values of y corresponding will be constantly equal to b', and those of x will be successively b, $b.$ cos. 2C, $b.$ cos. 4C, $b.$ cos. 6C, &c. and, after n vibrations of a simple pendulum of the length $r+r'$, the value of x will become b. cosine $2n$C, or b. cosine $(360°.\frac{n}{m})$. Hence it is evident that at the commencement of the motion the body will begin to vibrate backwards and forwards in the parabola KND, as in the last article, when $c=o$ (Pl. III. Fig. 9), but after a few revolutions the arch $2n$C will increase so much as to make the pendulum return to the line KC at a point e, Fig. 10, sensibly different from K, and falling between K and C. Thus when $n=\frac{1}{8}m$ (which corresponds to $\frac{1}{8}m$ vibrations of the simple pendulum $r+r'$) the arch $2n$C will be 45°, and the curve will be as in Fig. 10, which will be described by the pendulum according to the order of the letters *abcdefg*, as in the preceding article. When $n=\frac{1}{4}m$, the arch $2n$C will be 90°, and the curve will be as in Fig. 11. When $n=\frac{3}{8}m$, the arch $2n$C will be 135°, and the curve

will be as in Fig. 12, both these curves being described according to the order of the letters *cdfg*. When $n=\frac{1}{2}m$ (which corresponds to $\frac{1}{2}m$ vibrations of the pendulum $r+r'$) the arch $2nC$ will be 180°, the curve will become a parabola (as in Fig. 13), and the pendulum will vibrate backwards and forwards in the arch CSA. When $n=\frac{5}{8}m$, the arch $2nC$ will be 225°, the pendulum will then again revolve in the curve described in Fig. 12, but in a *contrary direction*, the motion being according to the order of the letters *gfedcba*; for at the point *e* where the curve touches the line CK, we have $\frac{dy}{dt}=o$ and $\frac{dx}{dt}$ changes sign by making $2nC$ successively equal to 135° and 225°, as evidently appears by the equations (C). When $n=\frac{3}{4}m$, the arch $2nC$ will be 270°, and the curve as in Fig. 11: When $n=\frac{7}{8}m$, the arch $2nC$ will be 315°, and the curve as in Fig. 10, both these curves being also described in a contrary direction to that when $n=\frac{1}{4}$ and $\frac{1}{8}$. When $n=m$, which corresponds to m vibrations of a simple pendulum of the length $r+r'$, or $2m+1$ vibrations of the simple pendulum of the length r, the arch $2nC$ will be 360°, the curve described will be as in Fig. 9, at the commencement of the motion, and the cycle of motions will be complete, provided m be a whole number, and the body will again begin to describe the same curves as in the former period. The remarks, made at the end of § 15 for the case of m not being a whole number, apply without modification to this.

If we put $\frac{a}{a'}=2-\frac{1}{m}$, we shall have $m=\frac{4r}{3r-r'}$, consequently $3r$ must exceed r' by a very small quantity to render m positive and great. In this case x will become equal to $b\,.$ cosine $(2a't-\frac{a't}{m})$, and in the successive revolutions, mentioned in the first part of this article, it will become b, b cos. $(-2C)$, &c. equal respectively to b, b cos. $2C$, b cos. $4C$, &c. as in the case of $\frac{a}{a'}=2+\frac{1}{m}$. Consequently the curves described must be identically the same, in both cases, but they will be described in a contrary direction.

19. When $\frac{a}{a'} = 3$, or $3r = r'$ the equation (H) becomes $\frac{x}{b} =$ cosine c . cosine $(3A \cdot \frac{y}{b'})$ — sine c . sine $(3A \cdot \frac{y}{b'})$ whence we easily deduce $\frac{x}{b} = (4 \cdot \frac{y^3}{b'^3} - 3 \cdot \frac{y}{b'})$. cosine $c + (1 - 4 \cdot \frac{y'y'}{b'b'}) \sqrt{1 - \frac{yy}{b'b'}}$. sine c, of the sixth order, except sine $c = o$, when it becomes of the third order.

In the case of $c = o$, the curve described will be as in Fig. 14. The body being let fall from rest from the point K, will vibrate backwards and forwards in the curve K*a*G*b*A, which is easily traced by putting $x = b$. cosine $3a't$, $y = b'$. cosine $a't$.

When $c = 90°$, the curve described will be as in Fig. 15, E*a*S*c*W*d* N*f*E, where $x = -b$. sine $3a't$, $y = b'$. cosine $a't$.

20. When $\frac{a}{a'} = 4$, and $c = o$, we shall have $x = b$. cosine $4a't, y = b'$. cosine $a't$. The body being then let fall from K (Pl. III. Fig. 16) will vibrate backwards and forwards in the curve K*a*S*c*D. When $c = 90°$, $x = -b$. sine $4a't, y = b'$. cosine $a't$, and the body will then describe the curve E*abcd*W*efgh*E, Fig. 17.

By taking c of different values, in this and in the last article, we should find as great a variety of curves as in § 17 : and, if instead of taking $\frac{a}{a'} = 3$ or 4, we had taken $\frac{a}{a'} = 3 \pm \frac{1}{m}$ or $\frac{a}{a'} = 4 \pm \frac{1}{m}$, m being a large number, we should find that all the varieties of curves thus discovered would be described by a pendulum adjusted to those values of $\frac{a}{a'}$.

Similar results would be obtained by making $\frac{a}{a'}$ equal to any other whole number, or equal to any whole number $\pm \frac{1}{m}$, m being a very large number; but it is unnecessary to enlarge on the subject, since the method of finding these curves is very easy from what is here taught, and there appears to be such an endless variety, that it would be useless to attempt to note them.

21. The equations (B) are exactly similar to those for finding the apparent motion of the earth viewed from the moon, in the manner mentioned in Mr. Dean's paper on this subject. For let the inclination of the lunar orbit and equator be $6^\circ\,39'=b$, the greatest equation of the moon's centre $6^\circ\,18'=b'$, at and $a't$ the mean motions of the moon from her node and perigee in the time t; $c+90^\circ$ and $c'+90$ the mean distance of the moon from these points when $t=o$, consequently the distance at the time t will be respectively $at+c+90^\circ$, $a't+c'+90^\circ$. The sines of these angles multiplied respectively by b and b' will give nearly the earth's declination x, and the equation of the moon's centre y, which may therefore be put under the form $x=b$ cosine $(at+c)$ and $y=b'$ cosine $(a't+c)$, which being precisely like the equations (B), all the consequences we have drawn relative to the motion of pendulums will apply to the motion of the earth received from the moon and referred to the concave surface of the visible hemisphere, and the form of the curves described will depend on the ratio or the terms a, a', or on the mean motions of the moon counted from the perigee and node.

The values of a, a', given in La Place's lunar theory (Mec. Cel. t. iii. p. 131) are $a=1{\cdot}004021$, $a'=0{\cdot}991548$, and as a' is nearly equal to a this falls under the case of § 14, and $m=\frac{a}{a-a'}=80\tfrac{1}{2}$ nearly, consequently the cycle of motions of the earth received from the moon will be completed in about $80\tfrac{1}{2}$ revolutions counted from the node, as Professor Dean has observed in his paper. The values r, r', corresponding to a compound pendulum which completes its motions in the same number of revolutions may be found by making (as in § 5) $r+r'$

$: r :: aa : a'a' :: 1+\frac{1}{64} : 1$ nearly, hence $r' = \frac{r}{40}$, which agrees exactly with Professor Dean's experiment mentioned in the 245th page of the volume.

22. I made a few experiments in order to compare the preceding theory with actual observation. The first was similar to Mr. Dean's just mentioned, corresponding to the case of § 16. Taking AB (Fig. 1, Pl. III) equal to $4\frac{3}{4}$ inches, $r'=0{\cdot}65$ inches, $r=46{\cdot}5$ inches, and attaching to the point D a leaden ball of about half an inch diameter. These values give (by § 14) $2m = \frac{4r}{r'} = 286$, hence (by § 15) the cycle of the motions would be completed in 286 vibrations of a pendulum of the length r. The mean result of three different trials, in which GK (Fig. 2) was three inches, and the angle SGK successively 22°, 45°, 67°, made the number of vibrations 282, differing about $\frac{1}{71}$th. from the theory. *The ball being let fall from the point corresponding to* K, *vibrated at first nearly in the diagonal* KA, *the path then gradually became elliptical, and at the end of about* 70 *vibrations, corresponded to the figure* SWNE (Pl. III. Fig. 3) *described according to the order of these letters; this by degrees became more excentric, and at the end of* 140 *vibrations the motion was nearly in the diagonal* CD (fig. 4); *after a few more vibrations the curve again became elliptical and gradually opened till the* 210*th vibration, when the ellipsis was as in Fig.* 5, *similar to that of Fig.* 3, *but described in a contrary order* ENWS. *In about* 282 *vibrations the pendulum had completed its cycle of motions and recommenced the description of the diagonal* KA (Fig. 3). These results are nearly conformable to the theory.

In another experiment made to compare with the theory of § 18, AB was made equal to 69 inches, $r'=64{\cdot}4$ inches, $r=21{\cdot}9$ inches, which correspond to the latter case of that article where $\frac{a}{a'} = 2 - \frac{1}{m}$, and gives $m = \frac{4r}{3r - r'} = 67$. The body attached to the point D was a sphere of lead of $1\frac{1}{3}$ inches diameter. The measures r, r', were taken to the centre of the sphere, which differed but 0·01 inch from the centre of oscillation. *The ball being let fall from the point corresponding to* K (Pl. III. Fig. 9) *began to vibrate in the parabola* KND, *which gradually changed into the curves marked in Fig.* 10, 11, 12, 13. *After which the same curves were again described in a contrary order, as in Fig.* 12, 11, 10, 9. *By the mean of several trials it was found that in* 16 *vibrations of the pendulum of the length* (r+r′) *the ball described the curve of Fig.* 11, *according to the order of the letters* gfWdcEg. *In* 33 *vibrations it described the parabola* CSA (Fig. 13). *In* 50 *vibrations it described the curve of Fig.* 11, *in an opposite direction to its former course, or according to the order of the letters* gEcdWfg, *and in* 67 *vibrations it recommenced its former course in the parabola* KND, Fig. 9. The cycle of motions being completed in 67 vibrations, which agrees with the theory.

The comparison of the theory of § 19, 20, is not so easy as that of the preceding cases. For the value of r is much smaller in comparison of r', consequently the vibrations are quicker, and as the diagonal GK is taken much smaller, it becomes difficult to observe the form of the curves with any great degree of precision. A few rough experiments were however made in these cases, and the results appeared to be sufficientlv conformable to the theory.

LIII.

Demonstration of the rule for finding the place of a Meteor in the second Problem, page 218 *of this volume.*

BY NATHANIEL BOWDITCH.

WE shall refer in this demonstration to Pl. III. Fig. 18, which is similar to Pl. II. Fig. 2, with some additional lines and letters. The plane drawn through w perpendicular to Cw is supposed to cut sm in b, Mm in e, and Aa in c; forming the plane triangle bcw,* right angled in c, because the line bc is the common intersection of the two planes wcb, Ccb, drawn perpendicular to the plane Cwc, making the angles wcb, Ccb, acb, each equal to a right angle. On the right line Cw, let fall the perpendicular ag. In the plane triangle wem, erect the line ef perpendicular to we, intersecting wm in f and making $ef = we \times$ tang. ewm, or $we \times$ cotang. Cwm, because the angle Cwe is a right angle, the radius being unity. In like manner, in the triangle bem, erect ed perpendicular to be, intersecting ba in d, making $de = be \times$ tang. $ebm = bc \times$ cotang. Cas, because Cas or cab is the complement of ebm, the angle at c being a right angle.

The spherical angle AWB is evidently equal to the plane angle cwb, whose tangent is $\frac{bc}{wc}$. In the right angled plane triangle acb we have $bc = ac \times$ tang. cab or Cas. The plane triangle wca gives $ac : wc$ :: sine awc : sine caw, or :: cosine Cwa : sine Caw, because Cwc is a right angle. Hence tang. $AWB = \frac{ac \times \text{tang. } Cas}{wc} = \frac{\text{cosine } Cwa \times \text{tang.} Cas}{\text{sine } Caw}$ as in the note at the bottom of page 218. This may be reduced to

* The line bw was accidentally omitted in the figure.

another form by observing that cosine $Cwa = \frac{\text{sine } Cwa}{\text{tang.} Cwa}$, and that the plane triangle Cwa gives $\frac{\text{sine } Cwa}{\text{sine } Caw} = \frac{Ca}{Cw}$. Then the plane triangle Cag gives $ag = Ca \times$ sine $aCw = Ca \times$ sine $ACW = Ca \times$ sine AW, and $Cg = Ca \times$ cosine AW. Whence $wg = Cw \backsim Ca \times$ cosine AW, and $\frac{1}{\text{tang.} Cwa} = \frac{wg}{ag} = \frac{Cw \backsim Ca \times \text{cosine AW}}{Ca \times \text{sine AW}}$. This substituted gives tang. $AWB = \text{tang. } Cas \frac{Ca}{Cw} \cdot \frac{Cw \backsim Ca \text{ . cosine AW}}{Ca \text{ sine AW}} = \frac{\text{tang. } Cas}{\text{sine AW}} (1 \backsim \frac{Ca}{Cw} \times$ cosine AW).

The spherical angle MWB is equal to the plane angle *ewb*, and the plane triangle *ewb* gives *we* : *be* :: sine *ebw* : sine *ewb* or :: cosine AWB : sine MWB, because the angle $ebw = cbw =$ comp. *cwb* or AWB. Hence sine $MWB = \frac{be}{we} \times$ cosine AWB. Now in the plane C*mw*, the triangles C*mw*, *emf*, are similar; whence C*m* : C*w* :: *me* : *ef*; and in the plane C*am*, the similar triangles C*am*, *edm*, give C*a* : C*m* :: *de* : *me*, whence by composition of ratios C*a* : C*w* :: *de* : *ef* (and by substituting the above rules of *de*, *ef*,) :: *be* × cotang. C*as* : *we* × cotang. C*wm*; whence $\frac{be}{we} = \frac{Ca}{Cw} \times \frac{\text{cotang. } Cwm}{\text{cotang. } Cas} = \frac{Ca}{Cw}$. Cotang. C*wm* × tang. C*as*, which substituted gives sine $MWB = \frac{Ca}{Cw} \times$ cotang. C*wm*×tang. C*as*×cosine AWB, as in page 218. The rest of the work (depending on the common rules of spherics) requires no explanation.

LIV.

MEMOIR ON THE PRESENT STATE OF THE ENGLISH LANGUAGE IN THE UNITED STATES OF AMERICA ; WITH A

VOCABULARY,

containing various words and phrases which have been supposed to be peculiar to this country.

BY JOHN PICKERING, A. A. S.

THE preservation of the *English language* in its purity throughout the United States is an object deserving the attention of every American, who is a friend to the literature and science of his country. It is in a particular manner entitled to the consideration of the *Academy ;* for, though subjects, which are usually ranked under the head of the *physical sciences,* were doubtless chiefly in view with the founders of the Academy, yet, as our *language* is to be the instrument of communicating to the world the speculations and discoveries of our countrymen in science and literature, it seems also necessarily " to fall within the design of the institution ;" because, unless that language is well settled, and can be read with ease and satisfaction by all to whom it is addressed, our authors will write and publish, certainly under many disadvantages, though perhaps not altogether in vain.

It is true, indeed, that our countrymen may speak and write in a *dialect* of English, which will be generally understood in the *United States ;* but if they are ambitious of having their works read by Englishmen as well as Americans, they must write in a language that Englishmen can read with facility and pleasure. And if for some-time to come it should not be the lot of many *Americans* to publish any thing which shall be read out of their own country, yet all, who have the least tincture of learning, will continue to feel an ardent desire to acquaint themselves with the works of *English authors*. Let us then for a moment imagine the time to have arrived, when *Americans* shall be no longer able to understand the works of Milton, Pope, Swift, Addison, and the other English authors, justly styled *classic*, without the aid of a *translation* into a language that is to be called at some future day the *American* tongue! By such a change, it is true, our loss would not be so great in works purely scientific, as in those which are usually termed works of taste; for the obvious reason, that the design of the former is merely to communicate information, without regard to elegance of language or the force and beauty of the sentiments. But the excellencies of works of taste cannot be felt even in the best translations; a truth, which, without resorting to the example of the matchless *ancients*, will be acknowledged by every man, who is acquainted with the admirable works in the various *living languages*.

Nor is this the only view in which a radical change of language would be a loss to us. To say nothing of the facilities afforded by a *common language* in the ordinary intercourse of business between the people of the two countries, it should not be forgotten that our religion and our laws are studied in the language of the nation, from which we are descended; and with the loss of the language we should finally suffer the loss of those peculiar advantages, which we now derive from the investigations of the jurists and divines of that country.

But, it is often asked among us, do not the people of America now speak and write the *English* language with purity? A brief consideration of the subject will furnish a satisfactory answer to this question; it will also enable us to correct the erroneous opinions entertained by some Americans on this point, and at the same time to defend our countrymen against the charge made by some English writers, of a *design* to effect a radical change in the language.

As the inquiry before us is a simple question of fact, it is to be determined, like every other question of that nature, by proper evidence. What evidence then have we, that the English language is not spoken and written in America, with the same degree of purity that is to be found in the writers and orators of England?

In the first place, although it is agreed, that there is greater uniformity of dialect throughout the United States (in consequence of the frequent removals of people from one part of our country to another) than is to be found throughout England, yet none of our countrymen, not even those, who are the most zealous in supporting what they imagine to be the honour of the *American* character, will contend, that we have not in some instances departed from the standard of the language. We have formed some *entirely new* words, and to some *old* ones, that are still used in England, we have affixed *new significations*; while others, that have long since become *obsolete* in England, are still retained *in common use* with us. For example; it is admitted by all, that the verb *to advocate*, the adjective *lengthy*, and a few others, are of *American origin*; and, that the adjective *clever* and some other words of *English origin* have been generally used by us in a sense different from their present signification in England. If then, in connexion with these acknowledgments of our *own countrymen*, we allow any weight to the opinions of *Englishmen*, (who must surely be competent judges in this case) it cannot be denied, that we have in many instances deviated from the standard of the language, as *spoken and written in England at the present day*. By this, however, I do not mean, that so great a deviation has taken place, as to have rendered any considerable part of our language unintelligible to *Englishmen*; but merely, that so many corruptions have crept into *our English*, as to have become the subject of much animadversion and regret with the learned of Great Britain. And as we are hardly aware of the opinion entertained by them of the extent of these corruptions, it may be useful, if it should not be very flattering to our pride, to hear their remarks on this subject in their own words. We shall find that these corruptions are censured, not by a few contemptible critics, but, so far as the fact is to be ascertained from English publications, by all the scholars of that country, who take any interest in American literature. In proof of this, I request the attention of the Academy to the following extracts from several of the British Reviews; some of which are the most distinguished of the present day, and all of which together may be considered as expressing the general opinion of the literary men of Great Britain. That all the remarks are just, to the extent in which they will naturally be understood, few of our countrymen will be willing to admit.

The *British Critic*, for February 1810, in a review of the Rev. Mr. *Bancroft's* Life of Washington, says—" In the style we observe, " with regret rather than with astonishment, the introduction of several " *new* words, or *old* words in a new sense; a deviation from the " rules of the English language, which, if it continues to be practis- " ed by good writers in America, will introduce confusion into the " medium of intercourse, and render it a subject of regret that the " people of that continent should not have an entirely separate language " as well as government of their own. Instances occur at almost ev- " ery page; without pains in selecting, the following may be taken as " specimens," &c. The Reviewers then mention several words, which are all inserted in the Vocabulary annexed to this memoir.

The same Reviewers (in April 1808) in their account of Chief Justice *Marshall's* Life of Washington, have the following remarks:— " In the writings of *Americans* we have *often* discovered deviations

" from the purity of the *English idiom*, which we have been more " disposed to censure than to wonder at. The *common speech* of the " United States has departed very considerably from the standard " adopted in England, and in this case it is not to be expected that " *writers*, however cautious, will maintain a strict purity. Mr. Mar-" shall deviates occasionally, but not grossly," &c.

The *Critical Review* (for September 1809) in remarks upon *Travels through France, by Col. Pinckney*, says of the author's style—" He falls into occasional inaccuracies..... but the instances are rare, " and by no means so striking as we have *frequent* occasions of re-" marking *in most American* writers."

The same Reviewers (in July 1807) in speaking of *Marshall's* Life of Washington, have the following, among other remarks on the style of that work—that " it abounds with many of those idioms which " prevail on the other side of the Atlantic."

The *Annual Review*, for 1808, in speaking of the same work, after pointing out several instances of false English (in respect to many of which, however, the Reviewers have been misled by the incorrectness of the *English edition* of that work, as will be seen in the following Vocabulary,) has the following observations; which, if they had been made in a manner somewhat different, would probably have been more favourably received by those, for whose benefit they seem to be intended:—" We have been more particular in noticing these faults in " Mr. Marshall's language, because we are not at all certain that the A-" mericans do not consider them as beauties; and because we wish, " if possible, to stem *that torrent of barbarous phraseology*, with which " the *American* writers threaten to destroy the purity of the English " language."

The *Monthly Reviewers*, in their account of a little work, entitled *A Political Sketch of America*, cite, with approbation, the following passage—" The national *language* should be sedulously cultivated; " and this is to be accomplished by means of schools. This circum- " stance demands particular attention, for the language of *conversation* " is becoming incorrect; and even in America *authors* are to be found, " who make use of *new* or *obsolete* words, which no good writer in " this country would employ." *Monthly Rev. May* 1808.

The *Edinburgh Review* for October 1804 (which is the last I shall cite) has the following general observations on this subject:—

" If the men of birth and education in that other England, which " they are building up in the West, will not *diligently study* the great " authors, who purified and fixed the language of our common forefa- " thers, we must soon lose the only badge, that is still worn, of our " consanguinity."

The same Reviewers, in their remarks on *Marshall's* and *Ramsay's* Lives of Washington, say—

" In these volumes we have found *a great many words and phrases* " which *English* criticism refuses to acknowledge. America has " thrown off the yoke of the British nation, but she would do well for " some time, to take the laws of composition from the Addisons, the " Swifts and the Robertsons of her ancient sovereign..... These " remarks, however, are not dictated by any paltry feelings of jealousy " or pride. We glory in the diffusion of our language over a new " world, where we hope it is yet destined to collect new triumphs; " and in the brilliant perspective of American greatness, *we* see only " pleasing images of associated prosperity and glory of the land in " which we live."

Such is the strong language of the British literati on this subject. And shall we at once, without examination, ascribe it wholly to prejudice? Should we not by such a hasty decision expose ourselves to the like imputation? On the contrary, should not the opinions of such writers stimulate us to inquiry, that we may ascertain whether their animadversions are well founded or not? We see the same critics censure the Scotticisms of their *northern brethren*, the peculiarities of the *Irish*, and the provincial corruptions of their own *English* writers. We cannot therefore be so wanting in liberality as to think, that, when deciding upon the literary claims of *Americans*, they are governed wholly by prejudice or jealousy. A suspicion of this sort should be the less readily entertained, as we acknowledge that they sometimes do justice to our countrymen. The writings of Dr. *Franklin*, for example, have received their unqualified praise; and a few other American authors have been liberally commended by them. The opinions of these critics too are supported by those of some distinguished men in our own country. Dr. *Franklin* censures, without reserve, "the popular errors several of our own states are *continually* falling into," with respect to "expressions and pronunciation." Dr. *Witherspoon*, who, by having been educated in Great Britain, and by his subsequent long residence in the United States, was peculiarly well qualified judge on this subject, remarks:—"I shall also admit, though "with some hesitation, that gentlemen and scholars in Great Britain "speak as much with the vulgar in common chit chat, as persons of "the same class do in America; but there is a remarkable difference "in their public and solemn discourses. I have heard in this coun- "try in the senate, at the bar, and from the pulpit, and see daily in dis- "sertations from the press, errors in grammar, improprieties and vul- "garisms, which hardly any person of the same class in point of rank "and literature would have fallen into in Great Britain."

With these opinions of such distinguished writers before us, shall we entertain the illiberal jealousy that justice is intentionally withheld from us by our English brethren? Let us rather imitate the example of the learned and modest *Campbell*, who, though he had devoted a great part of a long life to the study of the *English* language, yet thought it no disgrace to make an apology for his *style*, in the following terms: "Sensible," says he, "of the disadvantages, in point of style, "which my northern situation lays me under, I have availed myself of "every opportunity of better information, in regard to all those terms "and phrases in the version, [of the Gospels] of which I was doubtful. "I feel myself under particular obligations on this account, to one gen- "tleman, my valuable friend and colleague, Dr. Beattie, who, though "similarly situated with myself, has with greater success studied the "genius and idiom of our language; and of whom it is no more than "justice to add, that the acknowledged purity of his own diction, is "the least of his qualifications as an author. But if, notwithstanding "all the care I have taken, I shall be found, in many places, to need "the indulgence of the *English* reader, it will not much surprise me. "....The apology which Irenæus, Bishop of Lyons in Gaul, in the "second century, makes for his language, in a book he published in "defence of religion, appears to me so candid, so modest, so sensible, "at the same time so apposite to my own case, that I cannot avoid "transcribing and adopting it:—'Non autem exquires a nobis, qui "apud Celtas commoramur, et in barbarum sermonem plerumque "avocamur, orationis artem quam non didicimus, neque vim con- "scriptoris quam non affectavimus, neque ornamentum verborum, ne- "que suadelam quam nescimus'...."*

Upon an impartial consideration of the subject, then, it seems impossible to resist the conclusion, that although the language of the United States has, perhaps, changed less than might have been expected, when we consider how many years have elapsed since our ances-

* Campbell's Four Gospels, preface, p. 28.

tors brought it from England, yet it has in so many instances departed from the English standard, that our scholars should lose no time in endeavouring to restore it to its purity, and to prevent future corruption.

This, it is obvious, is to be effected, in the first place, by carefully noting every unauthorised word and phrase; or (as Dr. Franklin many years ago recommended, in his letter to Mr. Webster on this subject*) by "*setting a discountenancing mark*" upon such of them, as are not rendered indispensably necessary by the peculiar circumstances of our country; and, even if we should continue to have a partiality for some of those expressions, and should choose to retain them, it will always be useful *to know them*. By knowing exactly what peculiar words are in use with us, we should, among other advantages, have it in our power to expose the calumnies of some prejudiced and ignorant writers, who have frequently laid to the charge of our countrymen *in general* the affected words and phrases of a few conceited *individuals*;—words and phrases, which are justly the subject of as much ridicule in *America*, as they are in *Great Britain*. As a general rule also, we should undoubtedly avoid all those words which are noticed by English authors of reputation, as expressions with which *they are unacquainted*; for although we might produce some English authority for such words, yet the very circumstance of their being thus noticed by well educated *Englishmen*, is a proof that they are not used at this day in England, and, of course, ought not to be used elsewhere by those who would speak *correct English*.

With a view to this important object I have taken some pains to make a collection of words and phrases, which I offer to the Acad-

* See the word *Improve* in the annexed *Vocabulary*.

emy, not as a perfect list of our real or supposed peculiarities of language, but merely as the beginning of a work, which can be completed only by long and accurate observation, especially of intelligent Americans, who shall have an opportunity of residing in England, and of well educated Englishmen who may resort to this country. It has long been the wish of our scholars to see a work of that sort; but, though several words have been occasionally noticed by Dr. Witherspoon, Dr. Franklin, and some others, yet nobody seems to have been willing to undertake the laborious task of making a general collection of them. Seeing no prospect of such a work, and observing, with no small degree of solicitude, the corruptions which are gradually insinuating themselves into our language, I have taken the liberty to ask the attention of the Academy to this subject, by laying before them the following Vocabulary; a performance, which I am sensible is not so worthy of their notice, as more time and ability might have rendered it.

In making this Vocabulary, I have resorted to all the sources of information in my power, and have, under each word, given some of the authorities for and against the use of it. I have also subjoined to some of the words, the criticisms of Dr. Franklin, Dr. Witherspoon, and other writers, at large, in order that the reader may avail himself of their instructive observations, without the trouble of searching for them through the numerous volumes of their works; and in all cases, where any word had been noticed by English or American writers, which I had also myself observed, (particularly during my residence in England, where my attention was first drawn to this subject) I have chosen to give it upon their authority, rather than my own. Many words will be found in the list, which are not in fact of *American origin*, or peculiar to Americans; but it appeared to me that it would be useful to insert all words, the legitimacy of which had been questioned, in order that their claim to a place in the English language might be discussed and settled. Several of the words have been obtained from British Reviews of American publications; and I may here remark how much it is to be regretted, that the reviewers have not pointed out all the instances, that have come under their notice, of our deviations from the *English* standard. This would be doing an essential service to the cause of literature, and be the most effectual means of accomplishing what those scholars appear to have so much at heart—the preservation of the English language in its purity, wherever it is spoken.

It has been asserted, that we have discovered a much stronger propensity than the English, to add new words to the language; and the little animadversion, which, till within a few years, such new-coined words have met with among us, seems to support that opinion. *With us*, every writer takes the liberty to contaminate the language with the barbarous terms of his own tasteless invention; but in *England*, new words are seldom hazarded even by authors of the highest rank. The passion for these ridiculous novelties among us, however, has for some time past been declining. Our greatest danger now is, that we shall continue to use antiquated words, which were brought to this country by our forefathers nearly two centuries ago—(some of which too were at that day *provincial* words in England) and, that we shall affix a *new signification* to words, which are still used in that country in their original sense. Words of these descriptions having long been a part of the language, we are not led to examine critically the authority on which their different significations rest; but those that are *entirely new*, like strangers on their first appearance, immediately attract our attention, and induce us to inquire into their pretensions to the rank they claim.

But it is not enough for us to note *single words;* our *idiom*, it would seem, is in some degree changed, and is in danger of still greater corruptions.* At the same time, therefore, that we are "setting a discountenancing mark" upon unauthorised words, we should assiduously study the language of the best authors, especially Dryden, Swift, and Addison, to the last of whom, Dr. Blair, in his Lectures on Rhetoric, justly applies Quintilian's well-known remark upon Cicero—that "to be highly pleased with his manner of writing is the cri-"terion of a good taste in English style—Ille se profecisse sciat cui "Cicero valde placebit;" and of whom Dr. Johnson emphatically says—"whoever would attain a good English style, familiar but not "coarse, and elegant but not ostentatious, must give his days and "nights to Addison." Dr. Franklin, who informs us in his *Life*, that it was *one of the greatest objects of his ambition to write English well*, formed his style upon that of *Addison;* and Franklin is one of the very few American writers, whose style has satisfied the English critics. This is the discipline to which the most distinguished scholars of Great Britain have submitted, and without which neither they, nor the scholars of our own country, can acquire and preserve a pure English style. It is related of Mr. Fox, that when speaking of his intended History of England, he said, he would "*admit no word into his book* "*for which he had not the authority of Dryden.*" This determination may perhaps seem, at first view, to have been dictated by too fastidious a taste, or an undue partiality for a favourite author; but un-

* That a radical change in the language of a people, so remote from the source of it, as we are from England, is not a chimerical supposition, will be apparent from the alterations that have taken place among the nations of Europe; of which no instance, perhaps, is more striking, than the change and final separation of the languages of Spain and Portugal, notwithstanding the vicinity and frequent intercourse of the people of those two countries.

questionably, a rule of this sort, adopted in the course of our education, (extending, however, to two or three of the best authors,) would be the most effectual method of acquiring a good English style. And surely if Fox found no necessity for any other words than Dryden had used, those authors have little excuse, who take the liberty not only of using all the words they can find in the whole body of English authors, ancient and modern, but also of making new terms of their own at pleasure. Who shall have a right to complain of scarcity, where that distinguished orator found abundance? Such standard authors, therefore, should be made the *foundation* of *our English;* but as our language, like all others, is constantly though slowly changing, we should also, in order to perfect our style, as we advance to mature age, study those authors of our own time, who have made the older writers their models. Every word in the writings of Addison, is not now in general use, in England; and many words have been adopted since his time, and are now sanctioned by all the best writers of that country. Such writers, therefore, as well as their illustrious masters, ought to be diligently read; for we should always remember, that in language, as in the fine arts, we can only attain to excellence by incessant study of the best models.

VOCABULARY;

or, a collection of various words and phrases, which have been supposed to be peculiar to the United States.

ACCOMPLISHED. Dr. Witherspoon thus notices a peculiar use of this word, which he places among his "*Americanisms*:" "He is a man of most *accomplished* abilities. A man may be said to be of distinguished abilities, or great accomplishments, but *accomplished abilities* is wholly new." *Withersp. Druid, No.* 7. No American at the present day would make use of this extraordinary expression. I have never found any person who has met with it in American publications.

ACCOUNTABILITY, " a being subject to answer, or account for." *Mr. Webster's Compendious Dictionary.* This word has been adopted from the *French*, by some of our writers, but it is not to be found in the English dictionaries, nor do I recollect seeing it in any English publications, except translations from the French.

To ADMIRE. To like very much ; used, in *New England*, in expressions like these—I should *admire* to go to such a place, I should *admire* to have such a thing, &c. It is never thus used by the English, and here, it is only used in conversation.

To ADVOCATE, to be an advocate for, to defend, to support. This word is used by all our writers. " Some are taking unwearied pains to disparage the motives of those federalists who *advocate* the equal support of," &c. *Hamilton's Letter, N. York*, 1800. " I shall endeavour to ascertain precisely the true value of this opinion, which is so warmly *advocated* by all the great orators of antiquity." *Adams' Lectures on Rhetoric*, &c. vol. i. p. 38. " This seems to be a foreign and local dialect; and cannot be *advocated* by any person who understands correct English." *Webster's Dissertation on the Eng. Lang.* p. 111.

This has been less censured than most *American* words by the English writers ; but it has not yet been adopted by them. I do not recollect having ever seen it in any *British* publication of high rank, except the *Edinburgh Review ;* and in that, I have observed it once only, which was in the following passage : " But though the argument is given up, and the justice of the Catholic cause admitted, it seems to be generally conceived that their case is at present utterly hopeless ; and that *to advocate* it any longer will only irritate the oppressed." *Edinb. Rev.* vol. xiii. p. 77. Notwithstanding the high reputation of this work, yet the *occasional* use of a word, in a periodical work published in *Scotland*, cannot be considered as conclusive evidence of its being in general use in *England*. The authority of this work, too, in the present case, is the less decisive, because, in addition to the above circumstances, it is understood, that some of the articles in it, have been written by *Irish*, and some by *American* gentlemen, residing in Scotland.

Since I met with the above *Scotch* authority, I have found an *Irish* one, for this verb, in a " Speech of Counsellor Phillips before a Convention of Catholics at Sligo, in Ireland"—" Indeed, gentlemen," says he, " you can have little idea what he has to endure, who in these times *advocates* your cause." I have never yet met with any *English* authority for it; and, in the preface to the London edition of *Ramsay's History of the American Revolution*, it is classed among those American words, which the English (to use the editor's words) " have altogether declined to countenance." Our own countryman, Dr. Franklin, who wrote very pure English, condemned it many years ago.* The English, in parliamentary language, commonly use, instead of it, the verb *to support*.—" Mr. W. shortly opposed the motion. . . . . Mr. S. *supported* it." Debates in Parliament, May 4, 1813.

ALIENISM; alienage. " —the prisoner was convicted of murder; on his arraignment he suggested his *alienism*, which was admitted." 2 *Johnson's New York Reports*, 381.

This is the only instance, in which I have ever met with this word. The term *alienage* is common in professional books, though it is not to be found in the English dictionaries. " Where he sues as executor, &c. the plaintiff's *alienage* is no plea." *Lawes' Pleading in Assumpsit*, p. 687; *et passim.*

To ALLOT; used with the preposition *upon;* as, I *allot upon* (i. e. reckon upon) going to such a place. It is used only in conversation, and that, chiefly in the interior of New England. It is very rarely used by people of education. Some use the verb *to count upon* in the same manner.

AMERICANISM, " a love of America and preference of her interest." *Webst.* This word is sometimes heard in conversation; but I have never known it to be used in *this sense* in any American publication. Dr. Witherspoon coined it (as he says) many years ago, to denote " an use of phrases or terms, or a construction of sentences, even among persons of rank and education [in America] different from the use of the same terms or phrases, or the construction of similar sentences in Great Britain." In this sense it is, as he justly observes, " similar in its formation and signification to the word

* See the word *Improve.*

Scotticism;" and it has accordingly been generally so used in America.

To AMERICANIZE, "to render American." *Webst.* I have never met with this verb in any American writer, nor in conversation.

ANNULMENT; the annulling: "the *annulment* of the belligerent edicts." *Correspondence of the Sec. of State and Mr. Pinkney, in* 1810. This substantive is not to be found in the dictionaries.

ANTAGONIZING; conflicting, opposing.

This word has been censured, by an American critic, as used in the following passage of a well known American publication.—"Nor can I forbear to remark the tendency of such *antagonizing* appeals," &c. This is the only instance in which I have known it to be used in this country. *Johnson* has the verb *to antagonize*, which he defines "to contend against another;" but his authority is the *Dictionaries;* and he says in his preface, that such words in his work "are to be considered as resting only upon the credit of those dictionaries." Mr. Webster has not admitted it into his dictionary.

ANTIFEDERALIST. This word was formed about the year 1788, to denote a person of the political party that opposed the adoption of the Constitution of the United States, which was then always spoken of by the name of the *Federal* Constitution. The word is not much used now, having been superseded by various other names, which have been successively given to the same party. See *Federalist.*

APPELLATE; relating to appeals: "In all cases affecting ambassadors, &c. the Supreme Court shall have *original* jurisdiction: In all the other cases before mentioned the Supreme Court shall have *appellate* jurisdiction." *Constitut. of U. States, art.* 3.

This is criticised as an *American* word in an English review of *Marshall's Life of Washington.* The reviewers' remark is, that Judge Marshall uses "*appellate* court for *court of appeals; appellate* being the term applicable to the *person* against whom the appeal is made." *Annual Rev. for* 1808, p. 241. The reviewers probably consulted *Johnson*, who cites from Ayliffe's Parergon [of the Canon law] the following expression—"the name of the party *appellate*, or person against whom the appeal is made." *Mason*, in his Supplement, makes the following remark upon this citation:

"Johnson gives this word for a *substantive*, and produces an authority from Ayliffe proving it to be an *adjective*. The sense there is, *appealed against*; but it is also used for *created on appeal*—'the king of France is not the fountain of justice; the judges neither the *original* nor the *appellate* are of his nomination.' *Burke*." The word seems to be here used by Burke, as it is in America. The passage cited by Mason is from the Reflections on the French Revolution, where Burke is discussing the French constitution; p. 261. *Dublin edit*. Though Blackstone often uses the term *original* jurisdiction, yet I do not recollect the word *appellate* in his Commentaries. "The next Court that I shall mention is one that hath no *original* jurisdiction, but is only a *court of appeal*." 3. *Blackst. Com*. 31. "The house of peers having at present no *original* jurisdiction over causes, but only *upon appeals*." p. 56.

APPLICANT, a hard student. This has been much used at our colleges. The English use the verb *to apply*, but the noun *applicant* does not seem to be in use with them. The only dictionary in which I have found it is *Entick's*, in which it is given under the word *applier*. A writer in the *Monthly Anthology*, (vol. vii. p. 263.) in reviewing Mr. Webster's dictionary, takes notice of this word, observing that it "is a mean word," and then adds, that "Mr. Webster has not explained it in the *most common* sense, *a hard student*."

To APPRECIATE, to rise in value.

The reviewer above mentioned makes the following remark on this word.—"He [Mr. Webster] gives 'appreciate *v*. to value, estimate, *rise in value*,' yet this third signification, being neuter or intransitive, is not, we believe, found in a single *English* author, and in the United States is only admitted into genteel company by inadvertence." *Monthly Anthol. ibid.* We also in the same manner use the noun *appreciation*; and the verb *depreciate* as a neuter or intransitive verb, signifying *to fall in value*; see *Depreciate*.

To APPROBATE. This was formerly much used at our colleges, instead of the old English verb *approve*. The students used to speak of having their performances *approbated* by the instructers. It is also used at this time by the clergy as a sort of technical term, to denote a person who is *licensed to preach;* they would say, such a one is *approbated*, that is, *licensed to preach.* It is also common in New England to say of a person, who is licensed by the county courts to sell spirituous liquors, or to keep a public house, that he is *approbated;* and the term is adopted in the law of Massachusetts on this subject.

To ATTAIN. The use of this verb, without the preposition *to*, has been said by some to be peculiar to *American* writers; but this is not the case. Dr. Campbell (*Philos. of Rhet.* B. ii. ch. 2. p. 207. Boston ed.) ranks this verb among those " which are used either *with* or *without* a preposition indiscriminately."

ASSOCIATION. " A convention of clergymen. New England." *Webst.* See *Consociation.*

AUTHORITY. " In *Connecticut*, the Magistracy, or body of Justices." *Webst.* Used also, at some of our colleges, (as I am informed by a friend) in speaking of the officers of the institution collectively.

AVAILED. Dr. Witherspoon thus notices, among his " *Americanisms*," a mode of using this participle. " The members of a popular government should be *availed* of the situation and condition of every part."—" The author of this did not know," he adds, " that *avail* is neither an active nor passive, but a reciprocal verb; a man is said to *avail himself* of any thing, but not to *avail others*, or *be availed* by them." *Druid*, No. 7. I think I have observed this idiom in one or two instances *in conversation;* but no American would, at this day, use it *in writing.*

AVAILS. " Proceeds of property sold, produce. *Connecticut.*" *Webst.*

To AVERAGE. " To reduce to a mean." *Webst.* It is also used as a *neuter* verb. " The work will be comprised in fifteen or sixteen volumes, *averaging* from four to five hundred pages each." A friend has suggested a doubt whether this is a legitimate English *verb*. I do not recollect seeing it in any English publications.

AWFUL; ugly, disagreeable. Many of the people of New England would call a disagreeable medicine, *awful;* they would call an ugly woman, an *awful-looking* woman; an ill natured child would be said to behave *awfully*, if he did not obey his parents. This word, however, is never used but in very familiar conversation, and is far from being so common as it was some years ago. A late English traveller has the following remarks upon it. "I found in several instances that the *country-people* of Vermont and other New England states make use of many curious phrases and quaint expressions in their conversation, which are rendered more remarkable by a sort of *nasal twang* which they have in speaking. Every thing that creates surprise is *awful* with them ; 'what an *awful* wind ! *awful* hole ! *awful* hill ! *awful* mouth ! *awful* nose !" &c. *Travels through Canada and the U. States, by John Lambert,* London, 1814.

B.

BACK AND FORTH ; backwards and forwards. He was walking *back and forth. New England.* Used only in familiar conversation.

BACKWOODSMEN ; a name given by the people of the *commercial* towns in the United States, to those who inhabit the territory westward of the Allegany mountains. "The project of transmuting the classes of American citizens and converting sailors into *backwoodsmen*, is not too monstrous for speculatists to conceive and desire." *Ames's works*, p. 144. This word is commonly used as a term of reproach (and that, only in the familiar style) to designate those people, who, being at a distance from the sea, and entirely *agricultural*, are supposed to be hostile, or indifferent, to the *commercial interests* of the United States.

BANDITTI. The use of this word, in *Marshall's Life of Washington*, as a noun of the *singular* number, is censured in the *Annual Review*, vol. vii. p. 241. The passage alluded to by the reviewers is this :—"The expulsion or suppression of *a banditti* of tories collecting on Long Island." *Life of Washington*, vol. ii. p. 285. I do not recollect seeing it thus used in any other American work ; and Judge Marshall himself, in other places, uses it as a *plural* noun. "The perpetrators of the late murders were *banditti* composed chiefly of Creeks and Cherokees." Vol. v. p. 281.

BANK-BILL ; a bank-note. It is remarkable that neither Dr. *Johnson*, nor the other Lexicographers have the term *bank-note* in their dictionaries, though they have *bank-bill*, which *Johnson* defines—" a *note* for money laid up in a bank, at the sight of which the money is paid." His authority is a passage from *Swift's* will—" Let three hundred pounds be paid her out of my ready-money or *bank-bills*." The same phraseology occurs in another part of the will. It is not certain, that *Swift* (or the scrivener who drew his will) intended by *bank-bills* what are now called *bank-notes* in England, as will presently appear; but if he did, the term *bank-note* was then also in use; and, at the present day, is the only name given to what are called *bank-bills* in *America*. In *Rees' Cyclopedia*, article BANK OF ENGLAND, the term *bank-note* is constantly used:—" This money [of the bank] consists in ordinary times, partly of coin, and partly of *bank-notes*." In the *American* additions to this work, *bank-bill* is generally used.

The term *bank-bill* seems to have been used formerly in England to denote a bank security, which differed in some respects from common *bank-notes*. From a case before Lord Holt in the year 1698, just after the bank of England was incorporated, (in 1 Lord Raymond's Reports, 738) it would seem, that the *bank-bills* were issued in the *real names of the original holders*, and *were renewed*, on request, in the names of the subsequent owners. It will appear also, from the following authority, that there was another difference between *bills* and *notes*:—" Upon this the credit of the bank [of England] recovered immediately, until in a few weeks their *notes*, which bore *no interest*, were equal with money, and their *bills*, that bore *interest*, better than money." *Tindal's Continuation of Rapin's Hist. of Engl.* vol. iii. p. 335, folio edit. The English statutes for preventing forgeries of the bank-securities also use both the terms, and, apparently, to signify two different things. Mr. *Webster* has *bank-bill*, but not *bank-note*.

BARBACUE. The following extract from the work of an English traveller in America will explain the meaning of this term, and at the same time vindicate the people of Virginia from the calumnies of prejudiced foreigners: " Mons. de Willd, in his French translation of these travels, makes the following observation upon the word *barbacue*:—' Cet amusement barbare consiste à fouëtter les porcs jusqu' à la mort pour en rendre la chair plus delicate. Je ne sache pas que les cannibales mêmes le pratiquent.'* In justice to the inhabitants of Virginia, I must beg leave to observe, that such a cruel and inhuman act was never, to my knowledge at least, practised in that country. A *barbacue* is nothing more than a porket killed in the usual way, stuffed with spices and other rich ingredients, and basted with Madeira wine. It is esteemed a very great delicacy, and is, I believe, a costly dish."* *Burnaby's Travels in North America*, 3d edit. 4to London, 1798, p. 29.

BE, (indicative mood present tense of *to be.)* This was formerly much used in the New England States, instead of *am* and *are*, in phrases of this sort—"*Be* you ready? *Be* you going to such a place? I *be*." It was common in England as long ago as when our ancestors left that country, and is often used in the common version of the scriptures—"They that *be* with us *are* more than they that *be* with them." 2 Kings, vi. 16. and in various other places; but it is now nearly obsolete in England. Mr. *Marshall*, however, observes, that "*be* is *generally* used for *is* in Gloucestershire." See his *Rural Economy of Gloucestershire*. The above use of *be* is not so common in *New England* at this time as it was some years ago; it is seldom heard now, except in the interior towns or among the vulgar. The vulgar also frequently use it instead of the auxiliary *have*; as, *be* you got it, for *have* you got it.

Dr. *Witherspoon* observes, that the verb *to be* is often omitted in phrases like this—"These things were *ordered delivered* to the army," for *ordered to be delivered*, &c. He then adds—"I am not certain whether this is a local expression, or general, in America." *Withersp. Druid*, *No.* 5. I have never known the verb to be omitted in the manner here mentioned.

BEAKER, the drinking vessel which we now call a *tumbler*. Twenty years ago, or more, this name was in common use in New England and in some other parts of the United States; but it is now seldom heard except among old people. It is to be found in the dictionaries, but I never heard it in England.

* *Translation.* "This barbarous amusement is, whipping pigs to death, in order to make their flesh the more delicate. I do not know that even cannibals practise it.

BESTOWMENT, the act of bestowing. This is sometimes heard from the pulpit in this country, and has been supposed to be of *American* origin. It is not to be found in *Johnson's* nor the other dictionaries, (except the *English* part of *Ainsworth's)* nor do I recollect meeting with it in English authors, or ever hearing it used in England. It cannot, indeed, be said to be very common in this country. Mr. *Webster* has it in his dictionary.

BETTERMENTS. A word used in some of the New England States, to signify the improvements made on new lands by cultivating the soil, erecting houses, &c. "*Betterments*, where plaintiff recovers in a real action, &c. the jury are to ascertain the increased value by reason of improvements." *Index to the laws of New Hampshire.* The act here referred to is commonly called the *Betterment Act.* This word is not in Mr. Webster's, nor in any of the English dictionaries that I have seen, except *Ash's*, and there it is called "*a bad word.*" It is thus noticed by an English traveller when speaking of that class of people who enter upon new lands without any right, and proceed to cultivate them—" These men demand either to be left owners of the soil, or paid for their *betterments*, that is, for what they have done towards clearing the ground." *Kendall's travels*, vol. iii. p. 160.

BOATABLE, "navigable with boats." *Webst.* "Tyoga river . . . . is boatable about fifty miles"—" the Seneca Indians say they can walk four times in a day from the *boatable* waters of the Allegany to those of the Tyoga." *Morse's Geography.* Not used by English authors, and rarely seen in *American* works.

BOATING, "conveying, or the practice of transporting in boats." *Webst.* This, as well as the preceding word, seems to be *technical* among boatmen, as *carting* is among *carters*, &c. Such words are rarely heard, except among the people of those occupations.

BOOK-STORE; the common name, throughout the United States, for a *bookseller's shop.* The *Edinburgh Review* notices this term, as one of our peculiarities; "Their *booksellers' shops* passing under the name of *book-stores.*" *Edinb. Rev. for Nov.* 1810, p. 121.

To BOTTOM; used with *on ; v. a.* "to build upon, to fix upon as a support." *Johnson.*

This word has been much used in the debates of the different legislative bodies in the United States, and has been supposed by some writers to be a pure *Americanism:* but this is not the case. The word, however, does not seem to be much used by good English writers of the present day. *Johnson's* authorities are, *Hale*, *Collins*, *Atterbury*, and *Locke*, the last of whom uses it also as a *neuter* verb, in the following sentence quoted by Johnson—"Find out upon what foundation any proposition advanced, *bottoms.*" *Burke* (who is the latest, and only modern, writer in whose works I have observed it) uses it both as an *active* and a *neuter* verb—"But an absurd opinion concerning the king's hereditary right to the crown does not prejudice one that is rational and *bottomed* upon solid principles of law and policy." *Reflections on the Revolut. in France*, p. 15, Dublin edit. of 1792. "All the oblique insinuations concerning election *bottom* in this proposition," &c. *ibid.* p. 37.

Notwithstanding these authorities, this verb can hardly be said to be in use in England. *Our* using it is alluded to as one of our peculiarities, in the *Monthly Review* for 1808, vol. 56. See *To Predicate.*

BOTTOM-LANDS; used in Pennsylvania and some other states to denote the rich flat land on the banks of rivers, which in the Northern states is generally called *intervale* land. See *Intervale.*

BREAD-STUFF; grain, bread-corn, bread. "One great objection to the conduct of Britain was her prohibitory duty on the importation of *bread-stuff*," &c. *Marshall's Life of Washington*, vol. 5. p. 519. The *Annual Review* (vol. 7. p. 241) points out this as one of the *Americanisms* of Judge Marshall's work. The term was first used, I believe, in some of the official papers of our government, soon after the adoption of the present Constitution. "The articles of exports . . . are *bread-stuffs*, that is to say, bread-grains, meals, and bread." *Report of the Secretary of State* (Mr. Jefferson) *on Commercial Restrictions*, &c. Dec. 16, 1793. It has probably been the more readily allowed among us, because we do not commonly (as the English do) use the word *corn* as a general name for *all sorts* of grain, but apply it almost exclusively to *Indian corn*, or maize. Mr. Webster has not the term *bread-stuff* in his dictionary. See *Corn.*

To BRIDGE. A peculiar use of this verb in *Connecticut* is thus noticed by an

English traveller: "Here a sufficient, though not very agreeable road, is formed by causeys of logs; or, in the language of the country, it is *bridged.*" *Kendall's Travels*, vol. i. p. 235.

BRIEF; prevalent; used in speaking of a rumour, as well as of epidemical distempers. It is mostly used in the interiour of New England. *Grose* has it in his *Glossary* among the *provincial* words of the *north* of England.

BRUSH for *Brush-wood. New England.* The word *brush*, in this sense, is not noticed, I believe, by any of the English lexicographers, except *Mason*, who cites *Spenser* as his authority for it. It is doubtless obsolete in England. Mr. Webster has both *brush* and *brush-wood.*

C.

To CALCULATE; to think, suppose, or expect; as, I *calculate* he will do such a thing. The use of this word, with some others, in the *country* towns of New England, is thus ridiculed by an English traveller—"The crops are *progressing*, says Nathan, though I *calculate* as how this is a *propitious* weedy soil," &c. *Lambert's Travels in Canada and the U. States*, vol. ii. p. 506, 2d edit. London, 1814.

CAUCUS. This noun is used throughout the United States, as a cant term for those meetings which are held by the different political parties, for the purpose of agreeing upon candidates for office, or concerting any measure which they intend to carry at the subsequent *public*, or *town*-meetings. The earliest account I have seen of this extraordinary word is the following, from *Gordon's History of the American Revolution*, published at London in the year 1788.

"The word *Caucus* (says the author) and its derivative *caucusing*, are often used in *Boston*. The last answers much to what we style parliamenteering, or electioneering. All my repeated applications to different gentlemen have not furnished me with a satisfactory account of *caucus*. It seems to mean a number of persons, whether more or less, met together to consult upon adopting and prosecuting some scheme of policy for carrying a favorite point. The word is not of novel invention. More than fifty years ago, Mr. Samuel Adams' father and twenty others, one or two from the north end of the town, where all the ship-business is carried on, used to meet, make a *Caucus*, and lay their plan for introducing certain persons into places of trust and power. When they had settled it, they separated, and used each their particular influence within his own circle. He and his friends would furnish themselves with ballots, including the names of the parties fixed upon, which they distributed on the days of election. By acting in concert, together with a careful and extensive distribution of ballot, they generally carried the elections to their own mind. In like manner it was that Mr. Samuel Adams first became a representative for Boston." *Gordon's Hist.* vol. i. p. 240, note.

An English traveller, (Mr. Kendall) who has taken notice of many American words, seems to think that this "*felicitous term*" (as he ironically calls it) is applied only to party meetings, or consultations, of the *members of the legislatures* in the different states; but this is not the case. All meetings of the parties, for the purpose of concerting any measures, are called by this name.

From the above remarks of Dr. *Gordon* on this word, it would seem that these meetings were in some measure under the direction of men concerned in the "*ship-business*;" and I had therefore thought it not improbable that *caucus* might be a corruption of *Caulkers*, the word meetings being understood. I was afterwards informed by a friend in *Salem*, that the late Andrew Oliver Esq. had often mentioned this as the origin of the word; and upon further inquiry I find other gentlemen have heard the same in *Boston*, where the word was first used. I think I have sometimes heard the expression, *a caucus' meeting*. It should be remarked, that this *cant* word is never used in good writing.

CENSUS, the enumeration of the inhabitants of the United States, which is made every ten years.

This is used by us to denote merely the *enumeration* of our inhabitants, which is a departure from the signification of the term among the *Romans*, from whose language we have borrowed it. In *England* they still use the old word *enumeration*, except when speaking of this country. As a *technical term*, however, the word *census* may be found useful.

CENT, "a copper coin of the United States, value one hundredth part of a dollar." *Webst.*

CERTAIN. Dr. *Witherspoon* thus censures a mode of using this adjective in America—" A *certain* Thomas Benson. The word *certain*, as used in English, is an indefinite ; the name fixes it precisely, so that there is a kind of contradiction in the expression. In England they would say, a certain person, called or supposed to be Thomas Benson." *Withersp. Druid, No.* 5.

CHAIR; used in some of the *southern* states, to signify a one-horse pleasure-carriage, which, in the *northern* states is generally called by the old English name, *chaise*.

CHECKERS or CHEQUERS ; a common name in some of the states, for the game, which in England is called *draughts*. *Ash* has the ancient word " *checkere*," for the chess-*board*, (for which he cites *Chaucer*,) but marks the word as *obsolete*. The *board* is here still called a *checker-board*, by those who call the game *checkers*.

CHUNK. Dr. Witherspoon has the following remark on this word—" *Chunks*, that is, brands, half burnt wood. This is customary in the middle colonies." *Withersp. Druid, No.* 7. It is also used to signify a large chip or bit of wood. It is a *provincial* word in England according to *Grose*, who in his *Provincial* Glossary (word *chuck*) says—" Chuck, a great chip. Sussex. In other counties called a *chunk* or *junk*." The vulgar here also (by whom these words are chiefly used) say *chunk* and *junk*. The *English* dictionaries all have *chump*. Mr. *Webster* has " chump or chunk, a short piece of wood." Hence probably the low word *chunky*, that is, short and thick, applied by the vulgar to the stature of a person ; as, he is a *chunky* fellow.

CHURCH. This word, in Johnson's third signification (*a place of worship*) is generally used by the people of the *New England* states to denote the place of worship of the members of the *church of England*, or Episcopalians, as we usually call them. The places of worship of other denominations of Christians are generally called *meeting-houses*. In the southern states, I believe, the word *church* is used by all denominations. See also, *Member of the church*.

CIVISM, " patriotism, attachment to the public welfare." *Webst*. This is one of the productions of the French revolution ; and, though frequently used several years ago, is now obsolete here, as well as in France. I think it was never more used by *American* than by *English* writers. I do not find it in any dictionary but Mr. Webster's.

CLAPBOARD; "a narrow board used to *cover buildings*." *Webst.* A *technical* word, in general use. In *England* a *clapboard* is a "board formed ready for the cooper's use, in order to make casks or vessels." See *Rees' Cyclopæd.* articles BOARD and CLAPBOARD, and *Bailey's Dictionary*.

CLEVER. This word is in constant use throughout *New England*, in a sense very different from the English. The following remarks of Dr. Witherspoon will explain the *American* and the *English* significations:

"He is a very *clever* man. She is quite a *clever* woman. How often are these phrases to be heard in conversation? Their meaning, however, would certainly be mistaken when heard for the first time by one born in Britain. In these cases *Americans* generally mean by *clever*, only goodness of disposition, worthiness, integrity, without the least regard to capacity; nay, if I am not mistaken, it is frequently applied where there is an acknowledged simplicity or mediocrity of capacity. But in *Britain*, *clever* always means capacity, and may be joined either to a good or bad disposition. We say of a man, he is a clever man, a clever tradesman, a clever fellow, without any reflection upon his moral character, yet at the same time it carries no approbation of it. It is exceeding good English, and very common to say, He is a clever fellow, but I am sorry to say it, he is also a great rogue. When *cleverness* is applied primarily to conduct and not to the person, it generally carries in it the idea of art or chicanery not very honourable; for example—Such a plan I confess was very clever, i. e. sly, artful, well contrived, but not very fair." *Withersp. Druid, No.* 5.

In speaking of any thing but *men* we use the word much as the English do. We say a *clever* horse, &c. and it is not uncommon to see in the London news-papers, advertisements in this form—"To be sold a *clever* grey gelding," &c. Dr. Johnson observes, that it "is a low word, scarcely ever used but in burlesque or conversation, and applied to any thing a man likes, without a settled meaning."

CLEVERLY. Used frequently in some parts of New England instead of *well* or *very well*. In answer to the common salutation, *How do you do?* we sometimes hear, I am *cleverly*. I believe, however, this frequent use of he word is confined to some particular towns.

CLITCHY ; clammy, sticky, glutinous. I have heard this word used in a few instances by old people in New England ; but it is very rarely heard. In *Devonshire*, in England, they have the *provincial* word *clatchy*, in this sense ; and it is doubtless the same word, a little varied in the pronunciation. See *London Monthly Magazine, for Jan.* 1809, p. 545.

CLOSURE ; a shutting up, a closing. I have never seen this word but once in any *American* publication—" Very soon after the *closure* of our ports, I did submit to the consideration of the senate a proposition," &c. *Letter to the Hon. H. G. Otis, by the Hon. J. Q. Adams*, Boston, 1808. The use of the word in this passage was objected to by one of our own critics, in " *Remarks and Criticisms*" on this Letter, (published in the New York Evening Post) in the following terms : " We object, too, to his new word *closure*, as it is at best a superfluous word, and has no support in analogy." Dr. Johnson has the word *closure* in this sense, upon the authority of *Boyle ;* but it seems to be rarely, if ever, used by the writers of the present day.

CLOTHIER ; a fuller ; " one who fulls and scours cloths ; in England, a maker of cloths." *Webst.*

Dr. Johnson's quotation from Shakspeare shews that the significations of *clothier* and *fuller*, in England, were at that time the same as they are there at the present day :

" The *clothiers* all, not able to maintain
The many to them 'longing, have put off
The spinsters, carders, *fullers*, weavers."

It is to be observed, that although we use *clothier* for *fuller*, yet the place, where the cloth is cleansed and dressed, is called a *fulling*-mill.

COMPANIONING ; used in the following passage of an American poem :

" ————Azora's voice,
Companioning, far sweeter than its own."

Upon which one of our own critics makes this remark : " *Companioning* is a word invented without taste, low and unpoetical." *Review of Linn's Valerian, a narrative poem, in the Monthly Anthology for* 1807, p. 321. The word was never used in this country, I presume, by any body but the inventor.

COMPOSUIST; a writer, composer; as, He is a good *composuist*. This extraordinary word has been much used at some of our colleges, but very seldom elsewhere. It is now rarely heard among us.

To COMPROMIT; to commit, expose, hazard. The government *compromitted* itself. The minister *compromitted* the welfare of his country.

This word is not used by *American* writers only, but is perhaps more common with them than with *English* authors. It occurs frequently in the official letters which have been published by our government, and may perhaps, like the French verb *compromettre*, from which we derive it, be considered as an authorised *diplomatic* term. The English verb to *commit* (which, though not to be found in *this sense* in any of the dictionaries except Walker's, is now generally adopted) seems to render this word unnecessary: See *Walker's* remarks on it.

To CONDUCT. This verb is much used in New England, in conversation, *without* the reciprocal pronoun: *Ex*. He *conducts* well, instead of, he *conducts himself* well. It is frequently used in this manner also by our *writers:* "There were times when he was obliged to exert all his fortitude, prudence, and candour *to conduct* so as not to give offence." *Eliot's New England Biograph. Dictionary*, p. 29. But this "corrupt idiom" (as an English traveller justly calls it) is not so firmly established here, as to have entirely excluded the correct *English* idiom. "You will *conduct yourself* in the office of an attorney," &c. *Attorney's oath, in Massachusetts Stat. of* 1785, c. 23. And in the valuable work of Dr. E. just cited, the verb is sometimes used *with*, as well as *without*, the pronoun: "No man could have *conducted himself* in this office better." p. 14. It is also constantly used *with* the pronoun in a late work, of a New England scholar, of great purity of style: "In every thing which is innocent or indifferent they should permit him to *conduct himself* by his own discretion." *Sermons on particular occasions*, Boston, 1812, p. 14. The writers of G. Britain invariably use it in this manner. "But in what manner will the House *conduct itself?*" *Fox's Hist. James II.* p. 3. "They took and pillaged several cities, *conducting themselves* all the while, in such a manner," &c. *Robertson's Charles V.* vol. ii. p. 359. Dr. Johnson also defines the verb *behave*, in these words—"to *conduct one's self;*" and he further remarks, that the verb *behave* also is "used almost always *with* the reciprocal pronoun."

CONGRESS; "the legislature of the United States of America." *Webst.* This word, originally a *common* name, and still so used in *Europe*, has in *America* become a *proper* name. English writers, however, *generally* use it with the article; as, *the* Congress passed such a law; but we, without; as, *Congress* passed such a law; just as they would generally say in England, such a law was enacted by Parliament, and not *the* Parliament.

CONGRESSIONAL; *from the noun* Congress. "The conflict between *congressional* and *state* authority originated with the creation of those authorities." *Marsh. Life of Washing.* vol. v. p. 354.

A reviewer in the *Monthly Anthology* (vol. vii. p. 263.) calls this one of the "*barbarisms*" in common use with us.

To CONSIDER. The use of this verb, without *as* after it, has been thus criticised by Dr. Witherspoon: "I do not *consider* myself equal to this task. The word *as* is wanting. I am not certain whether this may not be an *English* vulgarism, for it is frequently used by the renowned author of Common Sense, who is an Englishman born; but he has so happy a talent of adopting the blunders of others, that nothing decisive can be inferred from his practice. It is however undoubtedly an Americanism, for it is used by authors greatly superior to him in every respect." *Withersp. Druid, No. 5.* This idiom sometimes occurs in English writers of the present day.

CONSIDERABLE. This is still frequently used in the manner pointed out by Dr. Witherspoon in the following remarks: "He is *considerable* of a surveyor; *considerable* of it may be found in that country. This manner of speaking prevails in the northern parts." *Withersp. Druid, No. 7.*

CONSOCIATION; "a convention of pastors and messengers of churches." *Webst.* I believe this use of the term is peculiar to the state of Connecticut.

CONSTABLE. The following distinction is made, by Mr. Webster, between the English and American significations of this word: "In *England*, a governor or commander; in *America*, a town-officer of the peace with the powers of an under-sheriff." A writer in the *Monthly Anthology* speaks of this as "an idle attempt to exhibit a distinction" between them. *Entick* and other lexicographers define *constable*, a "kind of peace-officer;" and it is the fact, I believe, that in many of the cities, boroughs, and other local jurisdictions in England, they have peace-officers called *constables*, whose powers are not materially, if at all, different from those of *our* constables.

CONSTERNATED. I never met with this uncommon word in the writings of Americans, except in the following instance: "When it was found that General Hampton was not at St. Regis, his place of rendezvous, all ranks were *consternated*." *Letter from an officer in Gen. Wilkinson's army, in Dec.* 1813. The only English dictionary, in which I find it, is *Ash's*, and it is there said to be "*not sufficiently authorised*."

CONSTITUTED AUTHORITIES; the officers of government collectively, in a kingdom, city, town, &c. This expression has been adopted by some of our writers from the vocabulary of the French Revolution. "Neither could he perceive danger to liberty except from the *constituted authorities*, and especially from the executive." *Marsh. Life of Washing.* vol. v. p. 354. The English have used it only in translations from the French.

CONSTITUTIONALITY; "the state of being agreeable to the constitution, or of affecting the constitution." *Webst.* "The argument upon this question has naturally divided into two parts, the one of *expediency*, the other of *constitutionality*." *Debates in Congress*, on the *Judiciary* bill in 1802, p. 76.

This word is not in *Johnson* nor *Mason*; nor have I been able to find it in any other English dictionary. I do not recollect it in any English publications. The adjective *constitutional* is used in England as well as in this country.

CONTEMPLATION. A distinguished foreigner, who resided in England many years, and is well acquainted with the language, upon his arrival in this country was struck with the frequent recurrence of this word in conversation; as, "I have it *in contemplation* to do such a thing, *for* I *intend* to do such a thing." The expression is not uncommon in English *writings*, though I do not recollect it in *conversation*.

To CONTRIVE. Dr. Witherspoon has the following remarks on a singular use of this word: "I wish we could *contrive it* to Philadelphia. The words *to carry*, *to have it carried*, or some such, are wanting. It is a defective construction, of which there are too many that have already obtained in practice, in spite of all the remonstrances of men of letters." *Withersp. Druid, No.* 5.

I doubt whether this strange expression is ever used at the present day. I never heard it myself, nor have I been able to find any person that has heard it from any class of people in this country.

To CONVENE. This is used in some parts of New England in a very remarkable sense, that is, *to be convenient*, fit, or suitable; *Ex.* This road will *convene* the public, *i. e.* will be convenient for the public. The word, however, is used only by the illiterate.

CONVENIENT TO. A writer in the Monthly Anthology, for August 1808, p. 438, censures the following use of this word in Marshall's Life of Washington, vol. iii. p. 120. "The army was *convenient to* the highlands." This expression is not often to be found in American writings.

COPPER. The common name in New England for British half-pence, which, until the coinage of our *cents*, constituted the *copper* currency of this country. We used to say a *copper's worth* of any thing, as in England they would say a penny worth. The name is already nearly obsolete.

CORKS. The steel points fixed under the shoes of horses, in the winter, to prevent them from falling on the ice. It is the same thing, that in Johnson's and other dictionaries is called *frost-nails*. From the noun we have formed a verb *to cork*, and we accordingly say, the horse is *corked*, &c. I do not find the term or its derivatives in any of the English dictionaries, except *Ash's*, where the participle *corking* is thus explained—" turning *up* the heels of a horse's shoes." Mr. Webster has both the noun and the verb.

CORN. This word, in many parts of the United States, and particularly in *New England*, signifies exclusively *Indian corn*, or *maize*, which has been the principal sort of corn cultivated in those parts of the country. Wheat, rye, and the other sorts of corn are generally called *grain*, and frequently *English grain*. In *England*, *corn* is a *general* term, (as it was here used by our old writers,) and means all sorts of grain that are used for bread. " *Corn*, in Agriculture, a term applied to all sorts of grain fit for food; particularly wheat, rye, &c.—The *farmers*, indeed, rank under the denomination of corn several other grains, as barley, oats, and even pulse, peas, vetches, &c. which, however, they sometimes distinguish by the denomination, *smaller corn.*" *Rees's Cyclop.* art. CORN. The *meal* of Indian corn, which we call *Indian meal,* is in England generally called *Indian corn meal.*

CORN-BLADES; "leaves of maize *(south. states.)*" *Webst.*

CORN-STALK; "a stalk or stem of maize." *Webst.* The farmers of New England commonly use this word in the *plural* number, *corn-stalks*, or simply, *stalks*, to denote the upper part of the stalk (above the *ear* of corn) which is cut off while green, and then dried, to feed their cattle with.

COSSET; "a lamb brought up by the hand." *Webst.* Also, a favorite or darling. This word is used in *New England,* as the word *pet* is in the southern states and in England. It is now a *provincial* word in England, according to *Grose.*

COUNTY. In speaking of *counties*, the names of which are compounded of the word *shire*, (for example, Hampshire, Berkshire, &c.) we say the *county* of *Hampshire*, the *county* of *Berkshire*, &c. In England they would say, either *Hampshire* or *Berkshire* simply, without the word *county*; or, the county of *Hants*, the county of *Berks*, &c. The word *shire* of itself, as every body knows, means *county* and in one instance, (in Massachusetts,) this latter word is used instead of *shire*, as a part of the *name*: "the county of *Duke's County.*"

COUNTERACTION; a counteracting. It is sometimes, though rarely, used by American writers in this manner: He prevailed over his enemies by the *counteraction* [counteracting] of their designs. I never saw it so used in any English work. It is not to be found in any of the dictionaries except Mr. Webster's.

CREATURE. An English traveller makes the following remark on this word: "*Creature*, pronounced *creatur*, is used in New England, in regard to men, in all the senses of the French *animal*, *bête* and *monstre.*" *Kendall's travels*, v. iii. p. 255. In the *plural* number it is in very common use among farmers as a *general name* for horses, oxen, &c. *Ex.* The *creatures* will be put into the pasture to day. It is frequently so used in the *old* laws of some of the states. "The owners or claimers of any such *creatures* [*i. e.* 'swine, neat-cattle, horses, or sheep'] impounded as aforesaid shall pay the fees," &c. *Province Laws of Massachusetts*, *Stat.* 10. *Wm.* 3. A friend, to whom I have mentioned this use of the word, doubts whether it is peculiar to us.

CROCK; the black of a pot, or of a chimney. A writer in the *Monthly Anthology*, (v. 7. p. 263.) in reviewing Mr. Webster's dictionary, where this word is found, says—" *Crock* is indeed common enough in this section of the country, but it is not an *English* word, and our southern brethren ridicule us for using it." It is, in fact, only a *provincial* word in England, and is mentioned as such by *Mason*, who cites *Ray's South and East Country Words;* and in this latter work both the *noun* and the *verb* are marked as peculiar to *Essex*, in England. *Grose* also has it as a *provincial* word. It is never used here but in conversation.

CROW-BAR; an iron crow, or simply, a *crow*. Used in New England. *Crow-bar* is " a name often *provincially* applied to an iron crow or lever." *Rees' Cyclop. Marshall* has it among the " Provincialisms of *West Devonshire*." See *Rural Econ. of West of Engl.* vol. i.

To CULTIVATE. " While these *(in the phrase of a New England writer)* are *cultivating* the ocean." *Kendall's Travels*, v. ii. p. 113. This application of the word, must, I think, have been a peculiarity of the *writer* alluded to. I never knew it to be thus used in America.

CUSTOMABLE; " subject to duties. *(Law of Massachusetts.)*" *Webst.* This word I presume was never *in use*. I never heard it among *professional* men in Massachusetts, and *mercantile* friends, to whom I have mentioned it, do not recollect hearing it used. The word *dutiable* is sometimes heard in conversation. (which see.)

D.

DECEDENT; " one dead. *(Law of N. Jersey and Pensylvania.)*" *Webst.* This word is unknown in the *northern states*, even as a *technical* term.

DECENT; tolerable, pretty good: *Ex.* He is a *decent* scholar; a *decent* writer; he is nothing more than *decent*. This has been much used at some of our colleges; but never except in *conversation*. It has been thought by some to be an *Americanism*, but others have doubted whether it is.

DECIDEDLY. " He was *decidedly* at the head of the bar." *Marsh. Life of*

Washing. vol. v. p. 214. I do not find this adverb in any of the English dictionaries except *Entick's ;* I think, however, it is used by some English writers. In America it is very common both in conversation and in writing.

DELINQUENCY. The use of this word in the following passage of *Bancroft's Life of Washing.* (p. 207) is condemned by the English reviewers : " The *delinquency* of the United States to prepare for the approaching campaign ;" that is, (say the reviewers,) " *tardiness* or *unwillingness.*" *British Critic,* 1809, *p.* 182. It is not much used here ; I never saw it in any other instance than the above.

To DEMORALIZE ; "to corrupt, undermine, or destroy moral principles." *Webst.*

This has been adopted from the French since the revolution. It is used by some *English* writers, but perhaps not so often as by us. It is not in any of the dictionaries, I believe, except Mr. Webster's.

DEPARTMENT. See *Heads of Departments.*

DEPARTMENTAL ; " pertaining to a department." *Webst.*

This adjective has been ranked, by one of our own critics, among our " *barbarisms.*" See *Monthly Anthol.* v. 7. p. 263. It is not in the English dictionaries.

To DEPRECIATE ; v. *neut.* to fall in value. The English use this only as an *active* verb ; in *America* it is (like *appreciate,)* used as a verb *neuter.*

To DEPUTIZE ; to depute.

This word is sometimes heard in *conversation*, but rarely occurs in *writing.* I have never met with it but once in any of our publications : " They seldom think it necessary to *deputize* more than one person to attend to their interests at the seat of government." *Description of Nantucket, in the Port Folio for January* 1811, p. 33. Mr. Webster has noted it as a *Connecticut* word. It is also used in other parts of New England, but has always been considered as a mere vulgarism.

DEROGATORY The use of this adjective by itself, instead of *degrading*, has been observed upon by Englishmen as an *Americanism. Ex.* The government did such an act, which was very *derogatory ;* such conduct is very *derogatory*, i. e. *degrading.*

DESK ; a pulpit.

An English traveller has thus noticed the use of this word in *Connecticut :* " The pulpit, or, *as it is here called, the* DESK, was filled by three if not four clergymen; a number, which by its form and dimensions, it was able to accommodate." *Kendall's Travels*, vol. i. p. 4. It is also used in some other states: "They are common to every species of oratory, though of rarer use in the *desk*," &c. *Adams' Lectures on Rhetoric*, vol. i. p. 198. This word, however, with an epithet (as *sacred* desk, for example,) is, I think, to be found in English authors.

DESTITUTION; want, deficiency.

This is criticised in an English pamphlet on America, (quoted in the *Monthly Review*, vol. lvi. p. 104.) as one of our words, and this phrase is given as an example of our use of it: "were it not for my *destitution* of leisure," &c. The following may be added: "Is it not true that our *destitution* of competent fleets and armies, the state of our finances. ...combined to furnish," &c. *Answer of the House of Representatives of Massachusetts to the Governor's Speech, June Session*, 1813. This word is in the dictionaries, but does not seem to be in common use in England at this day.

DICTATION; a dictating. "Was not this an arbitrary *dictation* to a national vessel?" This word is in *Johnson*, upon the authority of *former dictionaries;* but, as Ash says, it is "not much used" in England; and it can hardly be said to be in use in this country.

DIME. "A silver coin of the United States, of ten cents." *Webst.*

DISCONNEXION. This word is not in *Johnson;* and it has been censured by an American writer, as an unauthorized word. See *Monthly Anthol.* vol. iv. p. 281. It is, however, sometimes used by English authors. *Mason* has it in his supplement, upon the authority of *Burke*, as he has also the participle *disconnected.*

DISDAIN; contempt.

Dr. Witherspoon gives the following example: "I should have let your performance sink into silent *disdain*." He then observes: "A performance may fall into contempt, or sink into oblivion, or be treated with disdain; but to make it sink into *silent disdain*, is a very crude expression indeed." No American author at the present day would use the word *disdain* in this extraordinary manner.

DOCITY, (*pronounced* dóssity.) A low word, used in some parts of this country to signify *quick apprehension.* It is used only in conversation, and generally with a negative, thus: He has no *docity.* It is a *provincial* word in England. I do not find it in any of the dictionaries, except *Bailey's* (fol. 1736) and *Ash's*, in which it is said to be " an incorrect spelling" of *docility.* In this country it is a *local* word, and employed only by the same class of speakers, that would use the low word *gumption*, which is also *provincial* in England. See *Gumption.*

DOMESTICS. It has been remarked, by Englishmen, that the people of New England always call servants *domestics.* The correlative *master* is also very seldom used in the *northern states. Domestic* is " a term of somewhat more extent than that of *servant.*" See *Rees's Cycloph.*

To DOOM; to tax at discretion. When a person neglects to make a return of his taxable property to the *assessors* of the towns, those officers *doom* him, that is, *judge* upon, and fix his tax according to their own discretion. Used in New England. " The estates of all marchants, shopkeepers, and factors shall be assessed by the rule of common estimation, according to the will and *doom* of the assessors." *Massa. Colony Laws*, p. 14 ed. 1660.

DOOMAGE. " A fine or penalty. Law of New Hampshire." *Webst.*

DUTIABLE. " Subject to duties or impost." *Webst.*

The use of this word in *Marshall's Life of Washington*, vol. ii. p. 73. has been censured by an American writer in the *Monthly Anthology*, vol. v. p. 438. It is very little used even in conversation.

E.

EAGLE; a gold coin of the United States, of the value of ten dollars.

EITHER. Dr. Witherspoon has the following remarks on one use of this word in America: " The United States or *either* of them. This is so far from being a mark of ignorance, that it is used by many of the most able and accurate speakers and writers, yet it is not English. The United States are thirteen in number, but in English *either* does not signify one of many, but *one or the other of two.* I imagine *either* has become an adjective pronoun, by being a sort of abbreviation of a sentence, where it is used adverbially, *either the one or the other.* It is exactly the same with εκατερος in Greek, and *alteruter* in Latin." *Druid*, No. 5. But Johnson says, " it is used *sometimes* of more than two; any one of a certain number; any of an indeterminate number."

To ELECTIONEER, *v. and* ELECTIONEERING, *n.* and *part.* We say, an electioneering pamphlet, an electioneering trick. The verb *electioneer* is not in any of the English dictionaries; and *Mason* alone has the noun *electioneering*, which he explains in the sense in which we use it; and cites, as his authority, this passage from the writings of *Soame Jenyns:*

"Adieu, say I, to all *electioneering*."

But of Soame Jenyns he says, in another place, his "writings are remarkably deficient in *accuracy* of English."

To ENERGIZE; to impart energy. "Instead of aiding and *energizing* the police of the college," &c. *The British Spy*, written in *Virginia*. This word is noted as "*unauthorized*," by a writer in the *Monthly Anthology*, vol. i. p. 635. I never saw it in any other American work. *Harris* (the author of Hermes) uses *energise*, but in a different manner.

EQUALLY AS, for EQUALLY. Dr. Witherspoon puts this among his "*Amercanisms*." He remarks—"Equally *as* well, and equally *as* good. This is frequent in conversation and public speaking. It is also to be found in some publications, of which it is needless to name the authors; but it is just as good English to say, the *most highest* mountain in America." *Druid*, No. 6.

ESQUIRE. This is often joined with the title of *Honourable*. *Ex.* "The Honourable A. B. *Esquire*." It is never thus used in England.

EVIDENTIAL; evincing. I have heard this word a few times from the pulpit, but never saw it in any American publications.

EULOGIUM; eulogy.

A writer in the *Monthly Anthology* (vol. i. p. 609.) observes, that "*eulogium* is not an English word." *Some* English writers, however, use it: "On this constitution a modern historian has passed a high *eulogium*." *Kendall's Travels*, v. i. p. 69. "The errors of public characters are too well known not to expose unfounded *eulogium* to the distrust of all who prefer truth to enthusiasm." *Seward's Life of Darwin*, *pref.* p. viii;

and in other places. It is not in Johnson, (quarto edit. 1799,) nor Mason's Supplement; nor do I find it in any of the English dictionaries except *Walker's*, and it was not inserted in the *early* editions of that work. It is in the *fourth* London edition (in quarto 1806) with this short remark; "the same as eulogy." It is not in Mr. *Webster's* dictionary.

EVOKED; conjured or raised up.

"Every phantom of jealousy and fear is *evoked*." *Letter of the Hon. J. Q. Adams*, Boston, 1808, p. 30. The *Editor of the New-York Evening Post*, in "*Remarks and Criticisms*" on this letter, says, "We doubt whether the verb *to evoke* be English; the substantive *evocation* is an English word." A *Boston* critic seems to intimate that *e*-voked here may be a mistake of the printer for *in*-voked.

EXCHANGEABILITY. *See the next word.*

EXCHANGEABLE. This and the preceding word are incidentally noticed, as unauthorized words, by a writer in the *Monthly Anthology*, (vol. i. p. 635.) who says they are used in *Washington's* [*official*] *Letters*, vol. ii. pp. 80, 94, 257. I do not find them taken notice of by any of the lexicographers except Mr. Webster.

EXECUTIVE. This word is now in general use here, as a noun, signifying the *Executive Power*, or, the *President* of the United States, in whom that power is vested.

A writer in the *Monthly Anthology* (1808, p. 437.) seems to think that "we have succeeded in *incorporating it* into the language, as it is now *in general use* in England." It is certainly *sometimes* used in England; but I do not recollect it in any instance except where the writer or speaker was alluding to the *American* Executive, and seemed to employ it as an *American name*. In the preface to the *London* edition of Ramsay's *History of the American Revolution*, (which however was published twenty years ago,) it is classed among those *American* words, which the *English* "have listened to without as yet adopting." The constitution of the United States says *the executive power*, and never simply, *the executive*.

To EXPECT; to suppose, think.

"In most parts of the world people *expect* things that are to come.

But in Pennsylvania, more particularly in the metropolis, we *expect* things that are past. One man tells another, he *expects* he has had a very pleasant ride, &c....I have indeed heard a wise man of Gotham say, he *expected* Alexander the Macedonian was the greatest conqueror of antiquity." *Port Folio*, 1809, p. 535. This use of the verb *expect* has now extended to other parts of the United States. It is *provincial* in England: "*Expect*, suppose. *North.*" *Grose's Prov. Gloss.*

F.

FACTORY. This is a new word in America, and is doubtless an abbreviation of *manufactory*; the latter word, indeed, is not in *Johnson's* and some other English dictionaries, but it is in Mason's Supplement, Walker's Dictionary, and Rees' Cyclopædia, and is well known to be in common use in England. The word *factory* (according to *Rees*) is applied "in *some* of the manufacturing counties [in England] to the places where *particular processes* of the manufacture are carried on;" but its common English meaning is well known to be (as Johnson gives it) "a house or district inhabited by traders in a distant country," and "the traders embodied in one place."

To FALL; To fell, to cut down.

A reviewer in the *Monthly Anthology*, vol. v. p. 438, condemns this as an "*American* barbarism" in the following passage of *Marshall's Life of Washington*: "for the purpose of cooperating with the Continental troops in breaking up the bridges, *falling* trees in the roads," &c. v. iii. p. 456. Dr. *Belknap*, in his *History of New Hampshire*, and all other American writers whose works I have consulted, use *to fell*; and *to fall* has always been considered as a *vulgarism* in New England. The verb *to fall*, in this sense, is to be found, indeed, in some of the English dictionaries, but most of them do not admit it. It is in the *English* part of *Ainsworth*, but in the *Latin* part, under both the words referred to, he says *to fell* trees. It is also in Ash, Sheridan and Walker, the last of whom has evidently copied his definition of this word from Sheridan. But it is not in Johnson, Mason, Bailey, Barclay, Entick, and various others. *To fell* is constantly used by *Evelyn*, throughout the chapter on *felling* trees, in his *Sylva*, (which was first printed in 1664,) and the same term is also used by his editor, the late Dr. Hunter, in his notes on that work; and it is constantly used in *Rees' Cyclopædia;* see articles, FELLING *of timber*, ASH tree, &c.

To FAULT; "to charge with a fault, to accuse." *Johns.* I have heard this verb used in a few instances by old people; but it is nearly obsolete here, as Ash says it is in England.

FEDERALIST; "a friend to the Constitution of the United States." *Webst.* Mr. *Webster* also has *Federal*, as a *noun* of the same meaning; but this I never heard except in the mouths of the most illiterate people; and it has always been considered as a corruption of *Federalist.*

FELLOW-COUNTRYMEN. "This is a word of frequent use in America. It has been heard in public orations from men of the first character, and may be daily seen in newspaper publications. It is an evident tautology, for the last word expresses fully the meaning of both. If you open any dictionary, you will find the word countryman signifies one born in the same country. You may say, fellow-citizens, fellow-soldiers, fellow-subjects, fellow-christians, but not fellow-countrymen." *Witherspoon's Druid*, No. 5. To the above authority I may add, that *Swift* begins the Drapier's Letters thus: "Brethren, Friends, *Countrymen*, and *Fellow-Subjects*," and ends them in a similar manner: "I am, my dear *countrymen*, your loving *fellow-subject*, fellow-sufferer," &c.

FIRSTLY. This adverb is frequently used by American writers; but there seems to be no *English* authority for it. None of the dictionaries have it, and English authors invariably use *first*, which has always been considered both as an *adverb* and an *adjective*. *Ex.* "This action [in an epic poem,] should have three qualifications in it; *first*, it should be but one action; *secondly*, it should be an entire action; and *thirdly*, it should be a great action." *Spectator*, No. 267; *et passim.* "The other purposes are to show *first*, that the time of the remarks was the favourable time....*secondly*, that on the enemy's side," &c. *Burke's fourth Letter on the Regicide Peace.*

FOLKS. Used in New England instead of *people* or *persons:* 1. for the persons in one's family; as, how do your folks do? i. e. family. 2. for people in general; as, what do *folks* think of his conduct in the affair?

Johnson observes, that "it is now used only in familiar or burlesque language;" and in *New England* it is less used now than formerly.

FORTED IN. "A few inhabitants *forted in* on the Potomac." Used in *Marshall's Life of Washington*, vol. ii. p. 28. and animadverted upon in the *Monthly Anthology*, vol. v. p. 438.

To FOURFOLD; v. "To assess in a fourfold ratio." *Webst.* Peculiar to the state of Connecticut.

FREDONIA, *n.* FREDONIAN, FREDE, FREDISH, &c. &c.

These extraordinary words, which have been deservedly ridiculed here as well as in England, were proposed sometime ago, and countenanced by two or three individuals, as names to designate the territory and people of the *United States*. The general term *American* is now well understood (at least in all places where the English language is spoken,) to mean an inhabitant of the *United States*, and is always so employed, except where unusual precision of language is required. *English* writers, in speaking of us, always say, the *Americans*, the *American* government, the *American* ambassador, &c. The words *Fredonia*, &c. are never now used except by way of ridicule.

FRESHET. This word is peculiar to New England at this day, and means, (as Dr. Belknap observes, in his *History of New Hampshire*, vol. iii. pref.) "a river swollen by rain or melted snow in the interior country, rising above its usual level, spreading over the adjacent low lands, and rushing with an accelerated current to the sea. In this sense," Dr. B. adds, "it is understood in New England, and, as it is a part of the language of the country in which I write, it is frequently used in this volume." The word, seems, had been noticed (in another work of Dr. Belknap's) by the Monthly Reviewers, who made this remark upon it—"We are not acquainted with this word."* In the next number of the Review, Dr. Belknap informs us, "a correspondent kindly attempted to correct what he imagined to be 'an errour of the press,' by substituting the word *fresh* in its place;

* 'Month. Rev. for Feb. 1787, p. 139.'

meaning a tide or flowing of fresh in distinction from salt water. But the reviewers were not satisfied that there was any errour of the press; and in fact there was not; the word *freshet* is a term familiar to the people of New England, as it was to their forefathers, who brought it from England, where it was equally familiar *in the last century*." Dr. Belknap then cites two authorities for the word; the first is from Milton's Paradise Regained, Book II. line 345, which is also given by *Johnson:*

> "——all fish from sea or shore,
> *Freshet* or purling brook, of shell or fin."

Upon which Dr. Belknap remarks, "It seems this author, by a *freshet*, meant a *spreading collection* of fresh water, distinguished from a brook." The commentators on Milton, however, seem to have understood it to mean a *stream*. In Todd's edition of Milton's works there is the following note on the above lines: "*Freshet*, a *stream* of fresh water. So Browne in "his Brit. Pastorals 1616, B. II. s. iii. of *fish*,

> Who now love the *freshet*, and then love the sea."

The other authority cited by Dr. B. is the *Description of New England*, written and published in England, in 1658, by Ferdinando Gorges, who uses the word, as Dr. B. justly observes, precisely in the sense in which it is now understood in New England: "P. 29—Between Salem and Charlestown is situated the town of Lynn, near to a river, whose strong *freshet* at the end of winter filleth all her banks, and with a violent torrent vents itself into the sea."

But if *Milton* did use this word in *poetry*, and Gorges in *prose*, almost two centuries ago, does it follow that it is *now* a part of the English language? If this rule should be adopted, it would authorize us to use many words which would be as new to most *Americans* of the present day, as *freshet* was to the English Reviewers. The English would doubtless use the term *floods* or *freshes*, as is done, in the following example, by an English traveller in New England: "This bridge, like the others, having been carried away by the *floods* or *freshes*, here called *freshets*," &c. *Kendall's Travels*, vol. i. p. 291. The *Encyclopædia Brittanica* also uses the term Freshes, which it says is "a local term signifying annual inundations, from the rivers being swollen by the melted snows and other fresh waters from the uplands, as is the Nile, &c. from periodical or tropical rains." One of *Johnson's* definitions of *Flood* is, "the swelling of a river by rain or inland flood;" and *Rees' Cyclopædia* says, "*Fresh* denotes the rise of water in a river, or a small flood." But *fresh* is *provincial* in England according to *Grose*, who defines it thus: "*Fresh*, a flood or overflowing of a river. This heavy rain will bring down the *freshes*. North." The people of the southern states use the word *fresh*.

FRONDESCE; to put forth leaves. "His powers began now to *frondesce* and blossom." *Eulogy on Dr. Rush by William Staughton*, D. D.

I never met with this word in any other instance than the above.

G.

GAWKY. This is sometimes used in conversation, by the people of New England, in the same sense as in the *North* of England, where it is *provincial:* "Gawky; awkward, generally used to signify a tall, awkward person. North." *Grose's Prov. Gloss.*

To GIRDLE. "The method is that of *girdling* the trees; which is done by making a circular incision through the bark, and leaving them to die standing." *Belknap's Hist. of New Hampshire*, vol. iii. p. 131. This is animadverted upon as an unauthorized word by a writer in the *Monthly Anthology*, vol. i. p. 635. It is also noticed, as one of our words, in *Kendall's Travels*, vol. i. p. 235.

GLUT; a large wooden wedge. *New England.* This is also a *provincial* term in England, in the same sense. See *Marshall's Rural Econ. of the Midland Counties*, and *Rees' Cyclopædia.*

GONDOLA. Thus noticed and explained by an English traveller: "Vessels of the burden above described are floated down to the sea by means of flat boats or lighters, *here* [in Portsmouth, New Hampshire,] called *gondolas*, and elsewhere *scows*." *Kendall's Trav.* vol. iii. p. 31. The word *gondola* is also used in this sense in other parts of *New England.*

GOUGING. The following account of this word is given by a late English traveller, upon the authority of an American: "The *General** in-

* General Bradley, a senator in Congress for the state of Vermont.

formed me, that the mode of fighting in Virginia and the other southern states, is really of that description, mentioned by preceding travellers, the truth of which many persons have doubted, and some even contradicted. *Gouging*, kicking, and biting are allowed in most of their battles....*Gouging* is performed by twisting the forefinger in a lock of hair, near the temple, and turning the eye out of the socket with the thumb nail, which is suffered to grow long for that purpose." *Lambert's Travels*, vol. ii. p. 300. "A diabolical practice (says the *Quarterly Review*) which has never disgraced Europe, and for which no other people have even a name." *Quart. Rev.* vol. ii. p. 333. The practice itself and the name are both unknown in *New England.*

GOVERNMENTAL; belonging to a government.

A reviewer in the *Monthly Anthology* (vol. vii. p. 263) ranks this among the "*barbarisms* in common use" in America. It is not in any of the dictionaries, nor is it ever used by the English.

GRADE; gradation, degree, rank, order. "To talents of the highest *grade* he [Hamilton] united a patient industry not always the companion of genius," &c. *Marshall's Life of Washington*, vol. v. p. 213. "The high *rank* he had held in the American army would obviate those difficulties in filling the inferior *grades* with men of experience." p. 309.

This word is criticised as an *Americanism* in the *Monthly Review*, vol. lvi. p. 104; and the Annual Review (in the account of Marshall's Life of Washington) remarks upon it thus—"At page 367 [of the fifth volume] and in many other places *grade* is used for *degree*. *Ann. Rev.* vol. vii. p. 241.

To GRADUATE. To take a degree at a university. This verb was, till lately, always used by us as a verb *neuter* or *intransitive*: *Ex.* He *graduated* at the university of Cambridge; but it is now very common to say, "he *was graduated* at Cambridge," &c. which is also used in England: "You, methinks, *are graduated.*" See *Brit. Crit.* vol. xxxiv. p. 538. But the other mode of using it is also common in English authors. In the *London Monthly Magazine* (for Oct. 1808, p. 224) a writer, speaking of Mandeville, says—"He *graduated* at Leyden in 1691;" and in the same work (for Feb. 1809) it is again used. In Rees' Cyclopædia, *art.* GLANVILL, it is said—" he took his first degree in the year 1655, and removing to Lincoln college he *graduated* master of arts in 1658," &c. In the same work, *art.* MAGNOL, (which appears to be written by Dr. J. E Smith, President of the Linnæan Society,) it is again used—" wherever Magnol *graduated*," &c. The *Eclectic Reviewers* also use it—" We think dissenters, merely as such, should not be deprived of the privilege of studying and *graduating* at the English universities, &c. *Eclect. Rev.* Apr. 1811. p. 295. *Johnson* has the word as a verb *active* only.

GRAIN. *See* CORN.

GRAND. Much used in conversation, for very good, excellent, fine, &c. *Ex.* This is *grand* news; he is a *grand* fellow ; this is a *grand* day. *New England*

GUBERNATORIAL ; " relating to a governor." *Webst. Ex.* At the late *gubernatorial* election ; that is, at the late election of governor.

To GUESS ; to imagine, suppose, believe, think, fancy. *New England.*

This is one of the most common words in our vocabulary ; and, from its frequent recurrence, has been the subject of more ridicule than any of our words. A late English traveller thus amuses himself with the use of it in the *country*-towns of New England : " Instead of imagining, supposing, or believing, as *we* do, they always *guess* at every thing. ' I *guess* as how, Jonathan, it's not so *could* as *yeasterday*.' ' Why I *guess*, Nathan, that the wind has changed.' " *Lambert's Travels*, vol. ii. p. 506.

It is well known to be an old English word, and is still sometimes, though rarely, used in England, very much as it is here. An intelligent friend informs me, that he has heard it used by people of Kent, in England, just as it is in New England.

GUMPTION. A low word, which is *sometimes* heard in *conversation* here, and signifies understanding or capacity, as it does in some parts of England, where it is a *provincial* word. *Grose*, under the word *gawm*, has this explanation—" Gawm ; to understand. I dunna gawm ye ; I don't understand you. Hence gawmtion, or *gumption*, understanding. *North.*" *Prov. Gloss.* See the word *Docity*.

To GUN ; to shoot. *Ex.* I am going a-*gunning*. *New England.*

HACK. An abbreviation of *hackney-coach.* In England *hack* signifies "a *horse* much used or let out for hire." *Mason's Supplem.* The English "instead of our abbreviation, *go call me a hack*, say, *go call me a coach.*" *Monthly Anthol.* vol. v. p. 660.

HEADS OF DEPARTMENTS. A general term, used in speaking of the *Secretaries of State, of the Treasury*, &c. collectively. "The temporary *heads of departments* were required to prepare and lay before the first magistrate such statements," &c. *Marsh. Life of Washing.* vol. v. p. 176.

HEAT or HET, (*pret. and part. of* to heat.) This is sometimes heard in conversation; but (as Mr. Webster observes,*) "the practice is not respectable." *Mason*, in his Supplement to Johnson, gives *heat* as a participle used by old poets for *heated*," and cites *W. Browne*. *Ash* has it, written *het*, on the authority of *Chaucer*, and says it is *obsolete*.

HEFT, *n.* and *To* HEFT, *v.* The noun *heft* is to be found in *Bailey's* and *Entick's* dictionaries in the sense, in which it is often used in this country, that is, to signify "heaviness, or the *weight* of any thing;" and in this sense (according to *Grose*,) it is *provincial* in England. The verb *to heft*, which here commonly signifies *to lift any thing in order to judge of its weight*, is not in the dictionaries. Both the noun and the verb are used only by the vulgar.

HELP, *n.* Often used in New England instead of *servants*; and it generally means *female* servants: *Ex.* My *help* is very good; such a one is very good *help*. The word *domestics* is, however, more common.

HITHER AND YON. Used in some parts of the interior of New England for *here and there*. It is a *provincial* expression in England: "Hither and yon; here and there, backwards and forwards. North." *Grose's Prov. Gloss.* It is never heard except in the *country* towns.

HOLPE *or* HOLP; from *help*. This form of the verb it seems is still used in Virginia, where, Mr. Webster says, "it is pronounced *hope*: Shall I *hope* you, Sir." *Webst. Dissertations*, p. 384. It seems too that in England, as late as when bishop Lowth wrote, the ancient irregular form *holpe* (in the *preterite*) was "still used in conversation." See his *Grammar, Irregular Verbs*, sect. 3. I never heard it during my residence in that country.

* Philosophical and Practical Grammar, p. 113.

HOMINY or HOMMONY; "food made of maize broken, but coarse, and boiled." *Webst.* Hence a vulgar comparison—As *coarse* as hominy.

HONORARY. Some writers among us frequently use this adjective instead of *honorable: Ex.* It was highly *honorary* to him.

To HOPE. "We may *hope* the assistance of God. The word *for* or *to receive* is wanting. In this instance *hope*, which is a neuter verb, is turned into an active verb, and not very properly as to the objective term, assistance. It must be admitted, however, that in some old English poets, hope is sometimes used as an active verb, but it is contrary to modern practice." *Witherspoon's Druid*, No. 5. This verb, I think, would not be used in the manner above pointed out, by any American writer of the present day.

HORSE-COLT. "We frequently see in advertisements [in America] these terms, *horse colt*, *mare colt*, &c. A *horse* colt is simply a *colt*, a *mare* colt merely a *filly*." *Port Folio*, *new series*, vol. ii. p. 309.

HUB; the nave of a wheel. Used in New England. It is a *provincial* word in England: "*Hubs*, naves of wheels." *Marshall's Rural Econ. Midland Counties* of England. It is not in the English dictionaries.

I.

ILLY; ill *adv.* This word has been much used, in America, both in conversation and in writing. It is not to be found in the English dictionaries, nor is it now used by English authors, the word *ill* being always employed by them both as an *adverb* and an *adjective*, just as the term *well* is. *Illy* has been thought by some persons to be of *American* origin; but this is not the fact. A friend has given me the following *British* authority: "He then set himself wholly to God unfeignedly, and to do all that was possible in that little remainder of his life which was before him, to redeem those great portions of it, that he formerly so *illy* employed." *Bishop Burnet's Account of the Life and Death of the Earl of Rochester*, as reprinted in the *Christian Monitor*, No. XX. p. 112. I was also told some time ago, by a friend, that it was used by *Steele* in the *Spectator*; but the *number*, in which it was used, was not recollected. I have not been able to find it in any part of that work. *Ainsworth* has *illy* in the *Latin* part of his dictionary, (under the words *malè* and *malùm*,) but in the *English* part he has *ill* only.

To IMMIGRATE, IMMIGRATION, IMMIGRANT. These words were first used in this country, I believe, by Dr. Belknap in his History of New Hampshire. In the preface to the third volume of that work he has the following defence of them: "There is another deviation from the strict letter of the English dictionaries, which is found extremely convenient in our discourses on population. From the verb *migro* are derived *emigrate* and *immigrate*; with the same propriety as from *mergo* are derived *emerge* and *immerge*. Accordingly the verb *immigrate*, and the nouns *immigrant* and *immigration* are used without scruple in some parts of this volume." There seems to be a convenience, as the learned author observes, in having these words in the language; but in practice they have not been found necessary. I do not recollect that any American writers (except such as have copied from Dr. Belknap's work) have adopted them. None of them are to be found, I believe, in any of the English dictionaries except *Bailey's* and *Ash's*; and these have only the *verb*, immigrate, not the *substantives*, immigrant and immigration. They are all unknown to the English authors of the present day. Mr. *Webster* has inserted them in his dictionary, upon the authority, I presume, of Dr. Belknap. Mr. Kendall (the English traveller already quoted) observes, that "*immigrant* is perhaps the only new word of which the circumstances of the United States *has* in any degree demanded the addition to the English language." *Kendall's Travels*, vol. ii. p. 252, *note*.

To IMPROVE; to occupy, employ. The use of this word in the *first* sense is very common in New England; but it is not much used in the *second* sense, as in the following example: "In actions of trespass against several defendants, the plaintiff may, after issue is closed [joined] strike out any of them for the purpose of *improving* them as witnesses." *Swift's System of the Laws of Connecticut*, vol. ii. p. 238.

The following remarks of Dr. *Franklin*, on this and some other words, will not be uninteresting to the reader. They are taken from his letter of Dec. 26, 1789, to Mr. *Webster*.

"I cannot but applaud your zeal for preserving the purity of our language both in its expression and pronunciation, and in correcting the popular errors several of our states are continually falling into with respect to both. Give me leave to mention some of them, though possibly they may already have occurred to you. I wish, however, that in some future publication of yours, you would set a discountenancing mark upon them. The first I remember is the word *improved.* When I left New England in the year 1723, this word had never been used among us, as far as I know, but in the sense of *ameliorated* or *made better*, except once, in a very old book of Dr. Mather's, entitled *Remarkable Providences.* As that man wrote a very obscure hand, I remember that when I read that word in his book, used instead of the word *employed*, I conjectured that it was an error of the printer, who had mistaken a short *l* in the writing for an *r*, and a *y* with too short a tail for a *v*, whereby *employed* was converted into *improved;* but when I returned to Boston in 1733, I found this change had obtained favor, and was then become common; for I met with it often in perusing the newspapers, where it frequently made an appearance rather ridiculous. Such, for instance, as the advertisement of a country house to be sold, which had been many years *improved* as a tavern; and in a character of a deceased country gentleman, that he had been for more than thirty years *improved* as a justice of the peace. This use of the word *improve* is peculiar to New England, and not to be met with among any other speakers of English, either on this or the other side of the water."*

Notwithstanding Dr. Franklin thus amuses himself at the expense of Dr. Mather, the word seems to have been used, at least in the *laws* of his

* Dr. Franklin then has the following remarks on some other words: "During my late absence in France, I find that several other new words have been introduced into our parliamentary language. For example, I find a verb formed from the substantive *notice—I should not have* noticed *this, were it not that the gentleman*, &c. Also another verb from the substantive *advocate; the gentleman who* advocates *or who has* advocated *that motion*, &c. Another from the substantive *progress*, the most awkward and abominable of the three; *the committee, having* progressed, *resolved to adjourn.* The word *opposed*, though not a new word, I find used in a new manner, as, *the gentlemen who are* opposed *to this measure*, to which I *have also myself* been opposed. If you should happen to be of my opinion with respect to these innovations, you will use your authority in reprobating them." *Franklin's Essays*, vol. ii. p. 79. *London edit.*

native state, long before the period above alluded to. See *Provincial* Statutes, 4. William and Mary, A. D. 1692. and *Massa.* Colony *Laws*, *title*, CATTLE, CORN-FIELDS, FENCES ; p. 12. Edit. 1660.

This use of the verb *improve* is also noticed by Dr. Witherspoon; see his *Druid*, No. 7.

IMPORTUNACY. This has been called an *American* word. (See Monthly Anthol. 1806, p. 92.) It is not in *Johnson*, but it is in *Bailey* and *Mason*, the latter of whom cites Shakespeare's *Two Gentlemen of Verona* and *Timon.* The word, however, does not appear to be much used by English writers of the present day.

INCIDENT TO ; *liable to.* " Such bodies are *incident* to these evils. The evil is incident or ready to fall upon the person; the person liable or subject to the evil." *Withersp. Druid*, No. 5. I have never known the word *incident* used in this manner in America.

INCIVISM ; " unfriendliness to a state or government." *Webst.* This modern word has never been heard in America since the first years of the French revolution.

To INCULPATE ; INCULPATION ; to accuse ; accusation. These words are used by some American authors ; but they are not in the English dictionaries, and are certainly not much, if at all, used by English writers.

INDESIRABLE. This word is censured in the Monthly Anthology, (1807, p. 281.) I have never met with it in American publications except in the instance there cited.

INEXECUTION. " The extensive discussions which had taken place relative to the *inexecution* of the treaty of peace," &c. *Marsh. Life of Washing.* vol. v. p. 474. I believe this has been sometimes used by English writers ; but they generally make use of the term *non-execution*, as Judge Marshall himself commonly does ; see pp. 184, 275, 370, 473, &c. of vol. v.

INFECTED. The *Annual Review* has hastily criticised Judge Marshall for using this word in his Life of Washington in a peculiar sense. The remark of the reviewers is :—" Vol. v. p. 144, [Eng. edit.] meaning to praise them, our author says, ' the patriotic veterans of the revolution, *infected* by the wide spreading contagion of the times, arrayed themselves under the banner of the laws.' *Ann. Rev.* vol. vii. p. 241. But the word *infected* is an error of the press, in the *London* edition, for *un-infected.* In this same sentence there is another alteration in the *London* edition : " the *patriotic* veterans" for "*patriot* veterans," as it stands in the *American* edition.

INFLUENTIAL; having influence. *Ex.* " Persons who are strangers to the *influential* motives of the day." *Marsh. Life of Wash.* vol. v. p. 380. " He was a very *influential* man." *Johnson* and other lexicographers have this word in the sense of *exerting* influence ; but it does not appear to be used now in England. *Burke*, in one instance, seems to use the word *prevalent* as we should *influential* : " I know that he and those who are much *prevalent* with him," &c. *Burke's Works, Letter Fourth on the Regicide Peace*, vol. v. p. 89. Amer. ed.

To INFORM. This verb is much used in the United States, in the following manner : The master of the ship which has just arrived, *informs* that he left London on such a day ; for *informs us*, or *says*, or *states*, &c.

To INFRACT. This is used by some American authors instead of the verb *to infringe*, which is commonly employed by good writers.

INFURIATED ; enraged, made furious.

This is a favorite word with some American writers, but is not in general use. The adjective *infuriate* is often used by the poets, and is in the English dictionaries ; but the participle *infuriated* and its verb are not.

INSULARITY. Used by some American writers. It is not in the English dictionaries, and, I believe, is never used by English authors.

INSURRECTIONARY. " Suitable to insurrections." *Mason.* This word was criticised a few years ago, in a review of " *Letters from Europe by a native of Pennsylvania*," (see Monthly Anthology for 1806,) as an *Americanism*, or, as the reviewers with some severity call it, an *Indianism.* It is not in *Johnson's* dictionary, but it is in *Mason's* Supplement, where this passage is cited from *Burke*—" True democratic, explosive, *insurrectionary* nitre." To which may be added the following, from the posthumous works of the same author—"Why, the author writes, that on their murderous *insurrectionary* system their own lives are not sure for an hour."—" Whilst the sansculotte gallery instantly recognized their old *insurrectionary* acquaintance," &c. *Burke's Fourth Letter on the Regicide Peace*, vol. v. of his works, pp. 34, 35. Amer. ed.

This word is a production of the French Revolution, and perhaps (like the term *sansculotte* and some others) would not have been used by Burke, except when writing upon the affairs of France. I have never met with it in any other English author, and it is not mentioned by any of the lexicographers but *Mason*.

INTERVAL-LAND, or INTERVALE. "Along the borders of the rivers, at a distance from one another, are some small portions of meadow, or of those culturable uplands, that, in New England, are included with meadow in the denomination of *interval-lands*. *Kendall's Travels*, vol. iii. p. 71. Mr. Kendall then criticises Dr. Morse for using *interval* as synonymous with *meadow*, observing, that "if the word *interval* were synonymous with *meadow*, it ought upon no account to be employed; and it is only because it is not synonymous, that it is useful, and deserves to be retained....The *interval*, intended in New England geography, is the *interval* or *space between a river and the mountains*, which on both sides uniformly accompany its course at a greater or less distance from its margin. Hence *interval-lands* include meadow and uplands, and in general the whole of the narrow valley through which in these regions the rivers flow." p. 183. Dr. *Belknap* uses the word *intervale*; observing, that he can "cite no very ancient authority for it; but it is well understood, in all parts of New England, to distinguish the low land adjacent to the fresh rivers, which is frequently overflowed by the *freshets*, and which is accounted some of our most valuable soil, because it is rendered permanently fertile by the bountiful hand of nature, without the labor of man." *Hist. of New Hampsh.* vol. iii. preface, p. 6.

To ISSUE. The *British Critic* for 1809 (vol. xxxv. p. 182) censures the use of this verb, in the following passage of the Rev. Dr. Bancroft's Life of Washington: "The northern campaign had *issued* in the capture of general Burgoyne. p. 169." It has been often used by American authors, and is still sometimes met with in writing. Dr. *Witherspoon* has not mentioned it among his *Americanisms*, but has himself used it in one instance: "A curious debate in a certain family, which *issued* in nothing." It is also used in *Ramsay's* Life of Washington, and censured in the review of that work in the Monthly Anthology, vol. iv. 664.

ITEM; an intimation, a hint. *Ex.* I had an *item* of his designs. This is a low word, and is used here only by the illiterate. It is in *Johnson's* dictionary; but *Grose* has it among his *provincial* words, and marks it as peculiar to the *North* of England.

JAG; a small load. *New England. Grose* has it among the *provincial* words of England: "Jag, a small parcel or load of any thing, whether on a man's back or in a carriage. *Norfolk.*" *Bailey* also marks it as a "*country*" word.

JOCKEYING. "The farmers impeached their honesty, accusing them of unfair dealing, or, as their phrase is, of *jockeying.*" *Kendall's Trav.* vol. i. p. 87. The verb *to jockey*, signifying "to cheat, to trick," is in Johnson's and other English dictionaries. I do not know whether it is at all used at this time in England or not. In America it is considered as a low word.

JOUNCE, *n.* and *to jounce*, *v.* These are sometimes heard in conversation; but they are considered as low words. They are *provincial* in England: "*Jounce*; a jolt or shake; a *jouncing* trot; a hard rough trot; Norf." *Grose's Prov. Gloss.*

K.

KEDGE; brisk, in good health and spirits. *Ex.* How do you do to day? I am pretty *kedge*. This is used only in a few of the *country* towns of New England, but is unknown on the sea-coast. It is *provincial* in England. *Grose* defines it, "brisk, lively," and says it is used in the *South*. *Ray* also has it among his "*South and East Country words,*" and explains it thus—"brisk, budge, lively. *Suffolk.*"

To KEEP; to stay at the house of any person. *Ex.* Where do you keep? I keep at my friend's house. *New England.* This is noted as an *Americanism* in the Monthly Anthology, vol. v. p. 428. It is less used now than formerly.

KEEPING-ROOM a parlour. *New England.* "The latter spent his evening in the parlour, or, as it is called, the *keeping-room.*" *Kendall's Trav.* vol. iii. p. 264. This is now more frequently called the *sitting room.* The term is *provincial* in *England:* "*Keeping-room*, a sitting room. *Norfolk.*" *Marsh. Rural Econ. Norf.* The term *parlour*, however, is in general use in the sea-port towns of New England.

KELTER or KILTER; good condition, order. *Ex.* This cart, or plough, is out of *kilter.* This is very common among the farmers of New England. It is one of the *provincial* words of Great Britain: "Kelter or kilter; frame, order, condition. *North.* In good kelter; in good case or condition." *Grose's Prov. Gloss.* It is also mentioned by *Marshall* among his "Provincialisms of Yorkshire," and by *Ray* in his "South and East Country Words."

KNOLL; a little round hill. In common use in the country towns of New England. *Grose* has it as one of the *provincial* words of the *North* of England.

L.

LANGUISHMENT. "This disease [pulmonary consumption] which, after the *country*-people among the whites, they [the Indians] call a *languishment.*" *Kendall's Trav.* vol. ii. p. 211, where the author is speaking of the island of *Nantucket.* The word is not in general use in New England.

LAY; *n.* terms or conditions of a bargain, price. *Ex.* I bought the articles at a good *lay;* he bought his goods on the same *lay* that I did mine. *A low word.*

To LAY for *to* LIE. Dr. Witherspoon observes, that "this is not only a prevailing vulgarism in conversation, but has obtained in public speaking, and may be often seen in print. I am even of opinion (he adds) that it has some chance of overcoming all the opposition made to it, and fully establishing itself by custom, which is the final arbiter in all such cases. Lowth in his Grammar has been at much pains to correct it; yet though that most excellent treatise has been in the hands of the public for many years, this word seems to gain, instead of losing ground." *Druid, No.* 6. This vulgarism, which is heard in England as well as America, is much less frequent at the present day, than it was when Dr. Witherspoon wrote. It is still heard in *conversation*, but in *writing* every body avoids it.

LEANTO, *n.* (commonly pronounced *linter.)* "The part of a building which appears to lean upon another." *Webst.* It is not in Johnson; but Mason has it in his Supplement, where it is called an architectural term, and is defined thus: "A low shallow building joined to a higher," which is the *New England* sense of it.

LEASE, *n.* Used in some towns of New England thus: A *cow-lease*, that is, a right of pasturage for a cow, in a *common* pasture. *Grose* has the word, as a *provincialism* of the *West* of England, and remarks, that it is perhaps the same as *lees.*

LEGISLATIVE. This, like the word *Executive*, is sometimes used in America as a *noun.* In the preface to the *London* edition of *Ramsay's History of the Revolution*, it is classed among those American names, which the English "have listened to without as yet adopting."

LENGTHY; longish, somewhat long. This word has been very common in America, both in writing and in conversation; but it has been so much ridiculed both by English and American critics, that our *writers* now avoid using it. Mr. Webster has admitted it into his dictionary, but it is not to be found in any of the *English* ones. It is applied by us (as Mr. Webster remarks) chiefly to writings or discourses. Thus we should say, a *lengthy* pamphlet, a *lengthy* sermon, &c. The English would say, a *long*, or sometimes, a *longish* sermon: They make much more use of the termination *ish* than we do; but this is only in the language of *conversation.* Sometimes they use *lengthened* where our writers would have employed *lengthy:* "For the purpose of bestowing upon him, and upon all that belong to him a *lengthened* and elaborate eulogy." *Quarterly Rev.* Jan. 1814, p. 314. A learned English friend, who has been in this country several years, informs me that he has sometimes heard *lengthy* used in conversation in *England.*

LIABILITY. This is in common use in the United States, but is not to be found in the English dictionaries. None of the lexicographers, indeed, have the noun *liableness*, except Entick and Mason, the last of whom gives it on the authority of *Butler's Analogy*.

LICIT; lawful. This word was criticised in the *Monthly Anthology* (1804, p. 54) in a review of the "Miscellaneous Works of David Humphreys, Esq." The reviewers say, "There is no such word as *licit*, and we cannot allow the author, respectable as he is, to coin language."

LICK; SALT-LICK. "A salt spring is called a *lick* from the earth about them being furrowed out in a most curious manner, by the buffalo and deer, which lick the earth on account of the saline particles with which it is impregnated." *Imlay's Topographical Descript. of the Western Territory of N. America*, p. 46, 2nd edit.

LIFT, *n.* Used by the farmers in some parts of New England to signify a sort of gate without hinges. In some counties of England they use the term *lift-gate* for the same thing: "Lift-gate; a gate without hinges, being lifted into notches in the posts. *Norfolk.*" *Marshall's Rural Econ. Nor.*.

LIKELY; sensible, of good talents. *New England.* "Throughout the British dominions, and in most parts of the United States, the epithet *likely* conveys an idea of mere personal beauty, unconnected with any moral or intellectual quality. But in *New England*....a man or woman as deformed as a Hottentot or an Ourang Outang, may be *likely*, or *very likely*. The epithet there refers to moral character." *Port Folio, Oct.* 1809, *p.* 535.

LINKS; sausages. Used in some of the *country* towns of New England. It is also used in *Suffolk* in England. See *Grose's Prov. Gloss.*

LINTO. See *Leanto.*

LISTER. "One who receives and makes returns of ratable estate. *Connecticut.*" *Webst.*

LIT or LIGHT, (*pret.* and *part.* of *to light.*) This word is censured, in a review of *Bancroft's Life of Washington*, in the Monthly Anthology, vol. iv. p. 666. The reviewers say, "it has never been admitted into good company, and we hope never will be." This form of the verb is to be found in all the dictionaries; but in this country, as in England, it is only used in conversation. Bishop Lowth remarks, (*See chapt. on Irregular Verbs*, *sect.* 1.) that "the *regular* form is preferable, and prevails most in writing;" and this is agreeable to the general practice in America.

To LOAN; to lend. In the preface to the London edition of *Ramsay's* History of the American Revolution, this is classed among those American verbs, which the English "have altogether declined to countenance," and "which, (says the Editor) "appear to be verbs invented without any apparent reason."

To LOCATE. 1. To place. "A number of courts properly *located* will keep the business of any country in such condition as but few suits will be instituted." *Debates on the Judiciary*, p. 51.

2. "To survey or fix the bounds of unsettled land, or to designate a tract by a writing." *Webst.* This verb is not in the *English* dictionaries.

LOCATION; "the act of designating or surveying and bounding land; the tract so designated." *Webst.* This substantive is in the English dictionaries, but not in this sense.

M.

MAD; angry, vexed. "I was quite *mad* at him, he made me *mad*. In this instance *mad* is only a metaphor for angry. This is perhaps an *English* vulgarism, but it is not found in any accurate writer, nor used by any good speaker, unless when poets or orators use it as a strong figure, and, to heighten the expression, say, he was mad with rage." *Withersp. Druid*, No. 5. This is considered here as a low word (in this sense) and at the present day is never used except in conversation. It seems to be an *Irish* idiom. In Miss Edgeworth's *Castle Rack Rent*, an *Irishman* says, "My lady would have the last word, and Sir Murtagh grew *mad;*" i. e. (as she explains it in the Glossary to the work) "grew angry." The same use of the word by an Irish youth in the "*Eton Montem*" (Edgeworth's Parents' Assistant) is the cause of his offending one of his *English* fellow-students, till the *Irish* meaning of the word is explained. The word occurs in the Spectator, No. 176, and seems to be used in this sense: "Indeed, my dear says she, you make me *mad* sometimes, so you do."

MANKIND. Mr. *Kendall* quotes the following expression of a *Vermonter*: "if the government can put *mankind* in gaols," &c. and then makes this remark: "It is to be observed that the word *mankind*, so ludicrous in its application here, is frequently used in *New England*, as in this example, for *men*, in the indefinite sense." *Travels*, vol. iii. p. 253. This use of the word is not known in the towns on the sea-coast.

MEMBER OF THE CHURCH. "Returning to his house I missed a young man who had been with us; and on inquiring for him, was informed, that he had stayed behind, to receive the sacrament, with the addition that '*he was a member of the church.*' I was at length made to understand, that the *church* consists in a narrow circle within the circle of settled, qualified, and approved inhabitants, as that is within the circle of the *society*; and that it is only to the *church* that the sacrament of the last supper is administered." *Kend. Trav.* vol. i. p. 115. *Members of the church* are frequently called, in New England, by way of eminence, *professors* of religion.

To MILITATE. The preposition *with* is often used by American writers after this verb; the English say, to militate *against*.

MISSION; an embassy. This word, till lately, was generally used to signify a *religious* embassy, as Dr. Johnson explains it. It was first employed as a *diplomatic* term, I believe, by *American* writers, but is now used in the same manner by the English. "He had heard it reported, that the gentleman who had been sent on a *mission* to America, &c." *Debates in Parliament*, Feb. 26, 1808. "The French *mission* was still suffered to remain at Stockholm." *Edinb. Rev.* No. XLI. p. 155.

MOCCASON or MOGGASON. "A shoe of soft *lether* without a sole, ornamented round the ankle." *Webst.* An Indian name.

MUSH. "Food of maize flour and water boiled. (Local.)" *Webst.* The same thing which in the *Northern* States is called *hasty-pudding*.

MUSICAL. A friend informs me, that in some towns in the interior of New England, this word is used in the extraordinary sense of *humorous*, or *sprightly*. They would say of a man of humour, he is very *musical*.

N.

To NARRATE ; "To relate, to tell." *Johnson.* This verb is noticed, by being printed in *italics*, in some English works, where extracts have been made from *American* publications. Dr. Johnson says, it is "a word only used in Scotland." Walker, without controverting Johnson's assertion, thus defends the word: "As it is regularly derived from the Latin *narro*, and has a specific meaning to distinguish it from every other word, it ought to be considered as a necessary part of the language. To *tell* seems to imply communication in the most general sense : as *to tell a story*, *to tell a secret*, &c. To *relate*, is to tell at some length, and in some order, as to *relate the particulars of a transaction.* But to *narrate* seems to relate a transaction in order from beginning to end ; which often becomes insipid and tiresome. Hence the beauty of Pope's—*narrative* old age :

> "The poor, the rich, the valiant, and the sage,
> And boasting youth, and *narrative* old age."

Writers do not, I think, observe this distinction. The word is used in the *Edinburgh Review.* See vol. ii. p. 507, where it occurs twice.

NATIONALITY. Used by some writers in America. I have also met with it once in the *Quarterly Review*, but it is printed in *italics*. It is a new word, and is not to be found in the dictionaries.

NAVIGATION ; shipping. "The word *navigation* is used in New England for *shipping*, and for *sea-faring*." *Kend. Trav.* vol. i. p. 321, note. It is in constant use in the first of these significations, but I never heard it used in the other ; nor do I perceive how it could well be employed as a substitute for this *adjective*. *Johnson* has "vessels of navigation," as one of the meanings of the word, but it is on the authority of *Shakspeare :*

> "Tho' you untie the winds, and let them fight
> Against the churches, tho' the testy waves
> Confound and swallow *navigation* up."

NETOP. An Indian word which, a friend informs me, is still sometimes used in conversation in *a few* towns in the interior of Massachusetts, to signify a *friend*, or (to use a cant word) a *crony*. The word is in *Roger Williams's Key to the Narraganset Language*, published in the *Collections of the Massachusetts Historical Society*, vol. v. p. 82. Williams says, "What cheer, *netop*, is the general salutation of all English toward them [the Indians.]"

To NOTICE; to observe, to take notice of. This is not, as some persons have supposed, an *American* word. It is a modern word, and is not in Johnson's dictionary. *Mason* says, it is "a word imported into English *conversation* from *Ireland*;" but it is now in use in *England*, both in conversation and in writing. "This work, which we really thought we had *noticed* long ago." *British Critic*, vol. xxxiv. p. 537. "The fourth, which we lately *noticed*, &c. vol. xxxv. p. 18. The only English dictionary, in which I find it, is *Ash's*, where it is said to be "*not much used.*" But that work was published forty years ago.

To NOTIFY. The following remarks of Dr. Witherspoon will explain the American and the English manner of using this verb:

"This is to *notify* the public; or the people had not been *notified*. By this is meant *inform* and *informed*. In *English* we do not notify the person of the thing, but notify the thing to the person. In this instance there is certainly an impropriety, for *to notify* is just saying by a word of Latin derivation, *to make known*. Now if you cannot say, this is to make the public known, neither ought you to say, this is to notify the public." *Druid*, No. 5. Some *American* writers, however, preserve the English idiom. "The official letter *notifying to* the Convention the appointment of Mr. Genet," &c. *Marsh. Life of Washing.* vol. v *Appendix*, p. 18. The practice of writers in *England* seems to have been invariable from the days of Addison to the present: "Having *notified to* my good friend Sir Roger, that I should set out for London," &c. *Spectat.* No. 132. The act of *notifying to* the world." *Johns. Dict. under the word* Publication. "The Commander in Chief, therefore, has it in command to convey to all those officers the highest displeasure of the Prince Regent for conduct so unmilitary and disgraceful, and to *notify to* them that they are no longer officers in his majesty's service." *Duke of York's General Orders, Sept.* 10, 1813. In *advertisements* in the newspapers, where we should commonly say, *the public*, or *the inhabitants of the town*, &c. are hereby *notified*, the English would say, *Notice is hereby given*," &c.

O.

To OBLIGATE. "The word *obligate* is unnecessary, and has no respectable support." *Review of Mr. Webster's Dict. in the Monthly Anthology*, vol. vii. p. 263.

To OBLIVIATE; to cause to be forgotten. I have never seen this extraordinary word but once in any American publication.

OBNOXIOUS. This has been generally used by *American* writers in the sense of *odious*, *offensive*, *noxious*, *disagreeable*, &c. "Habit renders the burden not only less *obnoxious*, but less oppressive also." *Marsh. Life of Washing.* vol. v. p. 264. The English formerly used *obnoxious* in the sense of *liable* or *subject to;* and *Johnson* accordingly explains each of these words by the others. But the practice in England is not invariable. A writer in the *European Magazine*, (for Sept. 1806, p. 182) mentions among the *improprieties* of the present day in *England*, this "use of the word *obnoxious* for *noxious* or *hurtful;* that such a thing is very *obnoxious*. Now, Sir, you know (says he to the editor) that the fact is, that the word is perfectly innocent of any such meaning, and that it simply implies, *incident*, *liable*, or *subject* to; such as, that people are *obnoxious* (liable) to agues." The use of this word in the sense of *odious* or *offensive* does not seem to to be altogether an *impropriety of the present day*. *Ash* (who wrote forty years ago) mentions this as one of the meanings of the word; he says, however, that "this sense is *colloquial*." At the present day it is often used in *writing*. "Every proposition made in your parliament to remove the original cause of these troubles by taking off taxes *obnoxious* for their principle or their design, had been overruled." *Burke's Fourth Letter on the Regicide Peace*. "While, therefore, the Church of Rome declares any mitigation of her most *obnoxious* doctrines to be impossible," &c. *Quart. Rev.* Jan. 1814, p. 421.

OCCASION. Dr. Witherspoon ranks the following use of this word among the "local phrases and terms" of New England: "Shall I have *occasion*, i. e. opportunity to go over the ferry." I never heard it used in this sense, but it is often used for *need* in this manner: I have no *occasion for* it.

OCCLUSION; a shutting up, closing. "The *occlusion* of the port of New Orleans by the Spaniards was calculated to give general alarm through the United States." *Letter of President Jefferson to Gov. Garrard, Dec.* 16, 1802.

This word has been often noticed, and ridiculed, by the English, as if it was a word in general use in America; which is by no means the case. Some few persons in this country, however, whose writings have reached England, have made use of it; but, though this may be a reasonable ground with an Englishman for presuming it to be one of our common words, yet the peculiar opinions of a few individuals can no more make a *usage* here than in England; and this very word has been the subject of as much ridicule in this country, as it has been there. Some persons have supposed that *occlusion* was used for the first time in this country in the letter above quoted; but this is not the fact. It was used many years before that, in Dr. Ramsay's *History of the American Revolution*, (published in 1789) vol. i. p. 103. "He had also hoped, that the prospect of advantage to the town of Salem, from its being made the seat of the custom-house, and from the *occlusion* of the port of Boston, would detach them from the interest of the latter," &c. In the *London* edition of the work, this word, being doubtless new to the English editor, was probably supposed to be an error of the press in the *American* copy, and it is accordingly changed into a word resembling it in sound, and which would occupy the same space in the page, the word *ex-clusion*. *Occlusion* is in the dictionaries.

OFFSET. This is much used by the *lawyers* of America instead of the English term *set-off;* and it is also very common, in popular language, in the sense of an *equivalent:* "The expense of the frigates had been strongly urged, but the saving in insurance, in ships and cargoes, and the ransom of seamen, was more than an *offsett* against this item." *Marsh. Life of Washing.* vol. v. p. 529. It is not in the dictionaries.

OLD for *stale ;* in this expression, *old bread. New England.* From the following extract this seems also to be a *Scotticism.* "The Scotticism *old bread* seems no way inferior to the Anglicism *stale bread.*" London *Monthly Magazine*, *Apr.* 1800, p. 239.

ONCE IN A WHILE. Dr. Witherspoon has put this among the "local phrases and terms" of the *Middle States :* "He will *once in a while*, i. e. *sometimes* get drunk." *Druid*, No. 7. It is often used in New England.

ONTO. A writer in the Cambridge *Literary Miscellany* (vol. ii. p. 217) proposes this as a *new* preposition in our language, to be used in such phrases as these : "An army marches *onto* the field of battle ; a man leaps *onto* a fence," &c. In the examples, however, which he gives, there seems to be no need of any thing more than the old simple prepositions, *on*, *upon*, or *to.* The vulgar, indeed, constantly say *on-to*, or *onto ;* nor is it, as this writer supposes, a *new* term in *writing.* A friend has referred me to the works of Mr. Marshall, the well known English writer on Agriculture, who uses it ; but he frequently divides it into its two parts, *on* and *to.* "When the stack has risen too high to be conveniently forked *on to* from the ground," &c. *Rural Econ. Yorkshire*, vol. ii. p. 144, *London edit.* 1788. And in his *Gloucestershire* (speaking of the method of feeding cattle in Wiltshire) he uses the compound : "The hay is all carried *onto* the land upon men's backs," &c. vol. ii. p. 154, *and in other places.* But Marshall's works are written in the most *familiar* style ; and some of the English Reviewers have censured him for what they call (in one of his works) "a new-fangled language of his own." See *Brit. Crit.* vol. xxii. p. 93. I had supposed that *on to* had never beed used by any *American* writer; but an obliging friend has given me the following example : "Take all your cigarrs and tobacco, and in some calm evening carry them *on to* the common," &c. *Lecture on the evil tendency of the use of tobacco upon young persons, by Benjamin Waterhouse, M. D.* p. 32.

TO BE OPPOSED TO ; to oppose. "Several members were in favour of this motion, but others, who *were opposed to* receding from the ground already taken," &c. *Marsh. Life of Washing.* vol. v. p. 206, *et passim.* Dr. Franklin many years ago censured this use of the verb as an innovation. See the *note* on the word *Improve.*

ORGANIZE, ORGANIZATION; applied to political bodies. In the preface to the *London* edition of *Ramsay's History of the American Revolution*, these words are spoken of as American "additions" to the language: "Some of these additions (says the editor) we have ourselves received, as in the case of the words "organize and organization," when applied to political bodies." p. vi.

To ORIGINATE, *v. a.* "To bring into use." *Johns.* The use of this as an *active* verb has been thought by some persons to be peculiar to this country; but this is not the case. It is perhaps not so common with *English* as with *American* writers, but it sometimes occurs in their works. One of the English Reviews thus mentions it among the "few blemishes in language" of a work entitled *Discourses on various subjects, by the Rev. Robert Gray*, author of the *Key to the Old Testament:* "We object to the word *originates* used actively." *Brit. Critic*, vol. i. p. 95.

It is very common with *American* writers: "Bartholomew Gosnold, who had *originated* the expedition." *Marsh. Life of Wash.* vol. i. p. 33. In the *London* quarto edition of Judge Marshall's work this expression is changed into—"who had *planned*," &c.

OVER for UNDER; *used in these expressions:* He wrote *over* the signature of Junius. He published some papers *over* his own signature.

A few of our writers still countenance this unwarrantable innovation; but the principle, on which it is defended, would unsettle the whole language. The use of the word *under* in phrases like the above, is as well established as any English idiom. As it has, however, been questioned, and some writers appear to be serious in their conviction, that it is incorrect to use *under*, it seems necessary to give the subject a brief consideration.

Mr. Coleman, the able editor of the New York Evening Post, has repeatedly exposed this "piece of affectation" (as he justly calls it,) and produced the following authorities from Dr. *Johnson* and from *Junius:* "The attention paid to the papers published *under* the name of 'Bickerstaff' induced Steele when he projected the 'Tatler' to assume an appellation which had already possession of the reader's notice." *Johnson's Life of Swift.* "I admit the claim of a gentleman who publishes in the Gazette *under* the name of *Modestus*." *Junius's Letters*.* But neither the arguments nor the authorities produced by Mr. Coleman seem to have convinced all the advocates of this *new* phraseology; for some of them imagine that in one case, at least, it is necessary. They observe, that where a writer assumes a *fictitious* name, we may say, *under the signature*, because some *disguise* or concealment is implied; but that where he signs his true name, we should say, *over* his signature. But what difference is there in reality between the two cases? The advocates of *over* contend that they are right in the use of that term, because the *writing* is placed *over* or *above* the name of the *writer*; but this is equally true in the case of a *fictitious* and a *real* signature. It is, indeed, a sufficient answer to them, that in *practice*, among the few writers who have adopted *over*, this distinction *is not observed*, but they use the term in both cases indifferently. But, after all, the question is a simple *question of fact—what is the practice of the best English writers?* Now it is so well known to be their invariable practice (and I may add, the practice of *our* best writers) to say *under* a name, and *under* a signature, that it will perhaps hardly be credited by English scholars, that any persons who pretend to speak the English language, could have questioned the propriety of it. To the authorities cited by Mr. Coleman I will subjoin only two or three others: "The first works which were published *under* my name," &c. *Dedication of the Tatler*. "I really doubt whether I shall write any more *under* this signature." *Private Letters of Junius to Mr. Woodfall*, No. 5. In the late edition of *Junius* by Woodfall (published in 1812) the expression *under the signature* is continually used: the very title page begins thus: "Junius, including Letters by the same writer *under* other signatures;" and in the *Advertisement and Preliminary Essay* to this edition the phrase occurs in almost every page.

....

* See the *New York Evening Post* of March 15, and Nov. 22, 1803. A writer in another newspaper, who adopts the signature of *The Good Old Way*, ironically closes his remarks upon this "awkward and absurd term," as he styles it, by thus employing *it* for *under*—"Given *over* my hand and seal," &c. *Salem Gazette*, Apr. 2, 1813.

P.

PACKET. To the usual definition of this word, *a vessel that carries letters*, Mr. Webster adds, "In *America*, a coasting vessel for *passengers*." A writer in the *Monthly Anthology*, (for Oct. 1809, p. 262) treats this (among other instances) as "an idle attempt to exhibit a distinction" between the English and American significations. The word seems, indeed, to be applied in England to vessels employed for carrying *passengers* and *letters*. The term *packet* has been considered as an abbreviation of *packet-boat*, which Entick and other English lexicographers define, "a boat for *advice* or *passengers*;" and this definition of *packet-boat* is adopted by Mr. Webster.

To PACKET. "To ply with a packet." *Webst.* I have never known this verb used in *America*; nor is this signification given in the English dictionaries. It is probably a *local* use of the word.

PAPPOOSE, *(accented on the last syllable,)* "the Indian name of a child." *Webst.* Hence, as some have supposed, the vulgar expression of carrying any thing *a-poose back* (for *pickback* or *pickapack*,) from the custom among the Indian women of carrying their children, or *pappooses*, on their backs. The term *pappoose* is only used in speaking of *Indian* children.

To PARADE; "to assemble and arrange, exhibit." *Webst.* Used in speaking of drawing up troops. *Ex.* The general *paraded* his troops at such a place. This verb is not in the *English* dictionaries, and I do not recollect hearing it used by *Englishmen*.

PARAGRAPH. Mr. *Kendall* (Travels, vol. i. p. 31.) after quoting a *Connecticut* writer, who speaks of the *paragraphs* of one of the laws of that state, makes this note upon the word: "By *paragraphs* is intended *sections* or *clauses*."

PARTLY; nearly, almost. A friend informs me that this word is thus used in some towns of the *Middle* States: His house is *partly* opposite, *i. e. nearly* opposite to mine. Dr. Witherspoon has taken notice of this word, and gives the following example: "It is *partly* all gone; it is *mostly all* gone. This (he remarks) is an absurdity or barbarism, as well as a vulgarism." *Druid*, No. 6.

PASSAGE; a passing. Used in speaking of the *passing* of laws. *Ex.* "Before the question was taken on the *passage* of the bill," &c. *Marsh. Life of Wash.* vol. v. p. 344. "The opinion....derived additional support from the *passage* of an act by the present Congress," &c. *ibid.* p. 510, *et passim.*

This use of the word *passage* is now very common in Congress and our other legislative assemblies, and has been adopted by many of our writers. It is criticised by the English Reviewers as an American innovation. See the *Annual Review, article, Marshall's Life of Washington.*

To PEAK or PEEK; to peep. A friend informs me that this word is very common in the towns on Connecticut river; but it is only used in conversation. The participle *peaking* also, he informs me, is used there for *sneaking*, as it is in *Shakspeare:* See *Johnson's Dict.* Mr. *Webster* has observed that *peek* is "used *corruptedly* for *peep.*" See his *Dissert. on the Eng. Lang.* p. 387.

PECULIARS. "All *peculiars*, viz. such places as are not yet layd within the bounds of any town." *Massachusetts Colony Laws*, tit. CHARGES PUBLICK; p. 15. Edit. 1660. This word is now so wholly obsolete with us, that I have heard even lawyers ask the meaning of it.

To PEEK. See *To Peak.*

PENDING. This is criticised as *obsolete*, in the review of *Mashall's Life of Washington* in the *Monthly Anthology*, vol. v. p. 438. It is rarely heard in this country except at the Bar.

PERK; "lively, brisk, holding up the head." *Webst.* This word is in *Johnson*, but is marked "*obsolete.*" It is used in the interior of New England, and is commonly pronounced *peark*, (the *ea* as in *pear*) just as it is written in the passage which Dr. Johnson quotes from *Spenser.*

PIECES; papers. The *Edinburgh Reviewers*, in their review of the American Mineralogical Journal, (published at N. York in 1810 by A. Bruce) make the following remarks upon an article in that work written by Dr. Mitchell: "The two first words of it bespeak a foreign idiom, characterizing, as might be expected, the Anglo-American language in which this Journal is written. The author begins by saying, 'These *pieces* were collected during a tour in the summer of 1809;' and soon afterwards describing a specimen of black flint, he adds, 'such as abounds in the Seneka *prairies*.' *Edinb. Rev. Nov.* 1810, p. 115.*

This *Gallicism* is not in common use here; but it has been adopted by some American, as it also appears to have been by some English writers: "I received this moment your letter....with the enclosed *pieces* relative to the present dispute between the king and the parliament." *Chesterfield's Letters*, No. 244.

PLEAD; for pleaded. This is in constant use, in the *colloquial* language of the *Bar* in New England; but the verb *to plead* is a regular verb, and in *England* the regular form *pleaded* seems to have been invariably employed for centuries. "He *pleaded* still not guilty." *Shakspeare, as cited by Dr. Johnson.* It is also used in the common version of the Bible. "There I will plead with you, face to face, like as I *pleaded* with your fathers in the wilderness." *Ezek.* xx. 35, 36; *and in various other places.* "Formerly the general issue was seldom *pleaded*." "Every defence which cannot be thus specially *pleaded*. 3 *Blackst. Com.* 305.

This word is noticed as an "inaccuracy" in the *Monthly Anthology*, for Feb. 1808, p. 109. and as an *Americanism* in the *Port Folio*, for Oct. 1809.

POND. "The soil and surface consist in a continuity of hills or downs of sandy loam with valleys and hollows that contain small streams, and lakes, or pools, in New England always denominated *ponds*." *Kendall's Trav.* vol. ii. p. 39.

POPULATED; peopled. "A thinly *populated* country." Very rarely used in America.

* The reviewers add to the remarks above quoted the following: "Other examples, proving the alteration to which our language has been exposed, chiefly by the introduction of *Gallicisms*, may be noticed in the rest of the Journal; resembling expressions found in American newspapers, where for '*a ship taken*' we read of '*a ship captivated*.' I presume this is not intended to be given seriously as a real specimen of the style of American newspapers, but (if the expression may be used) as a *caricature*; for I never saw the word *captivated* thus applied, even in our newspapers. We say "a ship *captured*" as the English do, but perhaps we make more use of this expression than they do.

PORTAGE. A *carrying place* by the banks of rivers, round waterfalls or *rapids*, &c. In this sense the word is very common, and has been thought necessary, in this country. In the following example it is used in a manner not common with American writers: "These re-inforcements could not arrive with the necessary quantity of provisions and other supplies, because the river La Bœuf....did not admit of their *portage* down it." *Marsh. Life of Wash.* vol. ii. p. 16.

PRAIRIE. A French term, which has been much used of late by American writers, to designate those remarkable meadows or plains which are described by travellers in Louisiana. Mr. Webster writes it *prairy*, and defines it "a natural meadow, or a plain naturally destitute of trees." None of our writers, that I recollect, have adopted this orthography. The word *prairie* is censured by the British reviewers, as a Gallicism. *See the word* Pieces.

PRAYERFUL; PRAYERFULLY. *Ex.* In a *prayerful* manner; may we be *prayerfully* disposed. This is used by some of the clergy; but it is not very common. It is not in any of the dictionaries.

PRAYERLESS; "not praying, not using prayers." *Webst.* I have never known this word to be used here. It is not in the English dictionaries.

To PREDICATE; to found. "Being *predicated* on no previous proceedings of the legislature." *Marsh. Life of Wash.* vol. v. p. 408. "It ought surely to be *predicated* upon a full and impartial consideration of the whole subject." *Letter of Hon. J. Q. Adams*, p. 5. Upon this passage the Editor of the New York Evening Post remarks: "The *predicate* is that which is affirmed of the subject of a proposition; it is here used as synonymous with *founded*."

This use of the verb *predicate* is very common with American writers, and in the debates of our legislative assemblies.

PRESIDENTIAL; "pertaining to a President." *Webst.* This is mentioned by a writer in the Monthly Anthology as "one of the *barbarisms* in common use" among us. *English* writers have sometimes used it, but only in speaking of *American* affairs: "The friends of Washington had determined to support Mr. Adams as candidate for the presidential chair," &c. *Quarterly Rev.* Jan. 1814, p. 497.

PROFANITY. This noun is in common use here, more particularly (as a clerical friend once observed to me) with the clergy. It is not in the dictionaries, and I do not recollect ever meeting with it in English authors: they continue to use the word *profaneness*. "We now see them turn their arms with unimpaired vigour against vice and *profaneness*." *Warburton*, as cited in *Knox on Education*, vol. ii. p. 274. This word was also used here from the first settlement of the country till the period of the Revolution.

To PROGRESS. This obsolete English word, which (as I have been informed) was never heard among us before the Revolution, has had an extraordinary currency for the last twenty or thirty years, notwithstanding it has been condemned by the English critics, and by the best American writers. The use of it in Judge *Marshall's Life of Washington* has been censured by some of our critics (see Monthly Anthology for August 1808); and a well known *English* Review, in noticing the same work, thus speaks of this verb: "We object to the continual use of the word *progress* as a verb; we are aware that authorities may be found for it in English writers, but such use had fortunately become obsolete till the American revolution revived it." *Annual Rev.* vol. vii. p. 241. It is true that *some* authorities may be found for it in English writers, and it is accordingly in *Johnson's* and other dictionaries; but *Johnson* has marked it as "*not used*." It seems also, that the accent was formerly placed on the *first* syllable, and not (as we pronounce it) on the *last*:

> "Let me wipe off this honourable dew,
> That silverly doth *prógress* on thy cheeks."

Dr. Franklin condemned the word many years ago. See the *Note* on the word IMPROVE.

PROVEN; proved. This is often heard in the debates of Congress, and is sometimes used by writers in the *Southern* States; but it is unknown in *New England*.

PROVINCIALISM. This has been censured by some American writers as an unauthorized word. But it is certainly in common use in England, though it is not to be found in the dictionaries. The English reviewers use it.

PROXIES. This word is thus noticed by Mr. *Kendall*, in his Travels, vol. i. p. 32. "The written votes or ballots, which through a mistake, or else abuse of terms, the statutes occasionally call *proxies*." This use of the term *proxies* is unknown, I believe, in any other state than *Rhode Island*, and, perhaps, *Connecticut*.

PUBLISHMENT; an official notification, made by the clerks of towns in New England, of an intended marriage. The term is in common use in most parts of New England, and is also adopted in some of their laws. "Any persons desiring to be joined in marriage shall have such their intentions published...or posted up by the clerk of such town; and a certificate of such *publishment*....shall be produced as aforesaid previous to their marriage." *Massachusetts Stat.* June 22, 1786. In England they use the word *publication* of the banns: "Marriage must be preceded by *publication* of the banns." *Rees's Cyclop.* v. MARRIAGE.

PUNK; rotten wood, touchwood, spunk. A friend has mentioned this to me as one of our corruptions of the English language. The word is in common use in many, if not all parts of New England, but it is not to be found in this sense in any of the dictionaries. Ash, however, in the Supplement to his dictionary, has the following signification of it: "—a kind of fungus often used for tinder;" but Bailey gives this meaning to the word *spunk*. Mr. Webster has *spunk*.

R.

RACKETS; (used in the *plural;)* a common term in some parts of New England, for the same things which in other parts are called *snow-shoes*. They are called *rackets*, no doubt, from their resemblance to the rackets used in playing tennis.

RAFTY; damp and musty, rancid. I have heard this word used by old people in New England. It is an English *provincial* word: "*Rafty;* damp and musty, as corn or hay in a wet season." *Marshall's Rural Economy of Norfolk.*

To RAISE. In *New England* the farmers commonly say *to raise* corn, wheat, &c.; but in England at the present day they say, *to grow* corn, &c. and this expression is now getting into use in this country. This verb, and the noun *Growers* (which, according to the English writers, is "a term *provincially* applied to farmers,") seem to be a part of the *technical* language of the agriculturists. Dr. *Johnson* calls *grow* a verb *neuter*, and his *twenty-first* signification of *to raise* is, "to procure to be bred or propagated;" one of his examples is this, "he *raised* wheat where none grew before." *Ash*, whose dictionary is the only one in which I find *to grow* as a verb *active*, says, it "is a colloquial word;" but, at the present day, it is certainly used by the agricultural writers of England.

In some of the *Southern* States they also use the verb *to raise* in this manner: I was *raised*, i. e. *brought up*, in such a town. The word is never thus used, I think, in the *Northern* States.

This verb is also much used in our legislative assemblies in the following manner: A member moves, that a committee should be *raised* to take any particular subject into consideration; and a committee is accordingly *raised*. The English say, in parliamentary language, a committee was *formed* or *appointed:* "Earl Liverpool moved that a committee of twenty one Peers be *appointed* by ballot to examine the Physicians on the state of His Majesty's health," &c. *Debates in Parliament*, *Jan.* 9, 1812; and "The usual committees were *formed*." *Report of debates in London newspapers.*

RAPIDS *(of a river; commonly used in the plural;)* "a part of a river where the water is rapid over a moderate descent." *Webst.* The following description of the *rapids* of the river Ohio will further explain the term: "They are occasioned by a ledge of rocks that stretch across the bed of the river, from one side to the other, in some places projecting so much that they are visible when the water is not high, and in most places when the water is extremely low. The fall is not more than between four and five feet in the distance of a mile," &c. *Imlay's Topograph. Descript. of the Western Territory of the U. States*, p. 51, 2d edit.

RAW SALAD. *Dr. Witherspoon* makes the following remarks on the expression: "*Raw salad* is used in the South for *salad*. N. B. There is no salad boiled." *Druid*, *No.* 7. I do not know whether this expression is used in the Southern States at the present day or not: It is not used, I believe, in New England.

RECIPROCITY. This word has been remarked upon, by some of our writers as "hardly admissible." See *Month. Anthol. for* 1806, p. 102. It is not noticed by any of the lexicographers but *Walker* and *Mason*, the latter of whom cites a *law* authority in support of it: "Any degree of *reciprocity* will prevent the pact from being nude." *Blackstone*. But it seems to be used by *English* writers; perhaps, however, it is mostly used by them in those political and other discussions which admit of a kind of language approaching to the *legal* style: It is often used in the *diplomatic* style. *Walker* has inserted it in his dictionary without informing the reader that it is a new word, as he usually does in such cases.

REDEMPTIONER; "one who redeems himself by services, or whose services are sold to pay certain expenses." *Webst.* This term is used in the *Southern* States generally to designate the Germans, Irish, and other Europeans, who emigrate from their own country to the United States, and sell their services for a term of time to pay their passage money and other expenses.

REFERENCE. The frequent use of this word in the following manner is noticed by a late English traveller among the "quaint expressions" peculiar to Americans: "Has the embargo act *progressed* in Congress? Which have you *reference* to?" *Lambert's Travels*, vol. ii. p. 506.

RELEASEMENT. The use of this word in *Bancroft's Life of Washington* is censured by some of the English reviewers. See *British Critic, vol.* xxxv. p. 182. It is very rarely used by American writers. I do not find it in any of the English dictionaries except *Bailey's* and *Ash's*, and it is unquestionably obsolete. I never met with it in any work printed in England, except once accidentally in the *Index* to *Smollet's History of England (Lond. edition of* 1796*)* in this article; "Murray Hon. Alexander—procession at his *releasement* from Newgate."

RELISHES. "About eight or nine in the morning they breakfast on tea and coffee, attended always with what they call *relishes*, such as salt-fish, beef-steaks, sausages, broiled fowls, ham, bacon, &c. *Priest's Travels in the U. States of America.*

To RELOAN; "to lend a second time." *Webst.* See *To Loan.*

To RELUCT. This word is censured, in a review of *Bancroft's Life of Washington* in the *Monthly Anthology* vol. iv. p. 666. Most of the dictionaries have it; but it is seldom used by American writers.

REMOVE. *n.* "At an infinite *remove.*" *First Ripe Fruits, being a Collection of Tracts, &c. by the Rev. John M. Mason, New York*, 1803. The English Reviewers quote the above expression as an example of what they call the "*occasional vulgarisms, possibly Anglo-Americanisms,*" of Dr. Mason's work. See *Review*, in the *Christian Observer*, v. ii. p. 564.

RENEWEDLY; anew, again. This word is often heard from the pulpit. It is not in the English dictionaries.

REQUIREMENT. This is sometimes, though rarely, used in America. I do not find it in any of the English dictionaries, except *Bailey's*, *folio* edition.

RESEMBLAGE. This has been criticised by some of the English reviewers of *Marshall's Life of Washington*, as an instance of the "incorrect language" of that work; the reviewers evidently considering it as the *American* word for *re-assemblage.* See *Annual review*, v. vii. p. 241. But they have, in this and several other instances, been misled by the incorrectness of the *English* editions of Judge Marshall's work. In the present instance, the *American* edition has *re-assemblage* which the reviewers themselves propose as the substitute.*

* The London *octavo* edition of this work (if we may judge from the examples given in the Annual Review) must be grossly incorrect; for of the *thirteen* instances which the reviewers give of *American* inaccuracies in language, several are errors of the *English press.* The word *infected* for *un*-infected has been already mentioned Another instance occurs in vol. ii. p. 551, London *octavo*, edit. [p. 479, Amer. ed.] where the reviewers suppose the author uses *patrole* for *parole.* But the London *quarto*, and the *American*, editions both have *parole.* No American would confound these two words. A *typographical* error also in the name of Dr. Robertson (which in the London *octavo* edition, it seems, is printed *Robinson*, though the *quarto* has *Robertson*) and an inadvertence on the part of the author, in giving that distinguished historian the title of *Mr.* instead of his usual one of *Dr.*, are made the subject of an unmerited degree of ridicule. In the *American* edition, the name is correctly printed. We have enough *corruptions* of our own to answer for, without being responsible for those which the English printers make for us. We should never, I trust, be so wanting in candour, as

RETORTIVE. This is called "a new word" in an American review of *Barlow's Columbiad.* See *Monthly Anthol.* v. vii. p. 117. I presume no other American author ever used it.*

ROCK. This is much used in *New England* instead of *stone*: We often hear the phrase *heaving rocks*, for *throwing stones.*

To ROIL.; "to render turbid by stirring up lees; to disturb the mind and excite anger." *Webst. New England.*

This verb is often used, in *conversation*, in the first of these senses, by people of all ranks; but the *second* sense is confined to the vulgar. I do not find it in the dictionaries, with either of these significations. *Grose* has it as a *provincialism* thus: "*Roil* or *royle;* to perplex, fatigue. *North.*"

ROILY; turbid, thick.

ROMANTICALLY. This is ridiculed in the *Monthly Anthology* for 1806, p. 92. as "an *Indianism.*" It is not in use in this country. I have, in one instance, met with the still more extraordinary word, *romanticity.*

RUGGED; hardy, robust. *New England.* Englishmen remark upon our use of this word in conversation in the above sense, as one of our peculiarities. Thus we often hear the expression, a *rugged*, i. e. robust boy.

RUN, *n.* "A small stream," *Webst. New England.* This is sometimes used in conversation, but not in writing. The English dictionaries do not give this sense of the word: Most of them, however, have *runnel*, which *Johnson* defines "a rivulet, a small brook;" but *Walker* says this is "little used:" I may add that in *America* it is never used.

RUNGS, *n. plur.* A very common name in New England for the *rounds* or steps

....

to charge these reviewers with ignorance because they have in this very review given our countryman Minot the name of *Minor.*

* Mr. Barlow has used a great number of words which no other American writer perhaps would have ventured to employ. Many of them have been condemned in the *Edin. Review*, vol. xv. p. 28, and by almost every one of Mr. Barlow's own countrymen. As these words may, with the strictest propriety, be said to be peculiar to Mr B. and will probably never be used again, I have thought it unnecessary particularly to mention them.

of a ladder. *Grose* gives it as a *provincial* word of the North of England, and *Ash* also calls it "a local word." The braces or *rounds* of common chairs are also called *rungs*. The word has generally been considered here as a mere corruption of *rounds*, and people of education use only this latter word.

S.

SABBATH. "On Sunday, or as it is here [in *New England*] uniformly denominated on *Sabbath*, I accompanied an entire family to church." *Kendall's Trav.* v. i. p. 115.

To SAG; to sink, or settle. An English friend has pointed out the use of this old word, as one of our peculiarities. It is in the dictionaries, but *Sheridan* and *Walker* say "it is not in use." It is used here in *Johnson's* first signification of *to swag*, that is, "to sink down by its weight;" and it has, I think, been generally considered as a mere corruption of that word.

SALAD. See *Raw Salad.*

SALT LICK. See *Lick.*

SAMP; "maize broken coarse, boiled and mixed with milk, &c." *Webst.* An *Indian* word.

SAPPY; "full of sap, *jucy*, young, *simple.*" *Webst.*

An American reviewer of Mr. Webster's dictionary, observes—"We never saw this word but once used in this *last* sense." *Monthly Anthol.* vol. vii. p. 263. Mr. Webster, however, in admitting this signification of the word has only followed *Entick's* dictionary, of which his own is "an enlargment and improvement."* The same signification of the word is also given in *Perry's* and *Dyche's* dictionaries, but I have not found it in any other. It is universally considered here as a low word, in this sense, and is not very often heard even in the most familiar language of conversation.

SAT for SET. *Ex.* "I *sat* out yesterday morning, for I *set* out." This is not, as some have supposed, peculiar to this country. *Lowth*, in commenting on the use of these two verbs in English works, observes, that "*set* can

* See *Preface* to Mr. Webster's Dictionary, p. xix.

be no part of the verb *to sit*;" (see his *Grammar, Irreg. Verbs)* and Dr. *Witherspoon* classes the example above given, among his "Vulgarisms of *England* and America." *Druid, No.* 6 I do not, however, recollect seeing *sat* ever used for *set* in any *English* publications of the present day, not even in the newspapers; and in *America* this error is much less common now than it formerly was; for though it is still heard in conversation, it is not often to be met with in writing.*

SAUCE. A *general term* among the country people of New England for all the common esculent vegetables. Hence those farmers, who supply the markets with vegetables, are sometimes called by their brethren, *sauce-marketers.* The term *sauce* is sometimes used "more strangely" (to adopt the words of an English friend) to signify *impertinence.*

In some parts of *England* (as the same friend informs me) the term *garden-stuff* is used as a general name for vegetables, and *Ash* accordingly has that term; the other English lexicographers have *garden-ware.*

SCOW; "a *large* flat-bottomed boat." *Webst.*

In some parts of the United States it is called a *gondola* (*which see.*) The word *scow*, says another American writer, is properly an American word, made from necessity to signify a *small* flat-bottomed boat, which is used only in America, and is just as good a word as the *track schuyts* of the Dutch. *Port Folio, New Series*, vol. vii. p. 328.†

SEA-BORD or SEA-BOARD; "towards the sea." *Bailey.*

This nautical term is often heard in conversation, and is sometimes used in writing. I do not find it in any of the English dictionaries except *Bailey's*, *Ash's*, and *Mason's Supplement to Johnson*: and it is doubtless out of use in England, except among sea-faring people. There is some difference of

* This gross inaccuracy has not escaped the ridicule of our own writers. The following laconic paragraph (among others) appeared a few years ago in a periodical publication:

"Why do so many persons write "*Sat out in* a coach." or "*sat* out *on foot.*

SAT VERBUM."

† Mr. Webster's definition agrees best with the *scows* or *gondolas* of the *Northern* States, which are strong built, heavy boats, about 30 feet long and 12 feet wide.

opinion among the lexicographers as to the *orthography* of this icrm, and *what part of speech* it is. *Bailey* writes the last syllable of it *with* an *a*, Sea-*board*; *Ash* copies Bailey's orthography, as well as his definition, and calls it an *adverb*. *Mason* writes it without the *a*, sea-*bord*, and calls it an *adjective*. His authority is *Spencer*, who, however, according to Horne Tooke, is one of "the worst possible authorities for English words :"

" SEA-BORD. *adj.* Bordering on the sea.

> There shall a lion from the *sea-bord* wood
> Of Neustria come roring.
>
> *Sp. F. Q.* B. III. c. iii. st. 47.
>
> The watry South-winde from the *seabord* coste
> Up-blowing doth disperse the vapour loste.
>
> *Ib.* c. iv. st. 13."

Mr. Webster has it as an *adjective* (adopting *Mason's* definition), and also as a *noun*, which he defines—" the shore or edge of the sea." He writes it Sea-*bord*.

The term *Land-board* I have never met with in any instance but the following, either in writing or conversation: " The position and circumstances, of the United States leave them nothing to fear on their *land-board*, and nothing to desire beyond their present rights. But on their *sea-board* they are open to injury," &c. *Report of the Secretary of State* (Mr. Jefferson) *on Commercial Restrictions &c. Dec.* 16, 1793.

SECTION. Since the French Revolution this word has been much used here instead of *part*, *quarter*, &c. *Ex.* " In this *section* of the United States." It is not in general use in England.

SECTIONARY; (*from the preceding noun*) belonging to a *section* of a country, or local. I have never met with this extraordinary word except in the following instance : " This veneration arises not from a little and selfish spirit of *sectionary* attachment." I have once also met with *sectional*.

SEE for SAW, (*preterite of to see.*) " I *see* him yesterday, or *see* him last week ; for I *saw* him. In Scotland the vulgar say, I *seed* him last week." *Withersp. Druid*, No. 6. This is never used except in the language of *conversation*, and at the present day is only heard among illiterate people.

SERIOUS. "*Serious*, has [in New England] the cant acceptation of religious." *Kendall's Trav.* vol. i. p. 323. *not.*

SEWENT : *See Suant.*

SHEW for SHEWED or SHOWED ; *pret.* of *to show*. *Ex.* "I *shew* it to him yesterday."

Several years ago this corrupt preterite was very common in New England, but it is now much less used than formerly.

SHOTE ; a young hog. *New England.* This is a *provincial* word in England. *Ray* in his *South and East Country words*, under the word *Sheat* says "A *Sheat* a young hog : *Suffolk*. In *Essex* they call it a *Shote* ; both from *Shoot*."

SIR. The words *Sir* and *Ma'am* are used in some parts of New England for *Father* and *Mother*, and for *Master* and *Mistress*. But they are not so common now as they were some years ago. At our colleges also, the Bachelors of Arts have the appellation of *Sir*, as in England they have that of *Dominus*.

SIRS ; *pl.* of SIR. One or two attempts have lately been made in this country to revive this antiquated plural, but they have been unsuccessful.

To SLAM ; *used in this expression* ; To slam to a door ; that is, to shut it with violence.

The common use of this low word is a subject of remark with Englishmen. It is not, however, peculiar to this country ; but in England, (according to *Grose*) it is a *provincialism*. I do not find this use of it in any of the dictionaries, except *Ash's*, *Barclay's*, *Perry's* and *Entick's* ; and *Ash*, in his Supplement, does not note it as *local*, or *provincial*, but only as "a colloquial word." Mr. Webster adopts Entick's explanation of it. English writers sometimes put it into the mouths of low characters in plays and novels.

SLANG-WHANGER. The *Monthly Reviewers*, in their account of he *English* edition of the well known American work called *Salmagundi*, have the following remarks on this term :

"When, for instance, he [the editor] tells us that '*Caucus*' (an assembly) is the only *American* word that he has found in these volumes, he evidently forgets the favourite compound term '*slang-whanger*' (*a newspaper-writer*) which occurs in almost every page; and indeed many more vulgarisms, or at best *provincialisms*, which we forbear to mention, but hope we may not see repeated in similar compositions," &c. *Month Rev.* vol. lxv. p. 429.

This word, which is of very recent origin in America, does not denote merely a "*writer*;" it also means a noisy *talker*, who makes use of that sort of political or other cant, which amuses the rabble, and is called by the vulgar name of *slang*. It is hardly necessary to add, that this term (as well as *slang-whanging*) is never admitted into the higher kinds of writing, but like other cant words, is confined to that familiar style which is allowed only in works of humour.

To SLAT; to throw down with violence, to dash against. *Ex.* "He *slat* the book down upon the floor." *A low word*, used only in conversation. It is an English *provincialism*, and is not in the dictionaries. *Ray* has it among his *North Country Words* thus: "To slat on, to leck on, [pour on] to cast on, or dash against. Vox *ονοματοπ.*" *Mason* adopts it from *Ray*, and adds an authority: "To slat, *v. a.* to dash. *Slatted* his brains out, then soused him in the briny sea. *Marston's* Malcon." Those people, who use it here, do not make the preterite *slatted*, but *slat*. It is not in Mr. *Webster's* dictionary.

SLEIGH; a carriage for travelling on the snow.

Mr. *Kendall*, after mentioning this word in his Travels (vol. iii. p. 119) has this note upon it: "A *local* name for *sledge*, learned of the Dutch colonists." Mr. Webster writes it *Sley*; and a reviewer of his dictionary has the following remark on the word:

"*Sley* being a vehicle in common use with us and unknown in England, has a claim, we confess, to a place in an English dictionary; but we insert it here to remark, that we have commonly, we believe always, seen it spelled *sleigh*" *Month. Anthol.* vol. v. p. 429.

SLIM; ordinary, mean. *A low word.*

Ray has *slim*, among his *North Country Words*; but says, that "its a word generally used [in Lincolnshire] in the same sense with *sly*." *Johnson* says, that even in its usual sense (i. e. *slender*) it is "a cant word, as it seems, and therefore not to be used;" though *Mason* is of opinion, that "*Addison's* using it may be deemed a sufficient reply to the supposition of its being *cant.*"

SLOSH or SLUSH. (*The first orthography is most conformable to the common pronunciation*). *A low word.* This term, and its derivative *sloshy*, (or *slushy*) are often used by the people of New England, in speaking of the state of the roads when they are covered with snow and a thaw takes place. It is very common to hear people say—The roads are *sloshy*; it is very *sloshy going*, &c. It is not in any of the English dictionaries; but all of them, I believe, except Bailey's, have the word *sludge*, and define it as Dr. Johnson does—"Mire, dirt mixed with water." *Grose* has *sludge* in the same sense, as a *provincial* term, peculiar to the *North* of England. (*Prov. Gloss.*) *Marshall* also has *sludge* among his Provincialisms of the *Midland Counties*; *sluss*, among those of *Norfolk*, and *slush* among those of *Yorkshire*; and he defines them all nearly in the same words. Mr. *Webster* has *sludge*, but not *slush* or *slosh.*

To SLUMP; "to sink or fall into water or mud, through ice or other hard surface. *New England.*" *Webst.* A colloquial word. "This word (says a reviewer of Mr. Webster's dictionary) is certainly unworthy of a place in such a work." *Monthly Anthol.* vol. vii. p. 264.

This is an English *provincialism*: "To *slump*; to slip or fall *plum* down in any wet or dirty place." *Ray's North Country words.* This author has it also, with the same explanation, among his *South and East Country words*, where he observes that "it seems to be a word made *per onomatopœian* from the sound." *Grose* copies *Ray*, but considers the word *slump* as peculiar to the *North* Country, and says, that "in the *South*, *flump* is used in that sense." *Prov. Gloss.* The word *slump* is in *Bailey's* dictionary (where it is marked as a *North* Country word), but it is omitted by *Johnson* and the other modern lexicographers, except *Ash*, who has it with this remark, that it is "a *local* word."

SLUSH. See *Slosh.*

SOCIAL. "In Franklin Place apartments are occupied by the Boston *Social* Library, &c. By *social* is here intended *society*; for by a perversion of language the *society-libraries*, of which some account has been given in a former chapter, are so called." *Kendall's Travels.*

SOCIETY. Mr. *Kendall* has the following remarks upon the use of this word in the state of *Connecticut:* "I have used the words *society* and *church* [See *Member of the Church*] in senses new to most English readers.....A *society* is a community or corporation established, for the most part, for the two-fold object of religious worship and common schooling; but in some instances, for religious worship only.....Sometimes a town composes *one* society, sometimes it includes *two* or *more*.....So far the arrangements suppose *uniformity* of religious opinions; but if these jar, then the *society*, as to *church arrangements*, has no reference to *territorial* subdivision. Two or three societies may subsist in the same town; and while one neighbour belongs to one, the next may belong to a second. In like manner a *society* may be composed of portions of the inhabitants of two, three, or four towns, who severally disagreeing with their immediate neighbours unite themselves with each other; but, however societies may be constituted, as to matters of *religious worship*, the second object, that of *common schooling*, is always of a local nature; and towns therefore, uniformly consist of one or more *societies* considered as distinct." *Kendall's Trav.* vol. i. p. 106. In most parts of New England, however, the term *society* is not applied to those communities or districts which are established for the purpose of maintaining *schools*, for they are commonly called *school-districts*.

To SOLEMNIZE; to make solemn, or serious. This is frequently heard from our pulpits. It is not explained in this sense in the English dictionaries, but is sometimes to be found in English authors. An obliging friend has given me the following example: "It seems to have a good effect in *solemnizing* the minds of the hearers." *Letter of Lindsey*, quoted in *Belsham's Life of that writer*, p. 113, *not.*

SOME; Somewhat, something. *Ex.* He is *some* better than he was; it rains *some*; it snows *some*, &c. Used chiefly by the illiterate.

This is not so much used in the *seaports*, as in the *country* towns, of *New England*. It is also a *Scotticism:* "*Some* is very often used in the *North* for somewhat or something; as, He is *some* better." *Monthly Mag. for May* 1800, p. 323.

SPAKE; (preterite of *speak*). This antiquated word is sometimes heard from the *pulpit*, and I have in one or two instances heard it in *conversation;* but it is always remarked upon as a singularity. This, and the old preterites *sang*, *sprang*, *forgat*, &c. (as Mr. Webster justly observes) "are entirely obsolete in *ordinary practice*, whether popular or polite; and it seems advisable not to attempt to revive them. In addition to this reason for omitting them (he adds) there is one which is not generally understood. The sound of *a* in these and all other like cases was originally the broad *a* or *aw*; which sound in the Gothic and Saxon, as in modern Scotch, corresponded nearly with *o* in *spoke*, *swore*. *Spoke* is therefore nearer to the original than *spake*, as we now pronounce the vowel *a* with its first or long sound as in *sake*." *Philosoph. and Practical Grammar*. p. 117. *not.*

SPAN; a pair. Used in this expression: A *span* of horses. *New England.* I do not find this sense of the word in any of the English *dictionaries* nor in *Ray's* or *Grose's* Glossaries. The Germans say, a *span* or *gespann ochsen oder pferde*, a *team* (not exclusively *one* pair) of oxen or horses. From *span* we have, in some parts of New England, the term *span-shackle*, or *draft-iron* of a cart or plough.

SPELL. "A *spell* of sickness, a long *spell*, a bad *spell*. Perhaps this word is borrowed from the sea dialect." *Withersp. Druid*, No. 6. where the author is speaking of the "*Vulgarisms* of *America*."

SPRIGH or SPRY; "nimble, brisk, quick in action." *Webst. Mr. Webster adopts the latter orthography.*

This word is very common in New England, in *conversation.* A reviewer of Mr. Webster's dictionary observes, that it "is a word which has neither use nor dignity." *Month. Anthol.* vol. vii. p. 264.

I do not find it in any of the English dictionaries; but a friend informs me, that it is used "by the common people in *Somersetshire*," in England; and *Grose* has a word which is perhaps the same, though with a different orthography: "*Sproil*, lively, active. *West* [of England]" *Prov. Gloss.* Under this word he refers to the word *stroil*, which, he says, in the *Exmore* dialect, means "strength and agility."

SPUNK. This is frequently used here by the vulgar to denote *spirit* or *courage;* and the same class of people use it in *England;* but perhaps it is not so common there as here. *Walker* says, it is "used in *Scotland* for animation, quick sensibility."

To SQUALE ; to throw a stick, or other thing, with violence and in such a manner that it skims along near the ground. *New England.* It is *provincial* in England : "To *squale ;* to throw a stick, as at a cock. *West* [of England]." *Grose's Prov. Gloss.*

To SQUAT ; to squeeze or press. *Ex.* The boy has *squat* his finger. Used by the vulgar in New England. It is an English *provincial* word : "To *squat* ; to bruise or make flat by letting fall. *South.*" *Grose's Prov. Gloss.* The dictionaries have *to squash*, in the same sense.

SQUATTERS. A *cant* name in New England for those people who enter upon new lands and cultivate them without permission of the owners. "The large proprietor.....upon visiting his lands, finds his timber cut down and sold, and crops growing, houses built, and possession taken by a race of men (the settlers and *lumberers*) who, in this view, are called *squatters.*" *Kendall's Trav.* vol. iii. p. 160.

SQUAW ; an *Indian* woman. "The men make the poor *squaws*, their wives, do all the drudgery for them." *John Dunton's Journal*, in the *Collections of the Massachusetts Historical Society*, vol. ii. p. 114. *New Series.* "Squaws ; *woman :* Squaws-suck ; *women.*" *Roger Williams's Key into the language of the Indians of New England ; published in the Collec. Massa. Hist. Society*, vol. iii. p. 203.

To SQUIGGLE ; to move about like an eel. Used in some parts of *New England*, but only in very familiar conversation. It is often used *figuratively* in speaking of a man, who evades a bargain, as an eel eludes the grasp. I do not find this word in any of the dictionaries, or glossaries.

To SQUIRM ; to move about like an eel. *New England.* This is an English *provincial* word : "To move very nimbly about, after the manner of an eel. It is spoken of an eel." *Ray's South and East Country words*, and *Grose's Prov. Gloss.* It is in none of the dictionaries except Bailey's (*octavo* edition) and *Ash's*, in the latter of which it is erroneously printed *squirn.* It is never used here except in the most familiar conversation.

STAGE ; a stage-coach. *Ex.* I rode in the *stage ;* the *stage* is gone, &c. In *England* they never use the word *stage* by itself, but say, either the *coach*, or the *stage-coach.* We say, the mail-*stage ;* the English say, the mail-*coach.* The expression is analogous to *post-coach*, *post-chaise*, &c.

STAGING ; scaffolding. Used in New England, and, I believe, in other parts of the United States.

STALKS. See *Corn-stalk.*

To STARVE ; " to perish or kill with hunger ; (with cold ; *England.*)" *Webst.* " This [' with cold'] applies to *conversation* only." *Month. Anth.* vii. 262.

STEAL (pron. *stail*) ; the handle of various implements ; as, a *rake-steal*, a *fork-steal*, &c. Used by the farmers in some parts of New England. It is a *provincial* word in England : "The *steal* of any thing, i. e. *manubrium.* The handle, or *pediculus*, the foot-stalk : *à Belg.* steel, stele : *Teut. stiel, petiolus.*" *Ray's South and East Country Words.*

STOCKHOLDER ; a proprietor, in a Bank or other incorporated Company. The words *proprietor* and *member* are sometimes used here, but *stock-holder* is the most common. In *England*, when speaking of the *East India* Company, they uniformly say *proprietors* or *members* ; and the same words are also used in most other cases. Sometimes, however, the term *share*-holders is used. The word *stock-holder* is not in the dictionaries, nor do I recollect meeting with it in any *British* publication, except in the following instance, where it is used to signify the holders of the *public* stock or *funds* : " The *stock-holders*, who allow inferior capitalists to derive a profit from commission, will diminish that allowance." *Edin. Rev.* vol. iii. p. 475.

STORE ; a shop. " Here are several shops and warehouses, called *stores*, for the sale of foreign goods," &c. *Kend. Trav.* vol. i. p. 128. " A druggist's shop is sometimes called an *apothecary's store.*" vol. iii. p. 128. This word is used in the same manner in the British province of *Canada.* See also *Book-store.*

STRICKEN. This antiquated participle is much used in our legislative assemblies. A member moves, that certain parts of a bill should be *stricken* out, &c. It has long been considered as an *obsolete* word in *England* : Dr. *Johnson* many years ago called it " the *ancient* participle of strike." But some individuals in that country, as well as in this, occasionally use it. The latest instance I have seen is the following, from a *London* newspaper : " Many of the foreigners were much *stricken* with the splendour of the scene." *The Statesman of June* 10, 1814, *in the account of the* " *Court at Carlton House.*" Our own critics have all condemned the use of it, and I do not reccollect meeting with it in any of our best writers.

SUANT; even, regular. *Ex.* The grain is sown *suant.* Used in some parts of New England. It is an English *provincialism: Marshall* has it among his *Provincialisms of the* West *of England* thus: "*Souant*; fair, even, regular. (A hackneyed word)." *Grose* also has it, with only the change of *s* into *z*, which is common in that part of England: "*Zuant*; regularly sowed. The wheat must be zown zuant." *Prov. Gloss.*

SUBSCRIBER. "Letters signed by princes are a very uncertain test of the talents of (what by a very convenient American innovation is called) the *subscriber.*" *Edinb. Rev.* No. xli. p. 188.

SUCCOTASH; "a mixture of new soft *maiz* and beans boiled." *Webst.* An *Indian* word.

To SWAP. See *To Swop.*

SWEEP, *n.* The same thing which in *Yorkshire*, in England, is called a *swape*; that is, "a long pole turning on a fulcrum, used in raising water out of a well." *Marshall's Provincialisms of Yorkshire.* It is hardly necessary to observe that it is used only in our *country* towns.

To SWOP or SWAP. "To exchange, or, as they term it, *to swap*, are the pursuits in which they wish to be constantly engaged." *Kend. Trav.* vol. iii. p. 87.

This word has been often noticed by English travellers in this country, and it may perhaps be more common here than in England; but it is used by the vulgar in that country. *Dr. Johnson* and the other lexicographers call it *a low word*, but do not speak of it as *provincial. Horne Tooke* also mentions it without any remark of that kind, and gives the following etymology of it: "The Anglo-Saxon verb is *swipan*, in modern English *to sweep. Swoop* and *swop* are (as we have already seen in so many other instances) its regular past participle, by the change of the characteristic I to O.....A *swop* between two persons, is where, by the consent of the parties, without any delay, any reckoning or counting, or other adjustment of proportion, something is *swept* off at once by each of them." *Diversions of Purley, Part* 2. p. 317—18 *Amer. Edit.* This word is also much used in *Ireland*: "He makes me an offer to *swop* his mare." *Edgeworth's Castle Rack Rent.* It is never used here in writing.

T.

To TACKLE ; to harness. *New England.* I never heard this word used in England, and it is not in *Johnson's* dictionary, as a *verb*, in any sense. *Ash* calls it " a *local* word from the subtantive" *Tackle*, and defines it—" To accoutre ; to put the saddle and bridle on a horse." *Entick* also has it with the following definition : " To saddle, accoutre, fit out, prepare."

T*o* TARRY ; to stay, to stop. *New England.* This verb is entirely obsolete in England ; and it sounds as strangely to the ear of an Englishman, as *I wist not*, *I wot not*, and a thousand other antiquated expressions of that sort would to us.

TAVERN. " By the word *tavern* in America is meant an inn, or publick house of any description." *Annual Rev.* vol. i. p. 106, *note*. This word is also noticed in *Kendall's Travels*, vol. i. p. 123 ; and the expression *to keep tavern*, in the same work, vol. ii. p. 148. In *Great Britain* (as an obliging English friend observes) " a *tavern* is a mere eating house ; an *inn* is a house with accommodations for man and horse." The word *tavern* is used in the British Province of Canada just as it is in the U. States. *See Lambert's Travels.*

TEDIUM ; " irksomeness, wearisomeness." *Bailey*, *fol. edit.*

An American reviewer of *Bancroft's Life of Washington* (where this word is used) observes that " *tedium* is not English." *Monthly Anthol.* vol. iv. p. 665. The only English dictionary in which I have found it is the folio edition of *Bailey's* ; the *octavo* edition of that work (of the year 1761) omits it. It is not in Mr. *Webster's* dictionary. It is extremely rare in the writings of Americans ; I never met with it except in the instance above alluded to by the reviewer.

To TEST ; "to compare with a standard, try, prove." *Webst.* This verb is now in general use with American writers. " An occasion presented itself for *testing* the firmness of the resolution he had deliberately taken," &c. *Marsh. Life of Wash.* vol. v. p. 400. [p. 469. *Lond.* 8*vo. edit.*] " Let us *test* this dogma by plain fact." *First Ripe Fruits*, &c. *by the Rev. John Mason, New York.* " In order to *test* the correctness of this French system of sermonizing," &c. *Adams' Lectures on Rhetoric and Oratory*, vol. i. p. 334. The use of *test* as a verb is condemned by the English Reviewers. The

Annual Review (vol. vii. p. 241) mentions, among the instances of "incorrect language" in *Marshall's Life of Washington*, the use of "*testing* for *putting to the test*," in the example above quoted from that work. The *Christian Observer* (vol. ii. p. 564) in the review of *Dr. Mason's First Ripe Fruits*, gives the expression above quoted from it as one instance of the "*occasional vulgarisms, possibly Anglo-Americanisms*," of that work. Some of our own writers have also expressed the strongest disapprobation of the use of this verb: "*Test* is a *verb* only in writers of an inferior rank, who disregard all the land-marks of language." *Monthly Anthol.* vol. vii. p. 264.

TO for AT. "I have been *to* Philadelphia, for *at* or *in* Philadelphia; I have been *to* dinner, for I have dined." *Withersp. Druid, No.* 6. Expressions like the following (which have been noted by an obliging English friend) are very common with the illiterate: "He lives *to* York; he is *to* his store. I have even heard, He isn't *to* home." Dr. *Witherspoon* classes this use of *to* among his "*Vulgarisms in America*." The following instance is from an *American* edition of *Robertson's* Charles V. "He put himself *to* the head of the men at arms, &c. Book iii. A. D. 1524 (*Vol. ii. p.* 175 Philadelphia *edition of* 1804) the *English* quarto edition, *p.* 203, has—He put himself *at* the head &c.

To TOTE; "to carry, convey, remove, &c. (*Virginia &c.*)" *Webst.* A reviewer of Mr. Webster's dictionary says—"Tote is marked by Mr. Webster, *Virg.* (*Virginia*) but we believe it a native vulgarism of *Massachusetts.*" *Monthly Anthol.* vol. vii. p. 264. Dr. *Witherspoon*, however, many years ago noted it as a word peculiar to "some of the *Southern* States." *See* his *Druid*, No. 7. It is mere vulgarism, and is much more used in the *southern* than in the *northern* states.

TOWN. "A collection of houses, a district of certain limits, the inhabitants or the legal voters of a town." *Webst.*

"*A collection of houses joining, or nearly joining each other*, is the first requisite in the definition of a *town*, though the word be taken in the loosest sense that is admissible in Europe. In *New England*, however, a *town* is very commonly described as containing two or three *villages*; and these are frequently separated from each other by two or three lakes, and two or three tracts of forest.....A *town*, then, in Connecticut and the other parts of

New England, is first, a district or geographical subdivision, in which sense is the phrase 'Inhabitants of towns;' secondly, it is a body corporate..... In truth, the *society*, *town* and *county* in these countries, are new modifications of the *parish*, *hundred* and *shire*, in which the powers, and immunities are differently distributed. *Kendall's Trav.* vol. i. pp. 12, 85, 113.

The word *town*, in the sense of *a district*, is in common use in *Ireland*: "The word town in *Ireland* does not mean as it does here [*in England*] houses inhabited, but is merely a technical description of a particular district, and is notorious there." *See the case of Massey* vs. *Rice*, *Cowper's Reports*, 348.

TOWNSHIP; "the territory or land of a town." *Webst.* This word is seldom used now in England, I believe, except to signify "the corporation of a town," which is Johnson's first sense of it. His *second* signification, however, is—"the district belonging to a town;" and his authority is Sir *Walter Raleigh.* The following instance is from a *modern* English author: "The common field *townships* were divided into a certain number of 'livings,' i. e. tenements or farms." *Marshall's Rural Econ. of Midland Counties*; word *Living.*

TRADE. Doctor's *trade*, that is, drugs or medicines. Used by the vulgar only. In the county of *Norfolk* in England, they have the name of *Doctor's geer.* See *Grose's Prov. Gloss.*

TRICKY; trickish. *A low word.*

TURNPIKE. "A toll-gate set on a road, *a road on which a turnpike is erected.*" *Webst.* This word (says an obliging English friend) is always used in America "to signify the *road.* It is unquestionably the *gate*, and in England they always say *the turnpike-road*, and by *turnpike* alone they mean the *gate.*" "The *turnpike roads* of England are placed under the management and direction of certain bodies of trustees," &c. *Hawkins' Pleas of the Crown, by Leach, B. I. ch.* 76. "The passage of carriages or horses through any *turnpike*, toll-gate, or bar, at which any toll is collected," &c. *Stat. 25. Geo. 3. c. 57, cited in the same chapter of that work.*

U.

UGLY; ill-tempered, bad. *Ex.* He is an *ugly* fellow, that is, of a bad disposition, wicked. The compound *ugly-tempered* is sometimes used. They are both used by the illiterate. *New England.*

UNFEELING, *n.* want of feeling. This word is censured in the *Monthly Anthology*, vol. iv. p. 281. I never saw it in any other instance than the one there referred to.

V.

VENDUE; auction. *New England.* This word was formerly more common than *auction.* It is now chiefly used in *legal* proceedings, in conformity with the phraseology of ancient statutes of the different States. It is neither in Mr. *Webster's*, nor the *English* dictionaries; but it has been added to some of the American editions of *Johnson* and *Walker.*

W.

To WAGE; "to lay a wager," &c. *Webst.* The English use the verb *to bet.* Dr. *Johnson* indeed says, that the verb *to wage* "is now only used in the phrase *to wage war;*" and does not give it in the sense of *laying a wager*, but has only the verb *to wager.* *Bailey*, however, and *Entick*, and some others have *to wage* in this sense.

WHARVES, *plur. of* wharf. *We* always make the plural of this noun, *wharves;* the *English* say *wharfs.* "There were not in London used so many *wharfs* or keys for the landing of merchants' goods." *Child, as cited by Johnson.* "Something that is artificial, as keys and *wharfs*, &c. Lord *Hale, De Portibus Maris, ch.* 2. "This occasioned the statutes.....which enable the crown by commission to ascertain the limits of all ports and to assign proper *wharfs* and quays in each port, &c. *Blackst. Com.* i. 264. "The Legislature must have supposed that the warehouses, quays, and *wharfs* would not be so constructed, &c. *Lord Ellenborough* in the case of *Harden* vs. *Smith*, 8 *East's Reports*, 20. The word *quay* (uniformly pronounced *key*) is in more common use in *London*, than *wharf.*

To WILT; to wither. This is *provincial* in the *South* and *West* of England: "To wilt, or wilter; to wither. These flowers are all *wilted.*' *Grose's Prov. Gloss.* It is not in the dictionaries.

SUPPLEMENT.

Any manner of means. A friend who has resided in *Connecticut* informs me that this expression is very common at the *Bar* in that state.

Anxietude. I never met with this word but in one instance in any *American* publication.

Appellate. (See *Vocabulary.*) The *Edinburgh Reviewers* use this term: "An appeal presupposes, in order to be effectual, a decided superiority in the Court of *appellate* jurisdiction." *Edinb. Rev.* No. xli. p. 110. "All the other branches of the *appellate* jurisdiction," &c. p. 120. I have also met with it once in *Leach's* edition of *Hawkins's Pleas of the Crown:* "Consent cannot give original jurisdiction to a court that has only an *appellate* jurisdiction." *Book I.* c. 76. § 132.

At for By, in this expression: "Sales *at* auction." The English say, Sales *by* auction, which is in analogy with Sales *by* private contract, sales *by* inch of candle, &c.

To Average. (See *Vocab.*) Used in some parts of England: "The fall [of snow] *averaged* full twenty inches, which unusual depth was formed in little more than six hours." *London Star of Jan.* 27, 1814, in a *Plymouth* article.

Banditti. (See *Vocab.*) The following is an instance of the use of this as a *singular* noun in an *English* work: "It was indeed a noble triumph of *a ferocious banditti* in arms over helpless women," &c. *Brit. Crit.* vol ii. p. 242.

Bank-bill. (See *Vocab.*) I have once met with this word in a *modern English* publication: "For nearly the same reasons that a *bank-bill* is frequently called by the name of the sum of money which it represents." *Brit. Crit.* vol. xxii. p. 35.

To Bottom. (See *Vocab.*) To the authorites cited and referred to under this word may be added the following: "Most of our laws respecting personal rights are *bottomed* upon it, [i. e. the Roman Law."] *Brit. Crit.* vol. xxi. p. 17.

To Conflagrate. *Ex.* "With the exception of *conflagrating* the Navy-yard." On this and some other words of the same kind an English friend remarks —"they are so obviously uncouth and ridiculous, that I think they will do little injury, and must be considered as peculiar to the quaintness or ignorance of the single writer that we first observe them in." I never met with the word *conflagrate* except in this instance.

Counteraction. (See *Vocab.*) I have lately met with this word in an English review: "All the eloquence and fire of Demosthenes could not rouse the Athenian people to a timely dread or steady *counteraction* of the formidable plans of Philip," &c. *Brit. Crit.* vol. i. p. 51.

Decidedly. (See *Vocab.*) I have remarked on this word, that I think it is used by *some* English writers. This expression is more guarded than it ought to be: the word is unquestionably in common use in all parts of Great Britain. See, among other instances, the *British Critic*, vol. xxi. pp. 109, 306, 368, 375, 397, &c. and the *Edinburgh Review*, vol. i. pp. 233, 378, 492, &c.

Degree. *Ex.* In a degree; that is, extremely. An observing friend, who has resided in the *Southern* States, informs me, that this expression is very common in *South Carolina*; but it is not much, if at all, used by people of education. I have never heard it it in *New England.*

Demoralization. "The destruction of morality." *Webst.* This noun (as well as the verb *demoralize*) is sometimes used by *American* writers. It is also to be found in the writings of some *English* authors, but it is not acknowledged by the critics of Great Britain as a legitimate word. The *Edinburgh Reviewers*, in their remarks on the style of a work of Miss H. M. Williams, thus speak of it: "Throughout all these comments we have the same contempt of *Anglicism* as in the translation. We have *imperturbability* again, and *demoralization.*" *Edinb. Rev.* vol. iii. p. 216.

To Deputize. (See *Vocab.*) Since the first part of the preceding *Vocabulary* was printed, I have found this verb in a collection of words, which *Bailey* has subjoined to the Preface of the second *folio* edition of his Dictionary, under the description of "*Words in some Modern Authors," which did not occur to him till the Dictionary was entirely printed.* It is, however, omitted in the *octavo* edition of his work (of 1761) and none of the succeeding lexicographers have thought it worthy of notice.

EULOGIUM. (See *Vocab.*) From deference to the opinion of the reviewer here quoted, I have only said that *some* English writers use this word. But it is certainly in more common use than even the Anglicised term *eulogy*. It occurs very often in the *Edinburgh Review*, *British Critic*, and other reviews.

FELLOW-COUNTRYMEN. (See *Vocab.*) A friend has pointed out to me an instance of the use of this word in *Southey's Life of Nelson*, ii. 237. *Amer.* ed.

FISK; the treasury, or exchequer. This word has been proposed by the learned translator of *Bynkershoek's Quæst. Jur. Pub.* as an addition to our language. He uses it in the text of his author, and then has this *note:* "As we make use of the words *fiscal*, *confiscate*, *confiscation*, why should we not adopt in America the word *fisk* from the Latin *fiscus*, which is the root of all these derivatives." *Duponceau's Bynkershoek*, p. 51. (chap. vii.) The word has not, however, been adopted by any other American writer.

FLOOR. Used in Congress in this expression.—To *get the floor*, that is, to obtain an opportunity of taking a part in a debate. The English say, *to be in possession of the House.* "Lord J. rose at the same time with the Hon. Baronet, but the Speaker decided that the Hon. Baronet *was in possession of the House*, if he claimed his right." *Debates in Parliament Jan.* 7, 1814, *as reported in the newspapers.*

GOVERNMENTAL. (See *Vocab.*) I did not think this word had ever been used by *English* authors, but I find it has been, by Mr. *Belsham* in his *Memoirs of George the Third.* It is, however, (with the words *liberticidal*, *royalism*, and some others) condemned by the *Edinburgh Reviewers*, who observe—that these words "are slight innovations upon the English language, which we cannot give up to the ravages of this thirsty reformer, any more than the English Constitution." *Ed. Rev.* vol. ii. p. 184.

To HAPPIFY. This extraordinary word is sometimes heard from our pulpits; and a clerical friend informs me that he has seen it in some of our printed sermons: I never met with it in print.

IMPROVEMENT, of a sermon; the conclusion. *Ex.* "To *make* some *improvement* of the whole." This expression, though probably much more common in this country than in *Great Britain*, is by no means peculiar to us. In an *English* review of *Sermons* by the late Rev. *John Drysdale, D. D.*

F. R. S. Edin. the following remark is made upon it: "The conclusion [of the sermon] is termed, somewhat inaccurately, *making an improvement* of the whole. The author, we presume, means, deducing from the whole what may contribute to the general improvement." *Brit. Crit.* vol. i. p. 379. In the review of another publication, the word *improvement*, used in the same manner, is noticed by being printed in Italics. *B. Crit.* vol. iii. p. 345.

IN for *INTO*; and *vice versa.* Mr. Coleman, in remarking upon the prevalence of this inaccuracy in *Newyork*, says—"We get *in* the *stage*, and have the rheumatism *into* our knees." *Newyork Evening Post*, Jan. 6, 1814. An observing friend in *Philadelphia* says—"The preposition *into* is almost unknown *here*. They say, when did you come *in* town? I met him riding *in* town."

INFERIOR. "*Inferior* and *superior* (says an English friend), in a *positive* sense, are almost universal in New England: A *very superior* mare, a *most inferior* horse," &c.

To ISSUE. (See *Vocab.*) The following is an instance of this use of *to issue* in a well-known *English* author: "This is our first justification, which, if duly improved, will *issue* in our full and final justification." *Taylor on Romans*, as cited in *Brit. Crit.* vol. iv. p. 30.

To JEOPARDIZE. This verb is often seen in the Debates of Congress, as they are reported in the newspapers. It is, perhaps, a corruption of the ancient verb *to jeopard*, as *to deputize* is of *to depute.* But even the verb *to jeopard*, which is in all the dictionaries, Dr. *Johnson* pronounces to be "obsolete;" *Ash* says, it is "not much used," and *Barclay*, that it is "used only in *divinity*." It is hardly necessary to remark, that *to jeopardize* is neither in Mr. *Webster's*, nor the English dictionaries.

JEOPARDY. This noun, as well as the preceding verb, is sometimes to be found in our writers: Dr. Johnson says, it is "not in use."

To LAY for *to LIE.* (See *Vocab.*) One of the latest instances, which I have met with, of this error in an *English* work, is the following (which is quoted in the *British Critic*, vol. iii. p. 532, note) from *Poems by John Bidlake, B. A.* London, 1794. The Reviewers observe—"In p. 4, we have the *common* but vulgar mistake of the verb *to lay* for *to lie*:

And on the ground to catch each sound would *lay*."

Marooning; used in this expression: "A *marooning* party." A friend, who has resided in Charleston (South Carolina) observes—"The country about Charleston is not so thickly settled as Massachusetts, and therefore a *marooning* party always carry their provisions with them: I think it always means *a party to the sea-shore*."

Mought; pret. of *might*. "*Mought* for *might* is heard in most of the States, but not frequently except in a few towns." *Webster's Dissertat.* p. 111.

Naked. The English reviewers (*Christ. Observer*, vol. iii. p. 564) notice the following expression in Dr. *Mason's First Ripe Fruits &c.*—"An act of *naked* trust," and they apply to it the remark which they make on the words *Remove* and *To test*; which see in the preceding Vocabulary.

To Obligate. (See *Vocab.*) This verb is in the dictionaries, and is sometimes used by English writers; but it is not considered as an authorized word. The *British Critic*, (vol. ii. p. 212) in the review of a *Discourse by George Somers Clarke, of Trinity College, Oxford*, makes this remark on it: "We object, however, to the use of the word '*obligated*,' for '*obliged*,' a low colloquial inaccuracy."

Package. A general term comprehending *bales*, *boxes*, &c. of merchandize. A mercantile friend says, he thinks this was originally an *American* word, but that it is now sometimes used in England. It is not in the dictionaries in this sense; but perhaps it has been considered as merely *technical.*

Pine-barrens. Used in the *Southern* States. "The road which I had to travel, lay through a dreary and extensive forest of pine trees, or, as it is termed by the Carolinians, a *pine-barren*, where a habitation is seldom seen, except at intervals of ten or twelve miles." *Lambert's Travels*, vol. ii. p. 226.

Poke; a bag. I have heard this old word used by some persons in the compound term *Cream-poke*, that is, a small bag, through which cream is strained.

To Pry. "To raise with a lever." *Webst.* This signification of the verb is not in the English dictionaries; and an English friend has noted it as an *Americanism.* He also remarks upon the use of *a pry*, for *a lever*, which is common among mechanics in this country.

Slice. A kind of fire-shovel. Used in some parts of New England. A friend has referred me to the *Gentleman's Magazine*, vol. lxiii. p. 1084, where it is said to be used also in *Bristol*, in *England.*

SPILE. "A peg or pin to stop a hole in a cask." *Webst.* This word is mentioned by an English friend, who observes, that it "is used here for a *spigot*, and vulgarly for a *pile*." The dictionaries have not *spile*, but *spill*, under which Dr. Johnson gives this example: "Have near the bung-hole a little vent-hole stopped with a *spill. Mortimer.*"

SPRINGY. This is often used here by the vulgar, (as an English friend observes) for *active* or *agile*: He is a *springy* man. It is in the dictionaries, in the sense of *elastic.*

STIMULUS. Some of our writers have doubted whether this is an authorized word. It is not in the dictionaries, but is in common use with the English Reviewers: "We should expect even the voluntary productions of the pen, without this violent *stimulus*, to be sufficient," &c. *Brit. Crit.* vol. ii. p. 362. "Will receive from his book a powerful *stimulus* to their ambition," &c. vol. iii. p. 518.

To SUBSERVE. This is sometimes used by English writers; but perhaps not so much as by those of this country. The English more commonly say *to be subservient to*, or to *serve*, as in the following example: "We are of opinion, that it may *serve* the interests of society," &c. *Brit. Crit.* vol. iii. p. 579.

SUPERIOR. See *Inferior*, in this *Supplement.*

TIDY. Neat, cleanly. *New England.* This colloquial word is in all the dictionaries; but in the *Gentleman's Magazine* (vol. lxiii. p. 1084) it is classed among the *local* words of the "*West* of England."

To for *AT.* (See *Vocab.*) A writer in the *Gentleman's Magazine* says, this is used "all over *Devon*, in *England*." vol. lxiii. p. 1084.

WOULD for *SHOULD*, in this expression: It *would* seem. This is very common in America: The *Scotch* writers also use it: "But these people, it *would* seem, need to be informed," &c. *Campb. Philos. of Rhet.* B. ii. ch. 3. sect. 3. (p. 255. Amer. edit.) The *English*, I believe, uniformly say, it *should* seem: "Irritated, as it *should* seem, by the exaggerated praises," &c. *Christ. Observer*, vol. ii. p. 44. "The want of correspondence is to be imputed sometimes, it *should* seem, to inadvertency, and sometimes to design." *Review of Dr. Combe's Horace* (*written by Dr. Parr*) in the *Brit. Crit.* vol. iii. p. 53. This use of *would* has escaped me in two or three instances in the preceding Memoir and Vocabulary. See *Errata.*

POSTSCRIPT.

I cannot dismiss this work, without making an acknowledgment of the obligations I am under to several English and American friends, some of whom took the trouble to examine a great part of it, and favoured me with their valuable remarks. After the Academy directed it to be published, I employed all my leisure in revising it; and the unavoidable delay which has taken place in the printing, has afforded me an opportunity of correcting many errors, and of making several additions. It has still, I am sensible, many imperfections, of which my own *Americanisms* may not be the least. It is now submitted to the candour of the public (as I have observed in the *Memoir*) merely " as the beginning of a work, which can be completed only by long and accurate observation."

Salem, Mass. Jan. 23, 1815.

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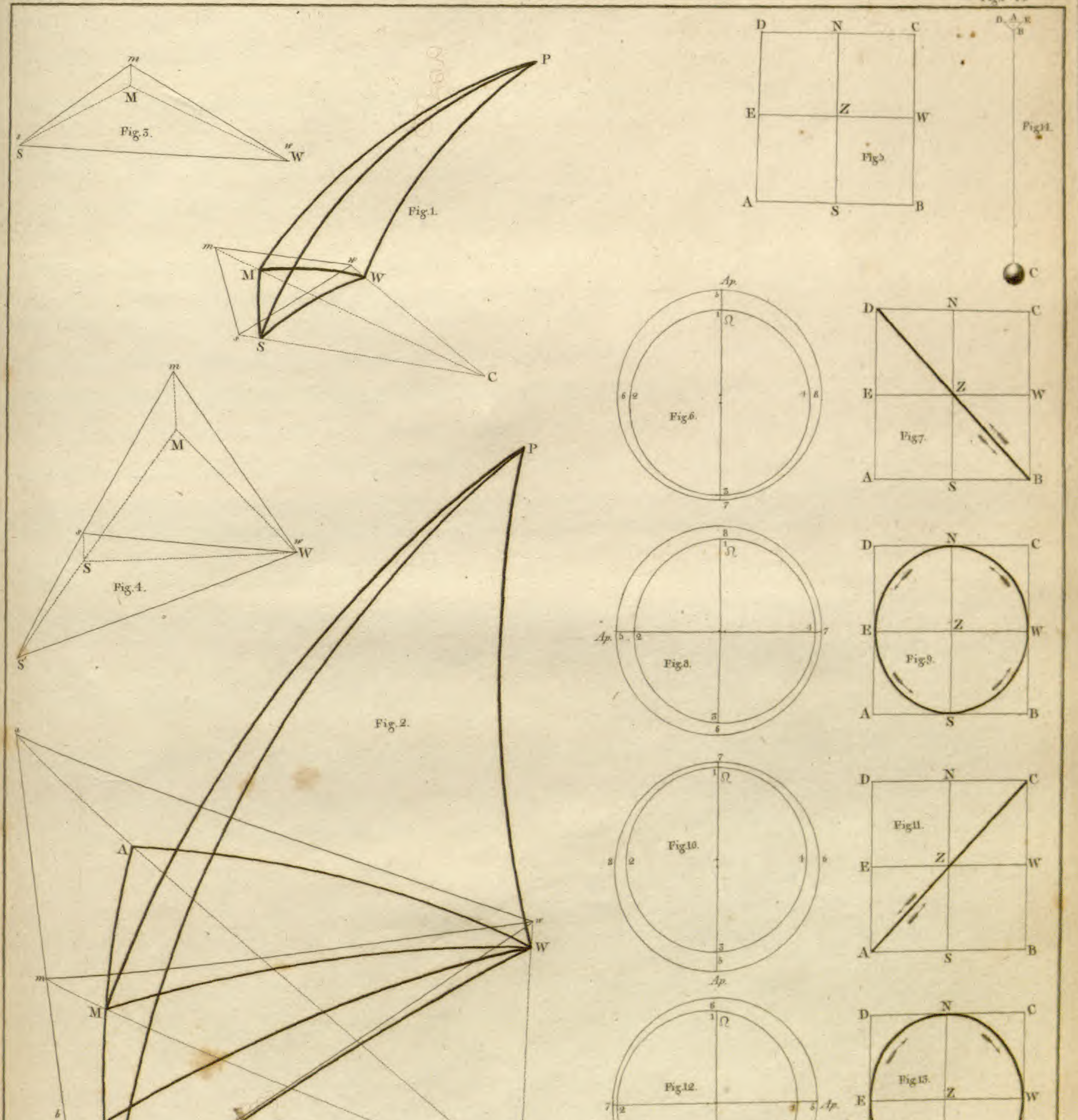


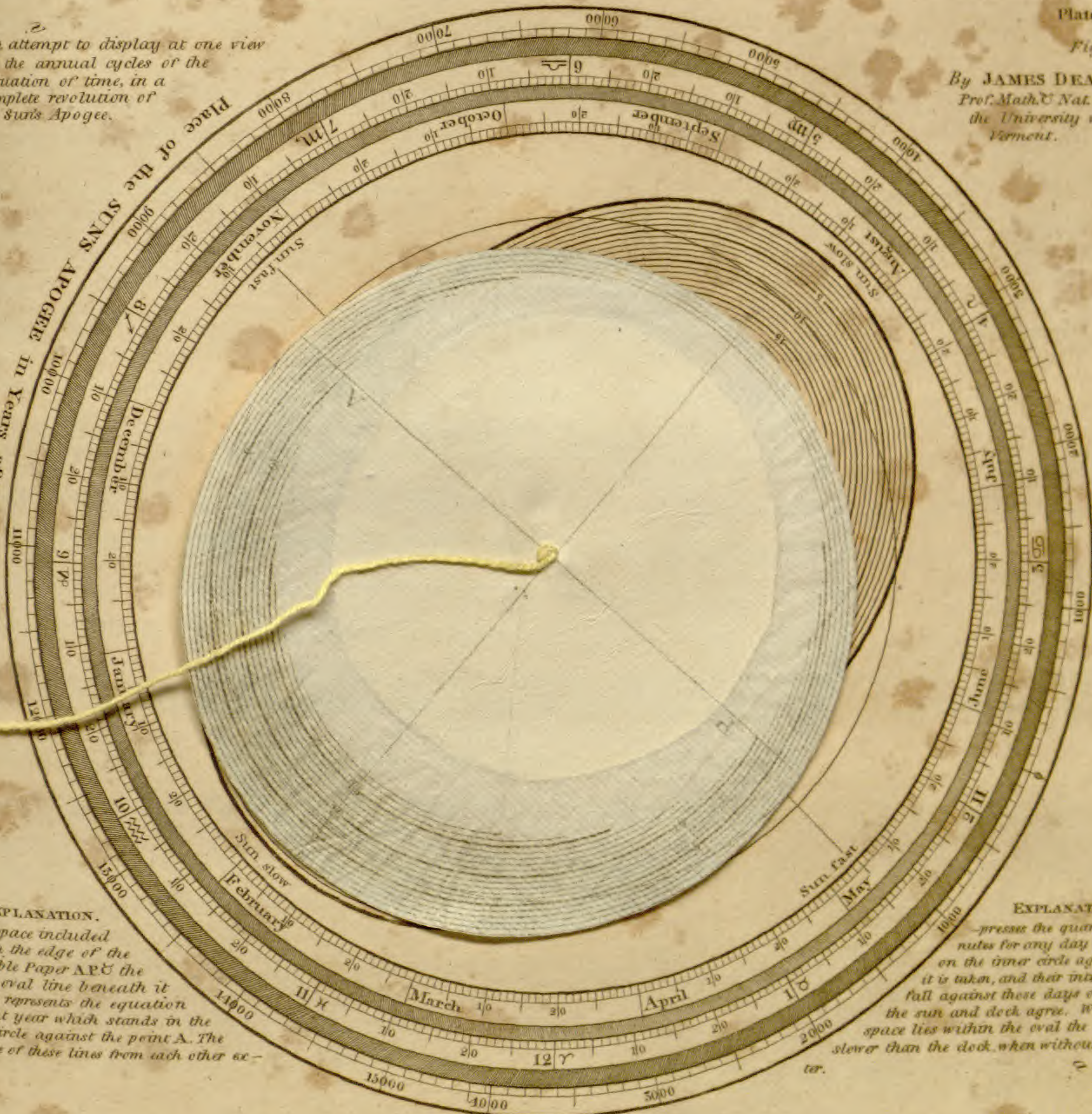
Hooker & Fairman Sc.

Plate II.

An attempt to display at one view all the annual cycles of the Equation of time, in a complete revolution of the Sun's Apogee.

Fig. 5.

By JAMES DEAN, A.M.A.S.
Prof. Math. & Nat. Phil. in the University of Vermont.



Explanation.

The space included between the edge of the moveable Paper A.P. & the strong oval line beneath it always represents the equation for that year which stands in the outer circle against the point A. The distance of these lines from each other ex-presses the quantity in minutes for any day of the year on the inner circle against which it is taken, and their intersections fall against those days on which the sun and clock agree. When this space lies within the oval the sun is slower than the clock, when without, it is faster.

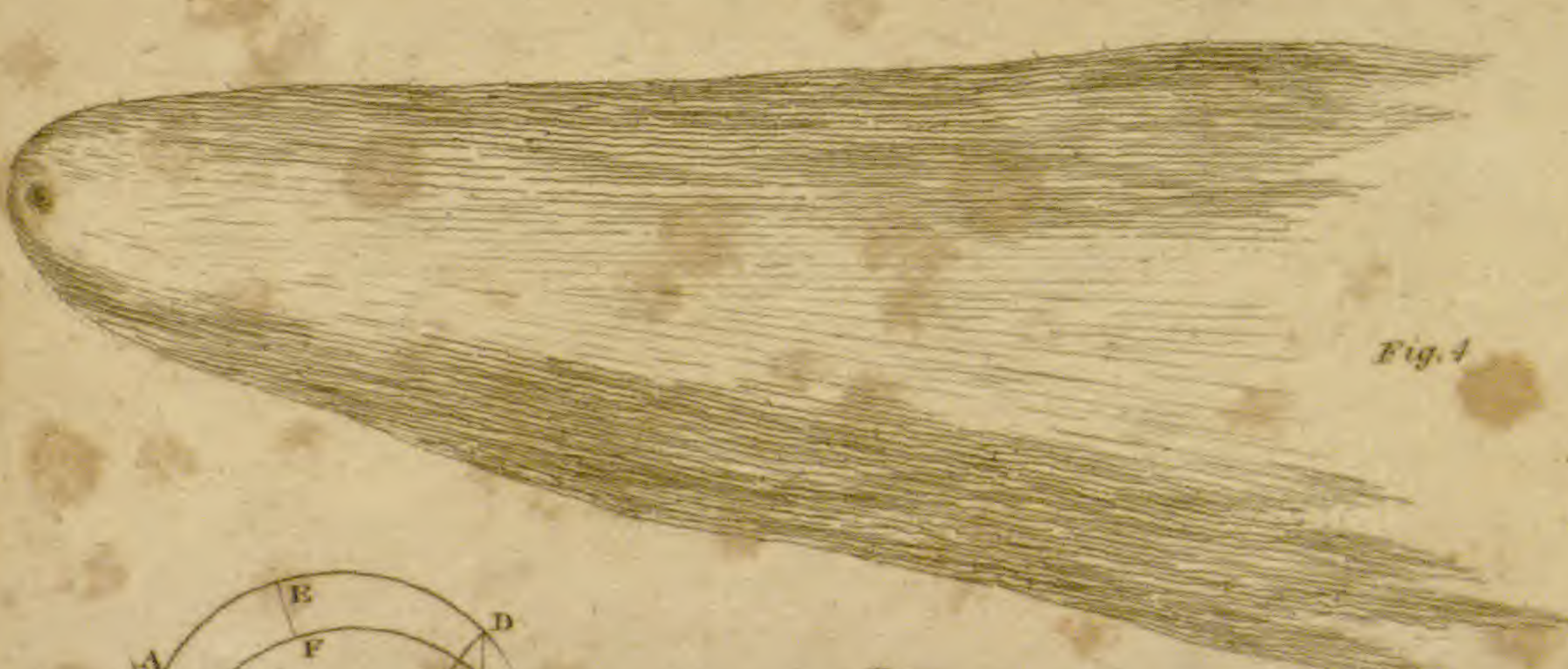


Fig. 4

Fig. 6

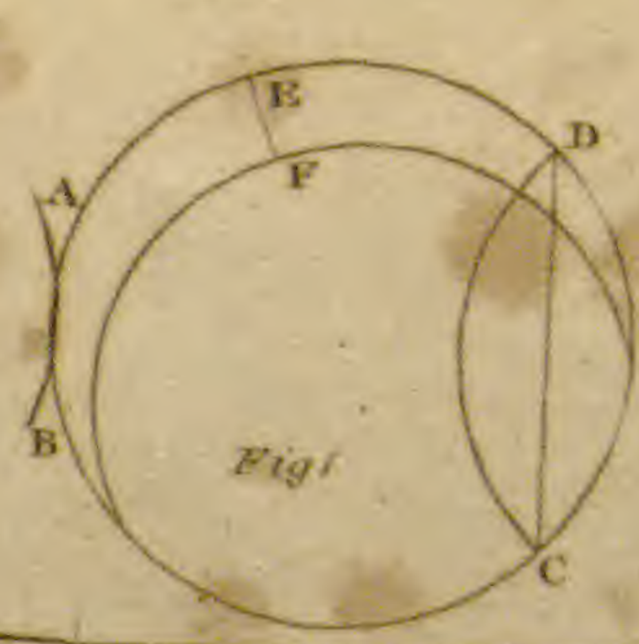


Fig. 1

Fig. 2

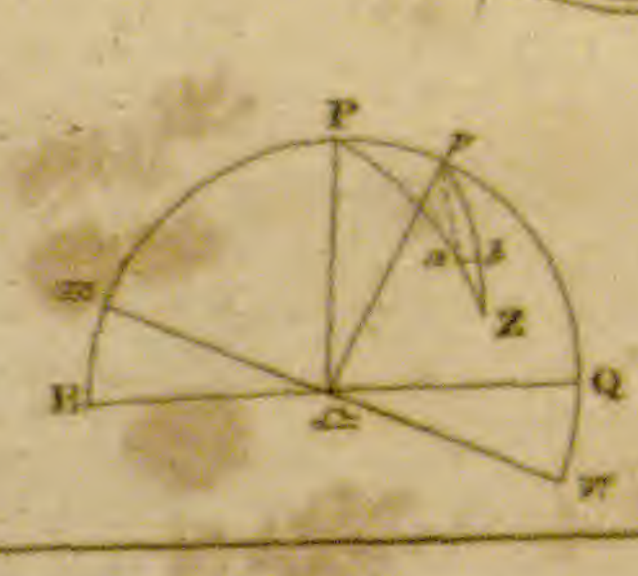


Fig. 3

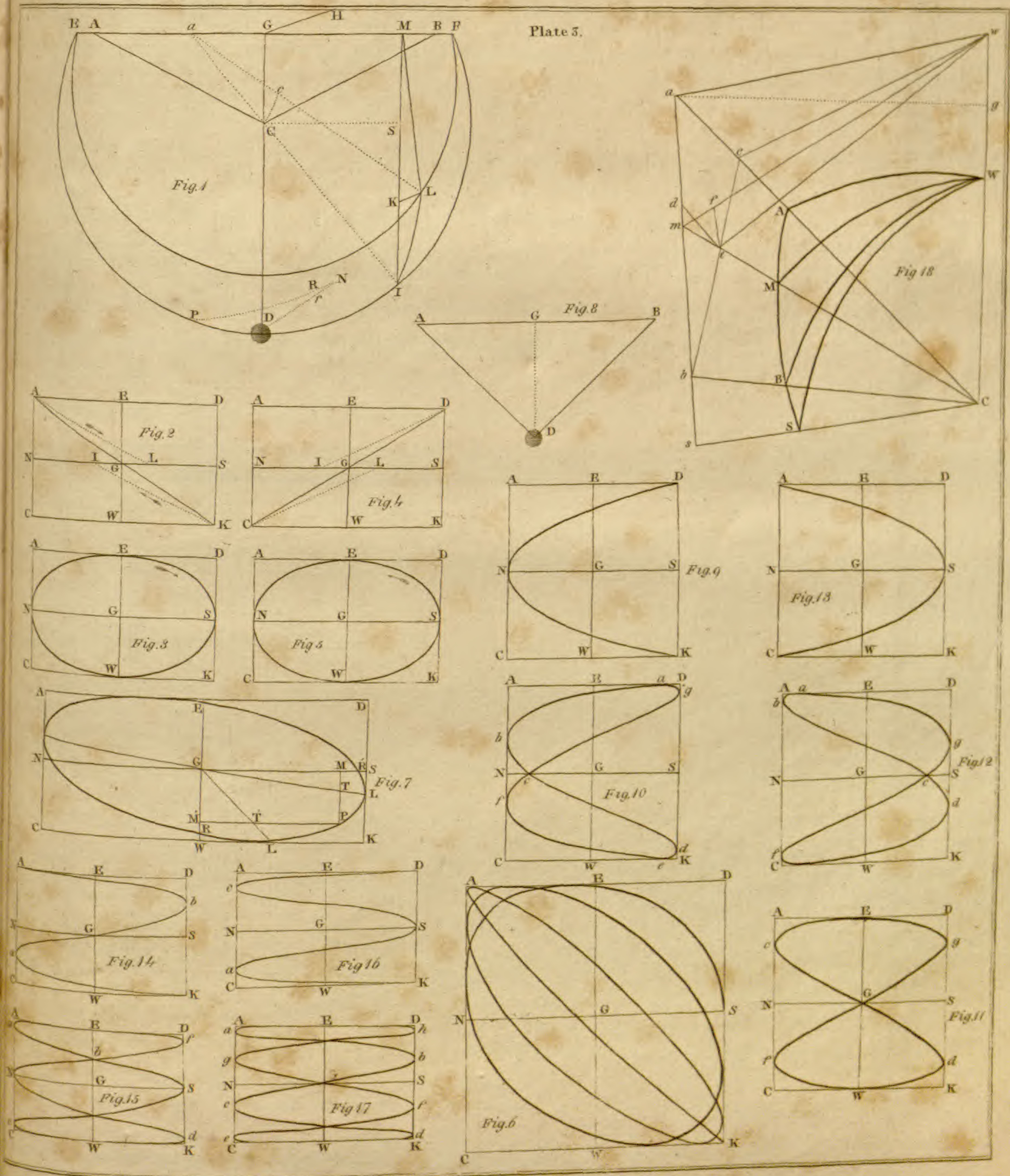


Plate 3.
Fig.1
Fig.2
Fig.3
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Fig.18

Fig.15.

Fig.12.

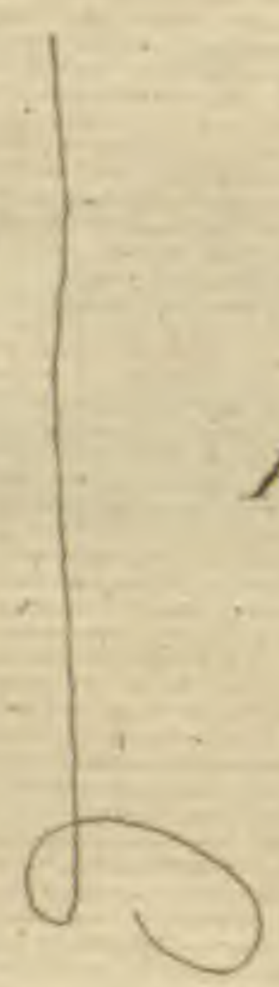
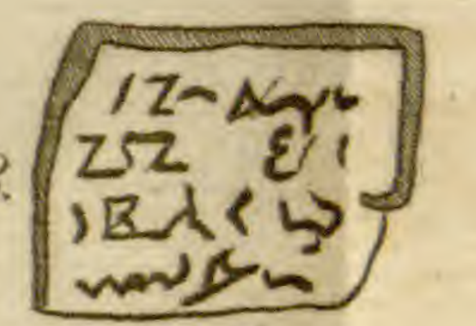


Fig.16.

Fig.18.



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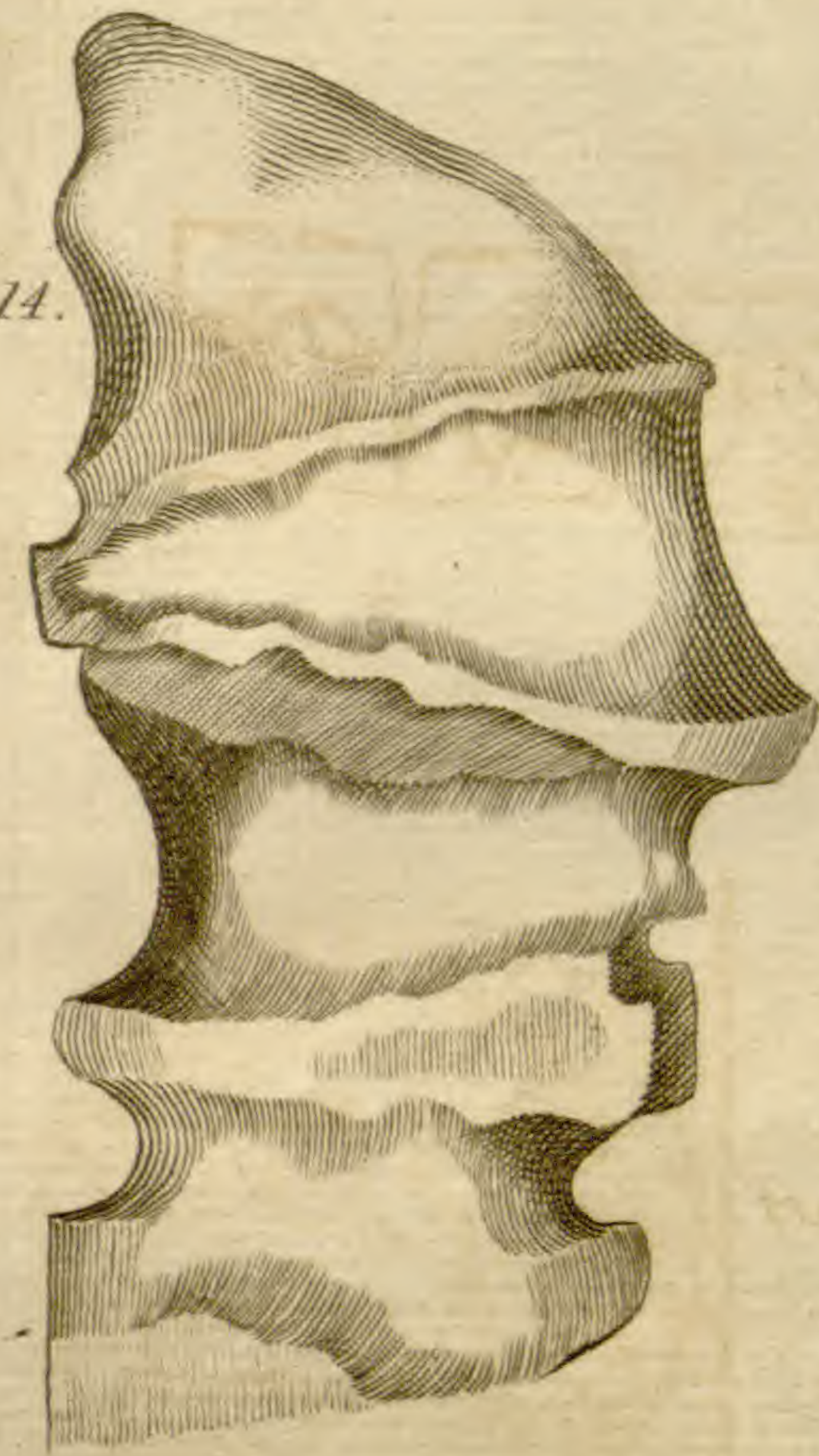

Fig.17.

Fig.11.

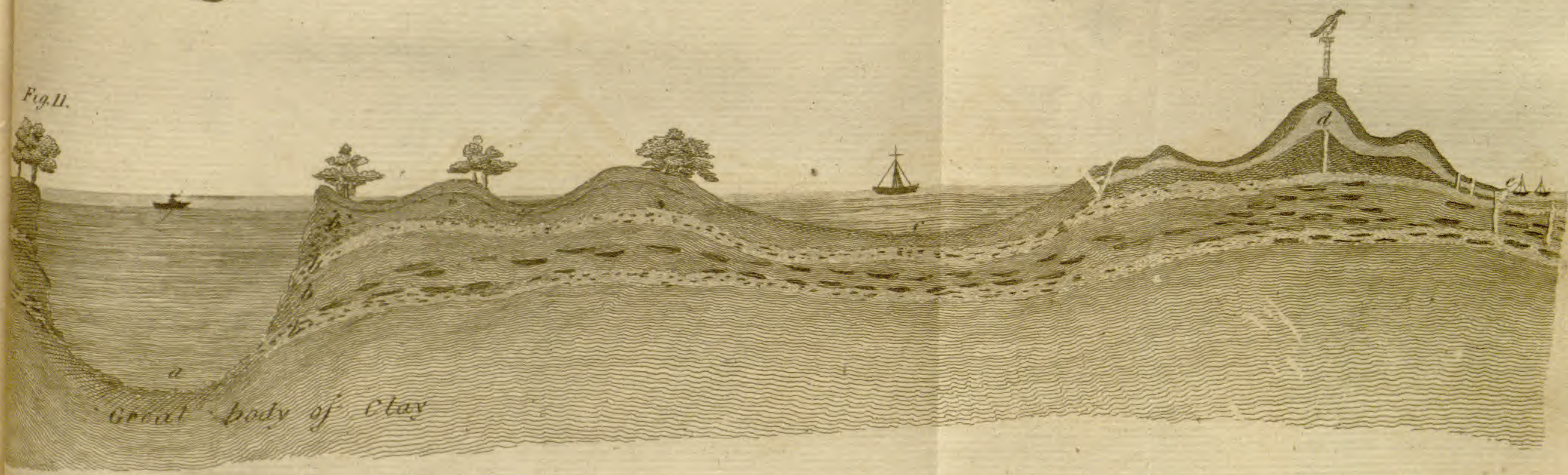

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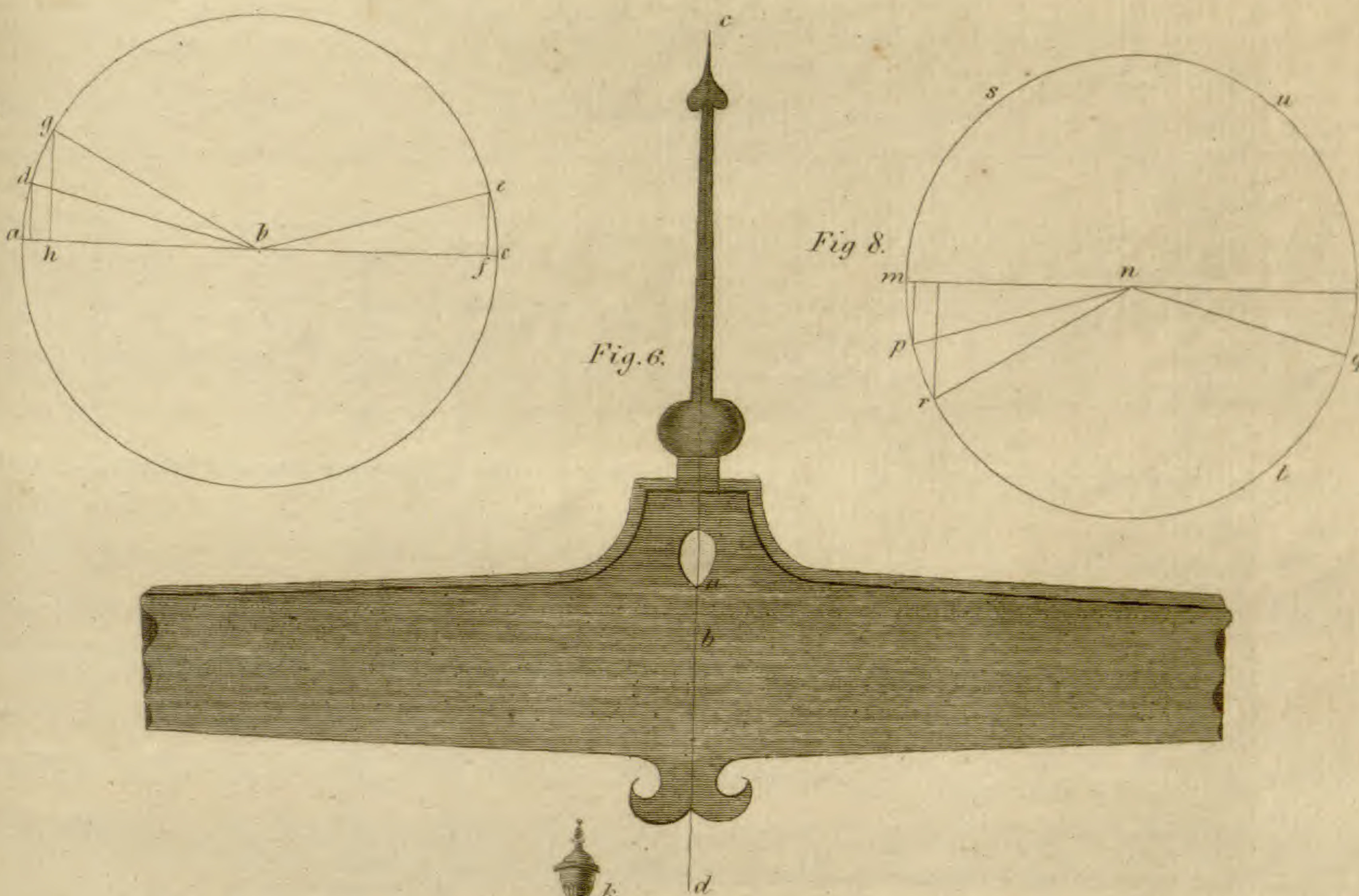
Fig.6.

Fig 8.



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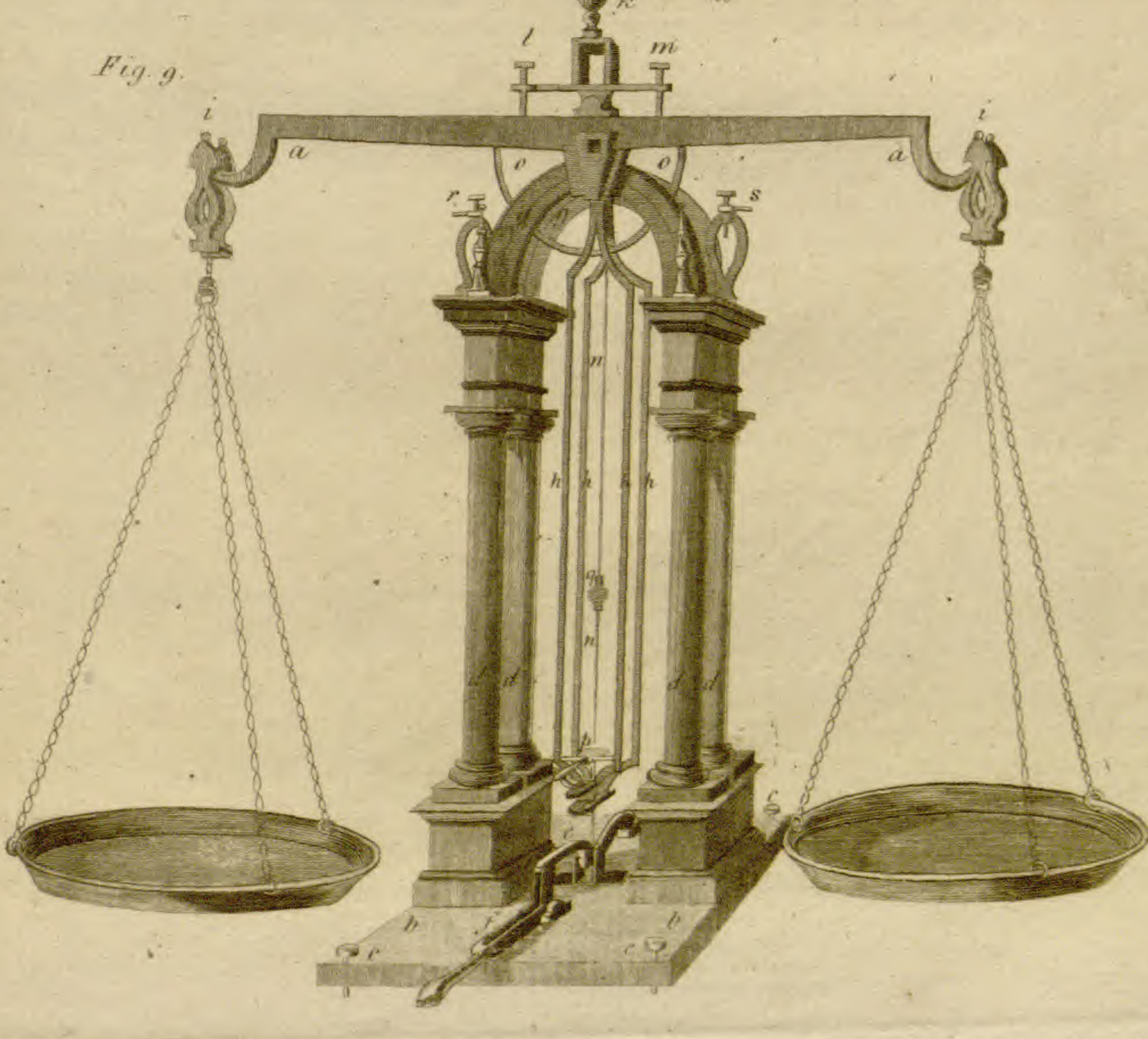


Wightman Sc.

Fig. 10.

	American Scale	Fahrenheits Scale	Reaumurs Scale
Mercury boils	966, 66	656	+277.33
Melted Lead fixes	905, 55	612	+257.77
Melted Tin fixes	669.44	442	+182,22
Water boils	350	212	+80
Spt of Wine boils	291.66	170	+61.28
Bees-wax melts	252.77	142	+48.89
Blood heat	191.66	98	+29.34
Water freezes	100	32	0
Zero of Fahrenheit	55.55	0	-14.2
Mercury freezes	0	-40	-32

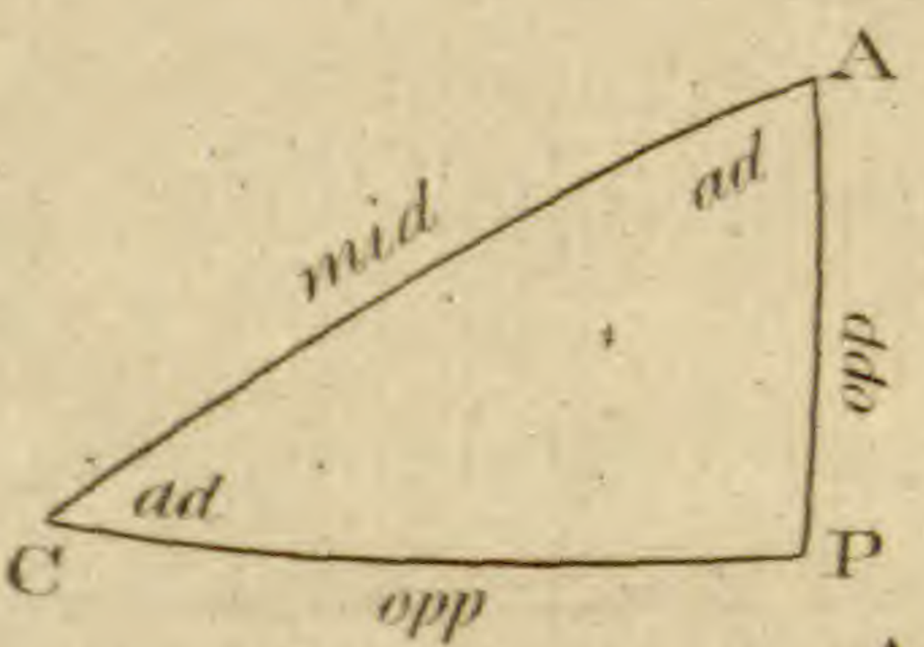
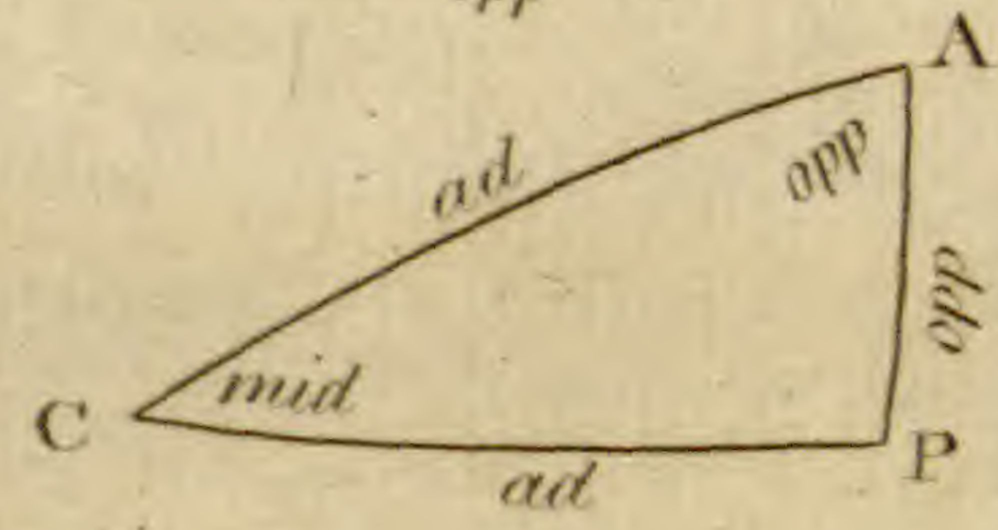


Fig. 1.



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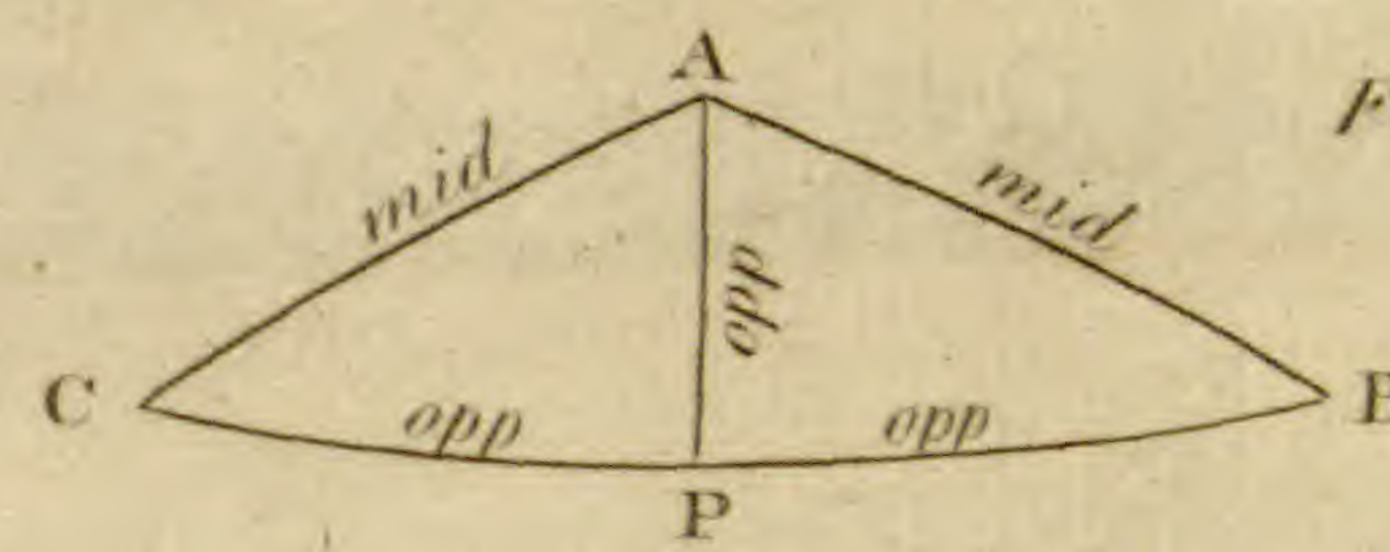

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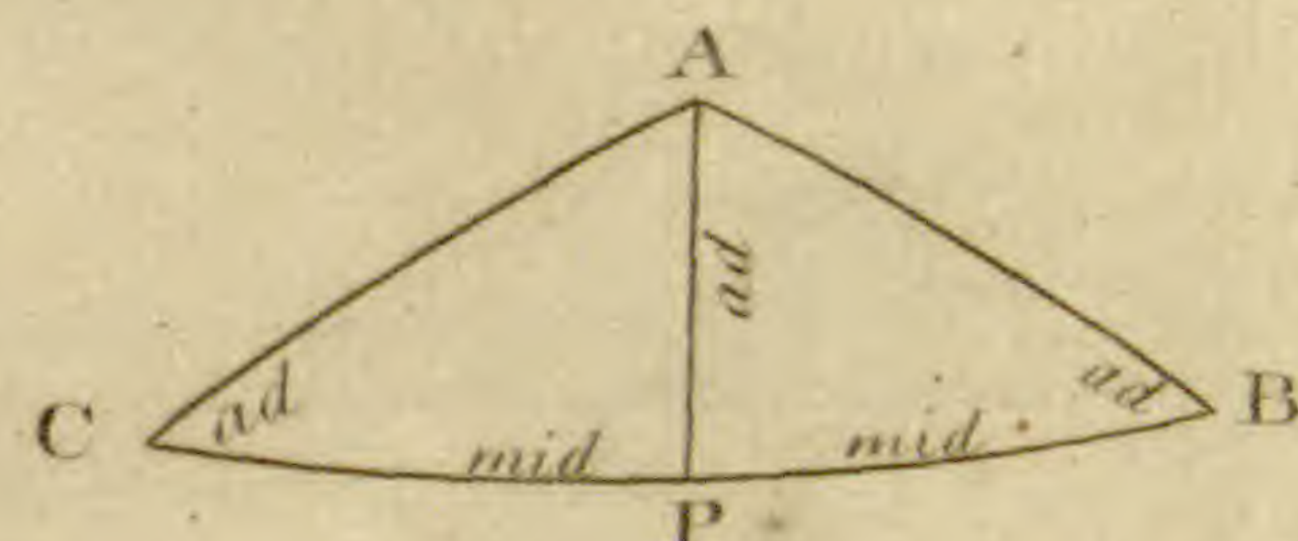

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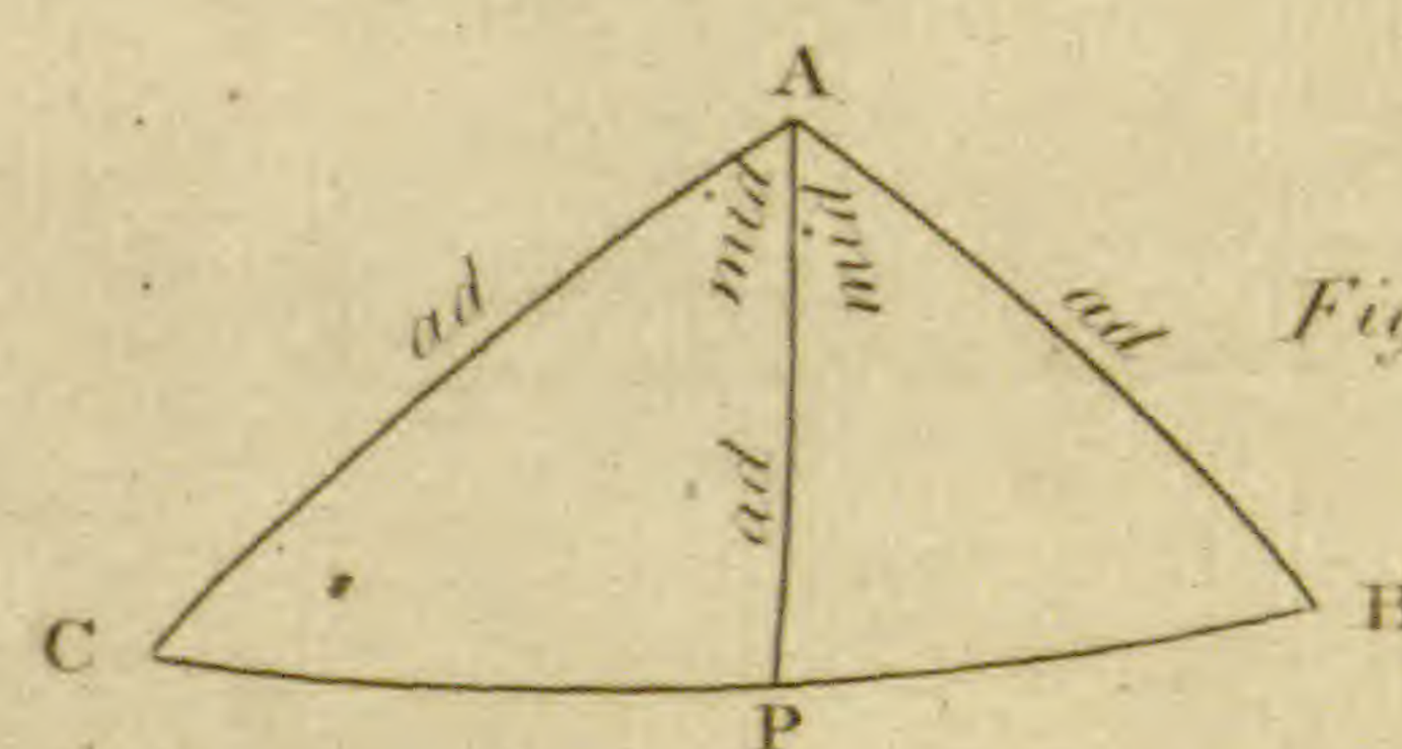

Fig. 5

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Fig. 19.

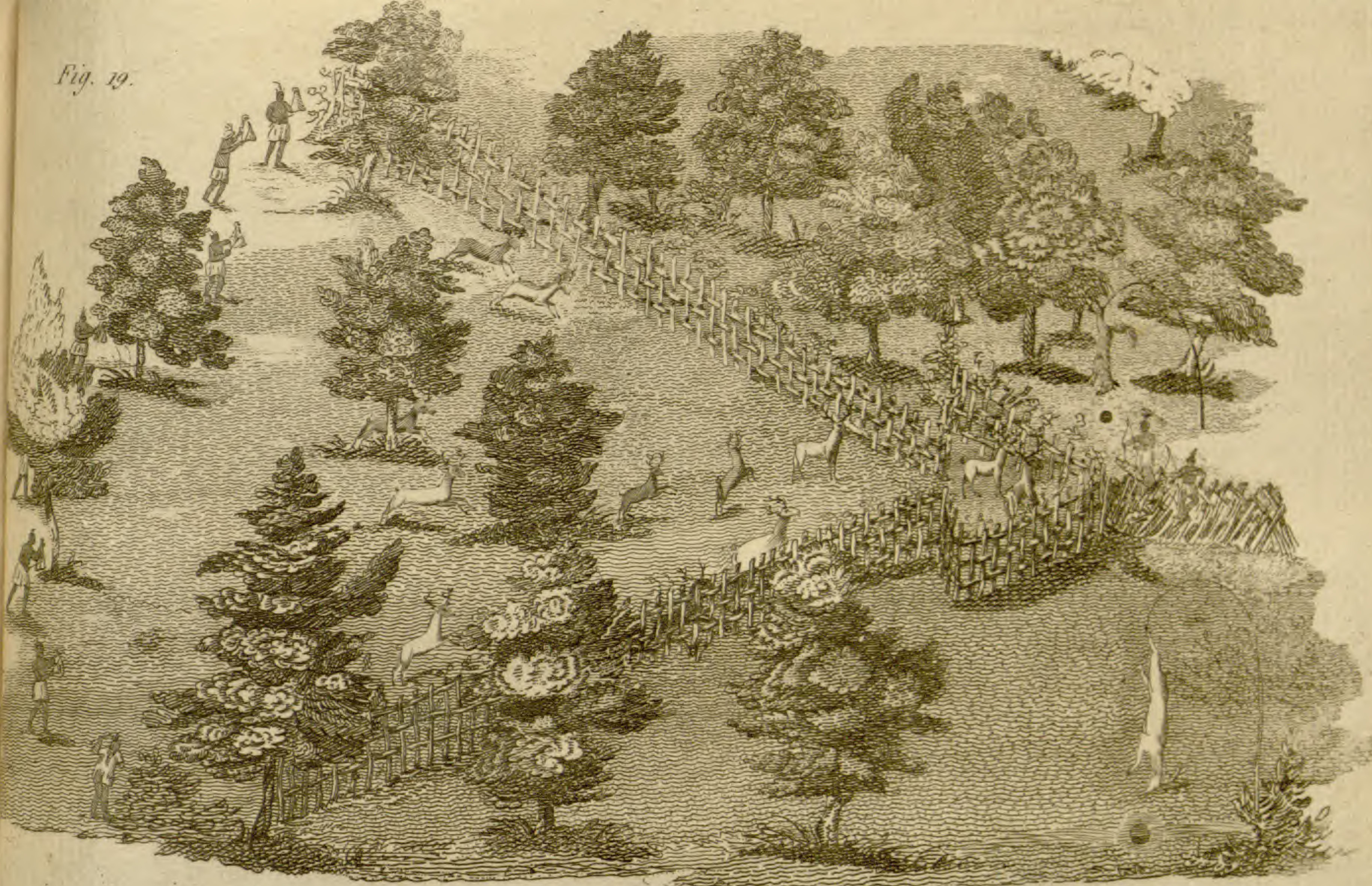

Fig. 21.

Fig. 20.

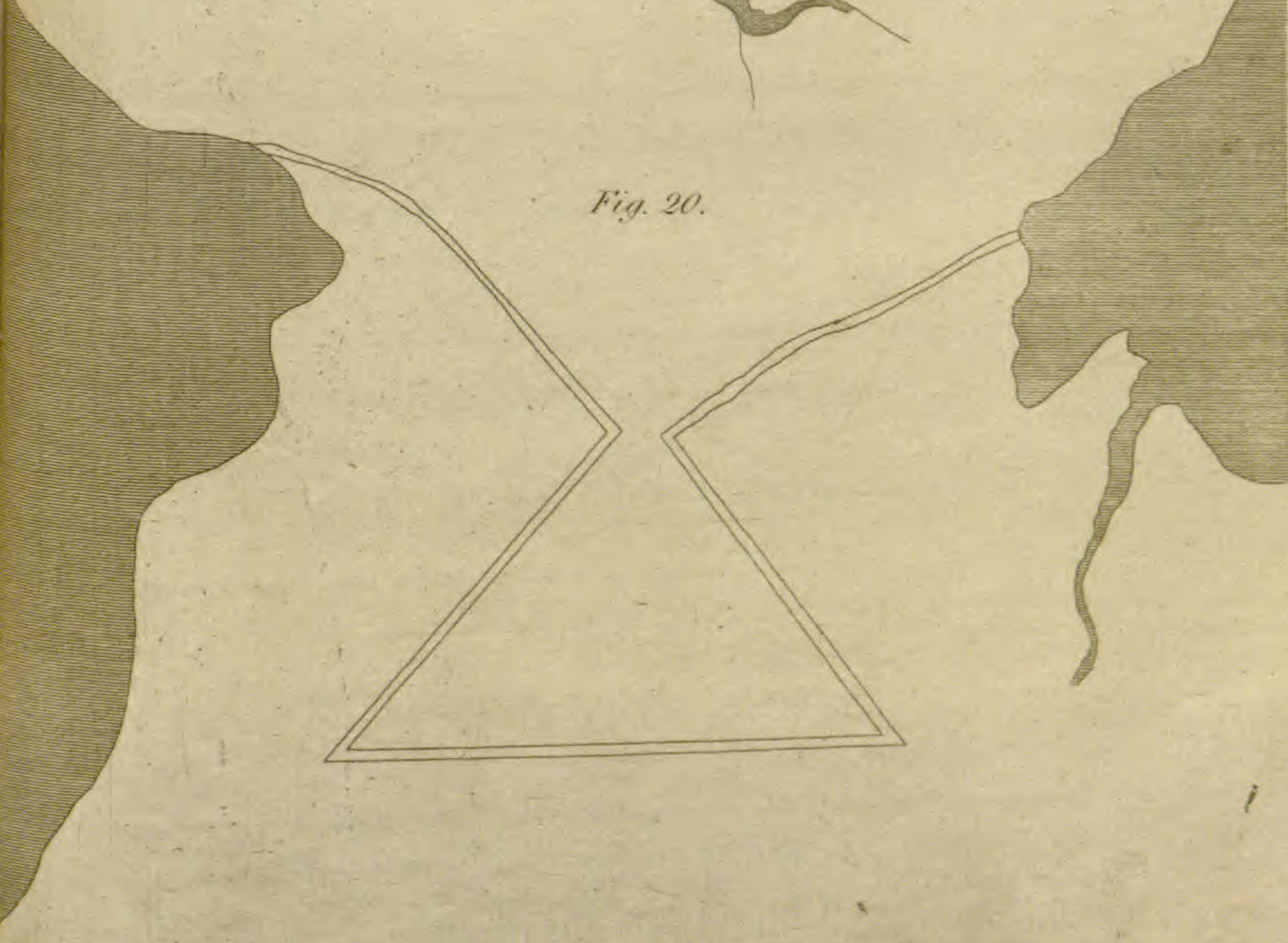

Fig. 13.