

XVIII.—*On Torsional Oscillations of Wires.* By Dr W. PEDDIE. With Two Plates.

(Read 16th March 1896.)

About two years ago I communicated to this Society a paper on the above subject, which was printed in the *Philosophical Magazine* (1894). The object of the investigations therein discussed was the determination of the law of decrease of torsional oscillations when the range of oscillation was large in comparison with the palpable limits of elasticity. An equation of the form

$$y^n(x+a)=b,$$

where y represents the range of oscillation, and x represents the number of oscillations which have taken place since the commencement of the observations in any one experiment, was found to give an exceedingly close representation of the results. The values of the quantities n , a , and b depend on the magnitude of the initial oscillation, and on the previous treatment of the wire. It was also found that, when the oscillations were allowed to die away to a sufficient extent, the value of n tended to diminish. The oscillations were practically isochronous.

It was shown further that the above formula could be deduced from the assumptions (1) that the loss of energy per oscillation is proportional to a power of the angle of oscillation, and (2), that, apart from this loss, Hooke's Law is obeyed. The latter assumption may be regarded as completely justified by the observations of G. WIEDEMANN, who showed that, after a rod has been "accommodated" by a few twists, in opposite directions alternately, to a given maximum, Hooke's Law was followed in all subsequent twists in one direction so long as the original maximum was not exceeded. The accuracy of the former assumption is therefore to be gauged by the completeness with which the formula suits the results of observation.

The conditions under which the resilience has maximum or zero values were discussed, and an expression, connecting the angle of "set" with the angle of torsion, was also deduced, and was tested by means of WIEDEMANN's observations, the agreement being very complete. And it was further pointed out that the well-known law of "compound interest," found by Lord KELVIN to hold in the case of very small oscillations, follows as a particular case when $n=0$.

The initial range had nearly a constant value in all the experiments discussed in the first paper, and therefore no attempt could be made in it to consider the variations of the parameters n , a , and b , consequent on changes in the initial conditions. In the present paper, three separate sets of experiments are described. Full confirmation is given of the accuracy of the above formula, and the nature of the variations of the parameters is investigated.

Modification of the Apparatus.

In the former experiments, an iron wire 89.1 cm. in length, and 0.1011 cm. in diameter, was used. Before measurement, the ends of the wire had been soldered into holes drilled axially in brass rods. One of these rods, with the wire suspended from it, was clamped in a vertical position. To the other rod, a lead ring, of considerable moment of inertia, was attached symmetrically. The oscillations were produced by twisting the wire in opposite directions alternately, by hand, the impulses being timed to suit the natural period of the wire, until the required maximum was reached. The unavoidable pendulum-swings of the wire were then damped out by hand as rapidly as possible.

The same wire was used in the new series of experiments, but the upper rod was passed through a cylindrical hole, of the same diameter as the rod, drilled vertically through a fixed metal block. The rod ended in a head which rested on the upper horizontal face of the metal block and thus supported the oscillating system. A horizontal lever, attached to the head, resting normally in contact with a stop, could be turned out from, and back to, the stop through a considerable angle. In this way, large or small oscillations could be readily produced. Two such double motions of the lever, properly timed, were found to be sufficient to produce the largest oscillation desired.

The angle of oscillation was read off on a scale, attached to the circumference of the lead ring, by means of a telescope placed a short distance away. Formerly, the reading was got by means of a fixed pointer placed close in front of the scale; in the new observations, it was got by means of a fibre placed in the focus of the telescope.

In the former experiments, the lead ring was of such moment of inertia that ten complete oscillations were performed in about 80 seconds. In the new series, for a reason which will appear subsequently, a lead ring of the same weight but of greater moment of inertia was used. When tested during the course of the first experiment (12.7.94), and subsequently at the date 25.7.94 after a number of experiments had been performed, nineteen complete oscillations took place in 300 seconds.

Symmetry of the Oscillations.

In the former experiments, positive elongations alone were read; for the period of oscillation was too short to admit of both elongations being read with accuracy. The zero from which the elongations were reckoned was the point about which the oscillations took place when the motion had died down to a large extent. This is a point about which the oscillations must be symmetrical, should such a point of symmetry exist throughout the whole motion. But the existence of such a point cannot, from the nature of the problem, be postulated *a priori*. The first positive elongation causes a considerable positive set of the zero from its original position.

The first negative elongation does not entirely destroy the positive set. The second positive elongation increases it, and the second negative elongation does not entirely remove this increase; and so on. Thus the conditions under which successive oscillations occur are continually varying, and one cannot therefore assume without proof that the oscillations are symmetrical about a fixed point. As a matter of fact, the present experiments have shown that there is a fixed point of symmetry.

If an arbitrary scale reading β be chosen as the zero in any one experiment, and if successive positive and negative elongations α, γ , be read from this zero, the point about which the oscillations are symmetrical must be $\beta + (\alpha - \gamma)/2$. A number of results, which show that this quantity is practically constant in any one experiment, are given in Table I. The dates of the experiments are given in the left-hand column. The number of complete oscillations which had taken place since the commencement of the experiment are given in the first row, and the corresponding values of the quantity $\beta + (\alpha - \gamma)/2$ appear in the various rows and columns underneath. The last column contains the values of the zero which were observed when the oscillations were stopped.

There may be an error of ± 0.1 in any of the calculated quantities. In the columns headed $\frac{1}{2}$ and 1, the error may be much greater, because the elongations decreased with great rapidity at first.

General Outline of Experiments.

Three series of experiments were carried out. The first of these, extending from the date 12.7.94 to the date 4.8.94, consisted of forty-two experiments. The treatment of the wire throughout this period was as nearly uniform as possible, and the initial range of oscillation was varied considerably in the different experiments. On those days on which small initial ranges only were used, the wire was oscillated with a large initial range after the observations were completed, so as to preserve the uniformity of treatment.

A second series, made between the dates 16.7.95 and 26.7.95, consisted of thirteen experiments. The main object was the investigation of the effect of fatigue. The wire was oscillated for some time, through as large a range as was possible with the given range through which the lever could be turned, before each experiment was begun—the number of complete oscillations varying from 1 to 200.

A third set, in which the initial ranges were on the whole smaller than those previously employed, consisting of ten experiments, was obtained between the dates 9.12.95 and 24.12.95.

Before the second set was begun, the wire was oscillated, with a large initial range, once or twice per day for about three weeks. Before the third set was begun, it was similarly oscillated, about once per day, for five or six weeks.

In those experiments in which the initial range had as great a value as could be attained conveniently, the range fell to about half its initial value in one oscillation.

First Method of Determining the Constants.

In the first determination of the values of the quantities n , a , and b in the expression $y^n(x+a)=b$, use was made of the equations—

$$m^n = \frac{x_3 - x_2}{x_2 - x_1},$$

$$a = \frac{x_2^2 - x_1 x_3}{x_1 + x_3 - 2x_2},$$

where $y_1 = my_2 = m^2y_3$, a suitable value being assigned to m . Three sets of values of y_3 , y_2 , and y_1 were chosen. These were respectively 5, 10, 20; 4, 8, 16; and 4, 7, 12.25 in all the cases in which the values of the quantities n , a , and b were determined by this method with two exceptions. In the experiment of date 16.7.94, the sets chosen were 5, 10, 20; 6, 10, 16.7; and 5, 8, 12.8; in that of date 4.8.94 (2) the sets were 3.5, 7, 14, and 4, 7, 12.25. These constant sets were chosen in order that, as far as possible, the determination of the quantities n , a , and b might be made under like conditions in the different cases. The arithmetical means of the values obtained for n , a , and b were then taken. It was hoped that, in this way, it might be possible to make out a systematic variation in the value of n as the value of the initial range was varied. But no indication of any change could be found, though the initial range was varied from its greatest value to about one-quarter of its greatest value; and the variety of the results obtained showed that any change which really existed was entirely hidden by irregularities arising in the observations themselves.

The columns headed n , a , and b in Table II. contain the averages; those headed n_1 , n_2 , and n_3 contain respectively the values of n as calculated from the three sets of values of y in the order specified above; and the column headed θ_0 gives the values of the initial range. Although these results are not subsequently employed, they are tabulated because they verify the conclusion, made in the first paper, that there is a slow diminution in the value of n as the oscillations die away.

Second Method of Determining the Constants.

Since a method of evaluating the quantities n , a , and b , dependent on the selection of particular points on the experimental curves, seemed to be incapable of sufficient accuracy for the indication of systematic variations in the value of n , it became necessary to use a method which gives values suiting, on an average, all points of any curve. Such a method is at once evident if we write the equation in the form—

$$n \log. y + \log. (x+a) = \log. b.$$

If the proper value of a be chosen, and if values of $\log. (x+a)$ be plotted vertically, while corresponding values of $\log. y$ are plotted horizontal, the points thus obtained lie on an average on a straight line, and the tangent of the angle which this line makes

with the horizontal axis is numerically equal to the value of n . The equation then gives the value of b if values of x and y , corresponding to a point on the line, are inserted in it. If too large a value of α has been assumed, the line will be curved from the origin; if too small a value has been assumed, the line will be curved towards the origin.

First Series of Experiments.

In the above way the constants were determined in all the cases included in the first series of experiments after the date 24.7.94. The results are given in Table III. It is evident that there is no stronger indication of systematic variation in the values of the quantities than was given by the former method of determination. On the whole, the value of n seems to be greater when the initial range is small. But no stress can be laid on this result, for, when the range is small, a possible error in an observed value of y is a large fraction of its total amount. Again, possible observational errors cause the graph to appear practically straight throughout a considerable extent, although different values of α are chosen in plotting it; and this causes an uncertainty in the deduction of the values of n and b which increases when the initial range is small. The values of n and b , given in the table, were those which were obtained from the *first assumed* probable value of α which made the graph sufficiently straight.

Second Series of Experiments.

It became evident that it was necessary to carry out another series of experiments, under distinctly different conditions, in order to re-test the question of systematic variation, or to determine if the results obtained in the two series had any aspect in common. The results of the second series are contained in Table IV. The numbers which are given in that table are not, in some cases, those which were at first adopted. But theory indicated, as will be found subsequently, that the product nb might be constant, and it was seen to be so nearly constant throughout such a large number of the cases, that, in those cases in which its value differed much from the average, a recalculation of the quantities was made— α being altered in such a way as to make nb take a value not much different from that observed on the average in the other cases. It was in general found that the change thus made brought the calculated values of y into closer agreement with the observed values.

Throughout this series, large initial ranges of oscillation were employed, and the various experiments practically differed only in the amount of fatigue to which the wire was subjected. The amount of fatigue is indicated in the column headed N , which gives the number of complete large oscillations which were given to the wire before the observations were commenced. The effect of fatigue in diminishing b and increasing n is very marked. That it is also persistent is evident on a comparison of the cases in which N had the value 1, and of the two cases in which N had the value 50.

Third Series of Experiments.

Since, in the preceding series, large values of the initial range had alone been used, the third series was undertaken with the object of testing the constancy of the product nb when the initial angle was small. The results are contained in Table V. The wire was not fatigued by oscillation before each experiment. In the first two experiments, the value of θ_0 was large, and a comparison of the values of n , in these cases, with the values of n in similar cases in the first and second series of experiments, shows that the effect of the great fatigue induced in the second series has persisted throughout the period of four and a-half months which elapsed between the completion of the second series and the commencement of the third.

Constancy of the Product nb .

When the product nb is made as small as 180, the convexity, towards the origin, of the curves in which $\log. (x+a)$ is plotted against $\log. y$ is usually distinct; when the product is as large as 250, the concavity, towards the origin, of these curves is also in general distinct. Thus the evidence that the product had, throughout the second and third series of experiments, a constant value not much different from 200 is of considerable strength. It is confirmed also by the results of the first series as given in Table III. Although these data were not determined with special precautions to obtain the best result, the products, with very few exceptions, fall within the limits just specified. In the particular exception 3.8.94 (1), the scale readings differed greatly, and for no obvious reason, from the readings got in the experiment 3.8.94 (3) under nearly identical conditions. And, in the exception 4.8.94 (1), the scale readings differed greatly from those which were obtained in the experiment 3.8.94 (4) under the same conditions. These two exceptions stand alone, in this respect, in all the series of observations. A new determination of the quantities n , a , and b was made, so as to give products of n and b not greatly differing from 200.

The results are given in Table VI. In almost every case these values of the quantities were found to give better agreement with the results of observation than the values given in Table III. This was, for example, the case in the experiment 4.8.94 (2).

Variation of n and b .

A comparison of the values of n and b in Tables IV., V., and VI. shows that the effect of increased initial range is of the same kind as the effect of fatigue. Fatigue causes a distinct and persistent increase in the value of n , and increase of the initial range also causes an increase in the value of n . Probably, if the wire were fatigued day after day by oscillation to a large and definite extent for a considerable period, a definite relation between n and θ_0 would become apparent. In the present series of experiments, no such relation can be established, for it is impossible to separate the effects of increased initial range and of fatigue. This is well brought out in fig. 2. The

single points show the values of n and θ_0 in the first series of experiments, Roman numerals being used to indicate the points corresponding to the first twelve experiments of the series. Points surrounded by circles indicate the values of n and θ_0 in the second series, the values of N given in Table IV. being placed alongside. The crosses give the results of the third series of experiments.

Explanation of Diagrams.

Fig. 2 has just been discussed. Fig. 1 shows the curves obtained from the readings in the experiment 20.7.94 (2). The abscissæ give the number of complete oscillations which have taken place since the commencement of the experiment. The ordinates of the upper curve represent the excess of the positive elongations over 20. The ordinates of the lower curve represent the defect of the negative elongations from 20. The ordinates of the middle curve are the means of simultaneous ordinates of the upper and lower curves. This curve, therefore (p. 612), shows the elongations referred to the zero about which they are symmetrical. Points on that curve which correspond to the abscissæ 1, 2, 3, 5, 7, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, are taken. The straight line in the figure is drawn on the average through points, whose ordinates are obtained by taking the logarithms of each of the above-noted abscissæ increased by 9, and whose abscissæ are the logarithms of the corresponding ordinates of the middle curve. From that line the values of n and b were deduced in the manner stated on p. 614. Only the lowest point, whose abscissa is 1.42, lies to any extent off the line. The second lowest point corresponds to the ordinate 20.5 in the middle curve. If the ordinate were 19.9 the point would be on the straight line, so that the discrepancy is only 1.5 per cent.

Fig. 3 illustrates the determination of limits (p. 616) between which the value of the product nb must lie. The points in that figure have been plotted, in the way just described, from the results obtained in the fourth experiment made on the date 3.8.94. In one case the value 12 was given to α , and nb had the value 195. Within experimental errors, all the points lie on the straight line. In the upper system of points, α and nb have the values 14 and 167 respectively, and the convexity of the system towards the origin is apparent. In the lower system, α and nb have the values 10 and 221 respectively, and it is evident that there is a tendency towards concavity to the origin.

The points in fig. 4 constitute a similar set for the experiment of date 18.12.95. When $\alpha = 10$, $nb = 182$, the system of points is convex towards the origin. When $\alpha = 9$, $nb = 205$, the system is practically straight; and the rectilinearity is even more complete in the lowest set of points, with the values $\alpha = 8$, $nb = 217$.

The numbers in Table VII. give the observational data from which the upper and lower curves in fig. 1 were plotted. The first, third, fifth, &c., numbers give the scale readings for the positive elongations, the second, fourth, sixth, &c., numbers give the scale readings for the negative elongations. The number of scale divisions contained in a complete revolution of four right angles was 46.1. Hence, to get the plotted

numbers, 46.1 has to be added to the first five positive elongations, and then 20 has to be subtracted from all positive readings; and the first negative reading must be called -1.5 , all the negative readings being then subtracted from 20.

The waves which are observed on the experimental curves in fig. 1 are due to slight pendulum-wise oscillations of the wire, which could not be avoided when the torsional oscillations were large. They do not appear in the middle curve.

Test of the Accuracy of the Formula.

In Table VIII. a comparison of the results of observation with the results obtained by calculation is given for all the experiments in the three series. The upper row contains values of x , and succeeding pairs of rows contain the logarithms of observed and calculated values of y corresponding to the given values of x —the calculations being made from the formula

$$y^n(x+a)=b,$$

and the values of a , n , and b being those given in Tables IV., V., and VI. In the first series of experiments the observed value of y usually exceeds the calculated value at the end of the first oscillation ($x=1$) by more than a possible error of observation, and sometimes, at the end of the second oscillation, the difference considerably exceeds one per cent. of the value of y . But it must be recollected that the above formula, from the point of view of theory (see former paper), can only be regarded as strictly applicable when two or three oscillations have taken place. With these exceptions, the results of observation and calculation may be regarded as being within the limits of possible observational error. When x is large, y is small, and the difference between observed and calculated values of y sometimes exceeds one per cent. of the value of y , but then so also does the possible observational error.

Critical Angle of Oscillation.

We have found that, in the present series of observations, the product of the quantities n and b may be regarded as being constant. Yet it is easy to see that this is a mere accidental circumstance depending on the particular unit in terms of which the angle of oscillation was measured. In terms of the unit here used we may write the equation in the form

$$ny^n(x+a)=B,$$

where B is an absolute constant. Suppose now that we choose the unit k times smaller. Then the new y (y' say) is k times the old, and we get

$$nk^n y'^n(x+a)=B'=Bk^n,$$

so that the most general form in which the equation can be put is

$$y'^n(x+a)=bk^n \tag{1}$$

certain that increase of (1) must, at all angles, be, on the whole, the determining cause of the change of configuration of the groups. Thus increase of stability, because of increase of (1) and (2) together, is the only case requiring consideration.

Numerical Value of the Critical Angle.

If we regard the scale-unit, used above in the measurement of y , as the true unit which gives nb constant, the dimensional data already given show that, in the wire used, the critical angle corresponds to a twist of about $0\cdot09$ degree per centimetre of length. But, in testing the constancy of nb , I frequently observed that the chosen value of nb was near the lower limit of the range of values, outside of which it could not be without causing distinct curvature in the system of points whose co-ordinates were $\log. (x + \alpha)$ and $\log. y$. Yet, in other cases, the value of nb seemed to be near the upper limit. Thus, when $n = 1$, 210 suits very well as the value of the product. And, if we put $Bk^n = 210$ when $n = 1$ and choose $k = 0\cdot9$, we get $B = 233$. If now $n = 1\cdot22$, the product becomes 205; and these values very well suit, for example, the cases, 22.7.95, 25.7.95 with $\alpha = 6$, and 30.7.94 with $\alpha = 9$. Again, when $n = 0\cdot7$ we get 230 as the value of the product, and this suits the case 24.12.95 with $\alpha = 210$. Also, if $n = 1\cdot33$, the product becomes 202, which agrees well with 23.7.95 and 26.7.95 (2).

If we assume these values for k and B , the value of the critical angle is slightly less than that corresponding to a twist of $0^\circ\cdot1$ per centimetre of length.

TABLE I.—*Showing the Constancy of the Zero of Oscillation.*

Date.	$\frac{1}{2}$	1	2	3	5	7	10	15	20	25	30	35	40	45	50	55	60	65	70	
12.7.94	29.8	30.1	30	30.05	30.1	30	30.1	30.05	30.1	30.15	30.15	30.2	30.05	30.15	30.1	30.15	30.2	30.2	30.2	30.14
13.7.94	30.15	30.15	30.15	30.15	30.1	30.2	30.2	30.15	30.15	30.15	30.15	30.2	30.15	30.1	30.15	30.1	30.1	...	...	30.16
16.7.94	29.9	30.05	30.15	30.1	30.1	30.1	30.1	30.05	30.1	30.1	30.1	30.15	30.05	30.15	...	...	...	...	...	30.12
17.7.94 (1)	30.1	29.95	30.25	30.25	30.15	30.15	30.2	30.25	30.2	30.2	30.25	30.2	30.25	30.2	30.3	30.25	...	...	...	30.23
17.7.94 (2)	31.8	30.95	31.15	31.2	31.1	31.25	31.35	31.2	31.35	31.3	31.25	31.3	31.25	31.25	31.3	31.3	...	...	...	31.3
18.7.94	31.85	31.45	31.3	31.6	31.45	31.45	31.5	31.6	31.6	31.45	31.55	31.55	31.7	31.6	31.5	...	...	...	...	31.56
19.7.94	31.1	31.15	31.25	31.4	31.25	31.25	31.35	31.4	31.5	31.35	31.3	31.45	31.45	31.45	...	...	...	...	...	31.4
20.7.94 (1)	42.1	31.45	31.45	31.45	31.45	31.55	31.45	31.4	31.45	31.5	31.5	31.55	31.5	31.45	31.35	...	...	...	...	31.47
20.7.94 (2)	31.75	30.85	31.0	31.05	31.05	31	31.05	31.15	31.2	31.05	31.1	31.15	31.2	31.2	31.15	31.15	31.15	...	...	31.16
21.7.94 (1)	31.6	32.25	31.65	31.55	31.6	31.7	31.45	31.7	31.7	31.75	31.65	31.8	31.8	...	...	...	...	...	...	31.71
21.7.94 (2)	31.75	31.8	31.6	31.6	31.65	31.7	31.7	31.7	31.8	31.7	31.75	31.85	31.8	31.75	31.8	...	...	...	...	31.76
23.7.94 (1)	31.5	31.7	32.0	32.1	32.2	32.2	32.15	32.2	32.2	32.15	32.2	32.25	32.2	32.2	32.18	32.15	...	...	...	32.2
23.7.94 (2)	31.8	32.0	32.05	32.05	32.05	32.1	32.05	32.05	32.05	32.05	32.05	32.1	32.05	32.15	32.05	...	...	...	...	32.09
24.7.94 (1)	32.55	32.5	32.5	32.8	32.9	32.95	32.15	32.85	32.85	32.9	32.9	32.9	32.85	32.95	32.9	32.85	...	...	...	32.9
26.7.95 (2)	38	36.5	36.5	36.55	36.55	36.6	36.66	36.6	36.65	36.55	36.6	36.6	36.6	36.65	36.6	36.65	...	...	...	36.6

TABLE II.—*Giving Values of n , a , and b , determined by the First Method.*

Date.	n_1	n_2	n_3	n	a	b	θ_0
12.7.94	1.010	0.869	0.839	0.903	15.40	249	31.2
13.7.94	1.060	1.034	1.028	1.041	12.62	308	24.5
16.7.94	1.012	0.843	0.843	0.915	15.60	257	33.0
17.7.94 (1)	1.100	1.022	1.022	1.041	9.67	264	45.0
17.7.94 (2)	0.965	0.902	0.887	0.918	11.47	206	56.5
18.7.94	...	...	...	1.043	8.00	224	55.5
19.7.94	1.020	0.972	0.986	0.991	8.23	203	54.0
20.7.94 (1)	1.022	1.085	1.032	1.046	8.30	225	43.0
20.7.94 (2)	1.000	1.057	1.027	1.038	7.99	208	52.0
21.7.94 (1)	1.087	1.043	1.020	1.050	8.40	224	44.5
21.7.94 (2)	...	...	...	0.982	9.10	200	51.0
23.7.94 (1)	1.093	1.054	0.979	1.042	8.50	222	44.5
23.7.94 (2)	1.057	1.016	0.992	1.022	9.92	218	24.0
24.7.94 (1)	1.090	0.941	0.913	0.981	9.56	196	38.2
24.7.94 (2)	1.099	1.023	1.015	1.046	8.10	209	33.5
24.7.94 (3)	1.031	1.030	0.945	1.002	8.10	190	33.5
4.8.94 (2)	...	1.017	1.014	1.016	16.00	242	14.4

TABLE III.—*First Determination of n and b by the Graphical Method.*

Date.	a	n	b	θ_0
25.7.94 (1)	8	1.035	203	46.0
25.7.94 (2)	8	1.000	185	49.4
25.7.94 (3)	8	1.021	193	39.8
27.7.94 (1)	8	1.030	204	42.5
27.7.94 (2)	8	1.038	194	40.9
27.7.94 (3)	8	1.035	198	38.7
30.7.94 (1)	8	1.059	213	36.3
30.7.94 (2)	9	1.030	212	29.7
30.7.94 (3)	9	1.040	214	25.7
31.7.94 (1)	10	1.045	216	20.3
31.7.94 (2)	10	1.029	216	24.0
31.7.94 (3)	10	1.004	210	24.9
1.8.94 (1)	10	1.000	207	28.1
1.8.94 (2)	12	1.012	217	18.5
2.8.94 (1)	10	1.020	217	28.3
2.8.94 (2)	12	1.025	219	17.2
2.8.94 (3)	14	1.044	220	13.9
3.8.94 (1)	16	1.267	336	10.8
3.8.94 (2)	8	1.018	194	42.5
3.8.94 (3)	20	1.007	189	10.0
3.8.94 (4)	12	1.000	195	16.5
4.8.94 (1)	14	1.043	255	16.3
4.8.94 (2)	14	1.064	247	14.4
4.8.94 (3)	40	1.024	339	6.4
4.8.94 (4)	40	1.061	275	6.2
4.8.94 (5)	10	1.058	222	19.9

TABLE IV.—*Results of the Second Series of Experiments.*

Date.	a	n	b	nb	θ_0	N
16.7.95	6	1.079	179	192	37.1	1
17.7.95	4	1.133	168	190	51.3	10
18.7.95	4	1.180	175	206	44.4	20
19.7.95	5	1.137	172	196	41.2	30
20.7.95 (1)	5	1.135	173	196	36.6	1
20.7.95 (2)	3	1.227	167	205	48.7	50
20.7.95 (3)	4	1.190	161	192	39.7	1
22.7.95	3	1.233	162	199	40.0	80
23.7.95	2	1.290	157	203	42.0	120
25.7.95	2	1.310	154	202	30.2	160
26.7.95 (1)	4	1.197	161	193	38.7	1
26.7.95 (2)	2	1.322	158	200	43.9	200
27.7.95	2	1.327	147	195	41.5	50

TABLE V.—*Results of the Third Series of Experiments.*

Date.	a	n	b	nb	θ_0
9.12.95	3	1.220	153	187	37.2
12.12.95	3	1.255	162	203	36.8
17.12.95	9	1.110	171	190	14.2
18.12.95	9	1.120	183	205	14.3
19.12.95 (1)	22	1.000	209	209	9.6
19.12.95 (2)	35	0.935	217	203	7.0
20.12.95 (1)	80	0.750	277	205	5.3
20.12.95 (2)	120	0.715	264	189	3.0
24.12.95 (1)	219	0.660	302	199	1.6
24.12.95 (2)	47	0.785	256	201	8.5

TABLE VI.—*Final Determination of n and b in the First Series.*

Date.	a	n	b	nb	θ_0
12.7.94	20	0.819	238	195	31.1
13.7.94	22	0.811	244	198	34.5
16.7.94	19	0.829	238	197	32.8
17.7.94 (1)	14	0.893	224	200	44.9
17.7.94 (2)	11	0.947	215	204	56.0
18.7.94	9	0.962	202	194	55.6
19.7.94	9	0.976	199	194	53.9
20.7.94 (1)	10	0.963	204	196	43.1
20.7.94 (2)	9	0.976	198	193	52.3
21.7.94 (1)	9	0.991	203	201	44.0
21.7.94 (2)	9	0.978	196	192	51.1
23.7.94 (1)	10	0.976	207	202	44.2
23.7.94 (2)	11	0.981	204	200	23.8
24.7.94 (1)	9	0.989	197	195	38.2
24.7.94 (2)	9	1.000	199	199	32.5
24.7.94 (3)	9	1.000	199	199	33.9
25.7.94 (1)	6	1.014	198	201	46.0
25.7.94 (2)	6	1.024	187	192	49.4
25.7.94 (3)	8	1.021	193	197	39.8
27.7.94 (1)	8	1.030	204	210	42.5
27.7.94 (2)	8	1.038	194	202	40.9
27.7.94 (3)	8	1.035	198	205	38.7
30.7.94 (1)	9	0.995	210	199	36.3
30.7.94 (2)	10	0.988	205	198	29.7
30.7.94 (3)	11	0.973	203	197	25.7
31.7.94 (1)	12	0.973	202	197	20.3
31.7.94 (2)	11	0.967	197	190	24.0
31.7.94 (3)	10	0.989	201	199	24.9
1.8.94 (1)	10	0.990	203	201	28.1
1.8.94 (2)	13	0.953	200	191	18.5
2.8.94 (1)	11	0.969	204	198	28.3
2.8.94 (2)	14	0.946	201	190	17.2
2.8.94 (3)	16	0.960	199	191	13.9
[3.8.94 (1)	30	0.875	234	194	10.8]
3.8.94 (2)	8	1.018	192	195	42.5
3.8.94 (3)	20	1.007	189	190	10.0
3.8.94 (4)	12	1.000	195	195	16.5
[4.8.94 (1)	18	0.910	219	200	16.3]
4.8.94 (2)	20	0.903	220	199	14.4
4.8.94 (3)	55	0.810	242	196	6.4
4.8.94 (4)	60	0.820	247	202	6.2
4.8.94 (5)	12	0.972	199	193	19.9

TABLE VII.—*Data for the Second Experiment of Date 20.7.94.*

37.40	41.09	37.24	35.60	34.65
44.60	21.54	24.97	26.63	27.53
11.16	40.64	37.07	35.48	34.66
8.48	21.97	25.19	26.73	27.63
5.37	40.21	36.97	35.47	34.67
12.22	22.32	25.43	26.88	27.76
2.68	39.77	36.83	35.42	34.62
14.32	22.64	25.65	27.04	27.75
0.98	39.36	36.68	35.33	34.53
15.75	22.95	25.74	27.04	27.74
45.78	38.99	36.50	35.22	34.42
16.83	23.27	25.82	27.06	27.80
44.76	38.72	36.29	35.06	34.38
17.75	23.60	25.94	27.14	27.87
43.92	38.50	36.14	35.03	34.39
18.53	23.93	26.07	27.24	27.97
43.29	38.27	36.07	35.02	34.37
19.23	24.25	26.26	27.36	28.04
42.66	38.04	36.03	34.96	34.32
19.88	24.46	26.44	27.45	28.01
42.04	37.78	35.92	34.90	34.22
20.48	24.63	26.51	27.45	28.03
41.54	37.52	35.76	34.77	34.14
21.05	24.79	26.56	24.47	...

TABLE VIII.—*Test of the Accuracy of the General Formula.*

Date.	Log. y	1	2	3	5	7	10	15	20	25	30	35	40	45	50	55
12.7.94	Obs. Calc.	1.380 1.288	1.314 1.265	1.265 1.240	1.199 1.191	1.149 1.154	1.093 1.100	1.013 1.018	0.940 0.945	0.870 0.879	0.813 0.822	0.770 0.771	0.724 0.730	0.690 0.685	0.643 0.644	0.602 0.608
13.7.94	Obs. Calc.	1.324 1.263	1.279 1.241	1.243 1.220	1.187 1.188	1.143 1.140	1.086 1.088	1.013 1.012	0.934 0.942	0.875 0.886	0.826 0.826	0.778 0.779	0.732 0.730	0.770 0.700	0.663 0.675	0.633 0.624
16.7.94	Obs. Calc.	1.394 1.300	1.318 1.268	1.267 1.245	1.204 1.198	1.149 1.152	1.093 1.099	1.013 1.013	0.944 0.944	0.875 0.877	0.819 0.822	0.770 0.773	0.716 0.724	0.690 0.690	...	...
17.7.94 (1)	Obs. Calc.	1.444 1.313	1.332 1.294	1.272 1.252	1.199 1.197	1.143 1.143	1.079 1.085	0.991 0.996	0.908 0.919	0.845 0.853	0.792 0.790	0.740 0.737	0.700 0.690	0.653 0.657	0.613 0.612	0.580 0.583
17.7.94 (2)	Obs. Calc.	1.446 1.350	1.330 1.292	1.265 1.259	1.190 1.198	1.130 1.120	1.064 1.069	0.973 0.970	0.886 0.888	0.813 0.821	0.756 0.762	0.708 0.708	0.653 0.661	0.613 0.614	0.580 0.576	0.556 0.546
18.7.94	Obs. Calc.	1.428 1.357	1.324 1.314	1.260 1.270	1.210 1.203	1.150 1.148	1.049 1.062	0.954 0.954	0.869 0.871	0.799 0.802	0.740 0.740	0.672 0.687	0.633 0.633	0.602 0.588	0.568 0.549	...
19.7.94	Obs. Calc.	1.425 1.330	1.316 1.288	1.250 1.246	1.170 1.180	1.114 1.120	1.049 1.043	0.939 0.939	0.857 0.857	0.785 0.787	0.716 0.724	0.672 0.668	0.623 0.623	0.580 0.580	...	...
20.7.94 (1)	Obs. Calc.	1.403 1.314	1.305 1.276	1.243 1.240	1.167 1.175	1.114 1.111	1.045 1.045	0.944 0.944	0.863 0.861	0.792 0.787	0.732 0.732	0.672 0.667	0.633 0.630	0.602 0.590	0.568 0.571	...
20.7.94 (2)	Obs. Calc.	1.420 1.328	1.312 1.285	1.248 1.243	1.170 1.177	1.111 1.113	1.037 1.037	0.929 0.933	0.850 0.849	0.778 0.784	0.716 0.721	0.672 0.665	0.623 0.616	0.580 0.574	0.544 0.538	0.505 0.509
21.7.94 (1)	Obs. Calc.	1.412 1.316	1.305 1.278	1.243 1.238	1.164 1.171	1.110 1.110	1.041 1.037	0.934 0.934	0.857 0.855	0.785 0.787	0.724 0.725	0.672 0.667	0.623 0.619	0.590 0.581	...	...
21.7.94 (2)	Obs. Calc.	1.410 1.326	1.308 1.285	1.246 1.249	1.164 1.180	1.104 1.105	1.037 1.010	0.934 0.932	0.850 0.852	0.785 0.777	0.716 0.717	0.663 0.655	0.613 0.609	0.568 0.568	0.532 0.530	...
23.7.94 (1)	Obs. Calc.	1.410 1.303	1.305 1.264	1.243 1.228	1.167 1.167	1.109 1.109	1.037 1.057	0.934 0.934	0.857 0.854	0.785 0.783	0.724 0.724	0.672 0.677	0.623 0.626	0.590 0.586	0.556 0.547	0.530 0.512
23.7.94 (2)	Obs. Calc.	1.288 1.254	1.230 1.214	1.187 1.187	1.127 1.127	1.072 1.076	1.009 1.002	0.908 0.914	0.832 0.828	0.756 0.766	0.708 0.710	0.653 0.655	0.613 0.613	0.580 0.572	0.544 0.534	0.518 0.502

24.7.94 (1)	Obs. Calc.	1.380 1.310	1.297 1.270	1.230 1.225	1.155 1.161	1.090 1.100	1.021 1.023	0.924 0.920	0.839 0.835	0.771 0.769	0.700 0.705	0.643 0.650	0.602 0.600	0.568 0.564	0.530 0.525	0.490 0.488
24.7.94 (2)	Obs. Calc.	1.356 1.300	1.269 1.253	1.215 1.215	1.146 1.151	1.086 1.091	1.021 1.011	0.919 0.912	0.839 0.829	0.763 0.762	0.699 0.704	0.653 0.649	0.602 0.602	0.568 0.558	0.531 0.519	...
24.7.94 (3)	Obs. Calc.	1.352 1.294	1.272 1.262	1.223 1.217	1.146 1.152	1.090 1.086	1.017 1.017	0.919 0.913	0.832 0.826	0.756 0.766	0.699 0.707	0.643 0.647	0.602 0.602	0.556 0.560	...	...
25.7.94 (1)	Obs. Calc.	1.400 1.311	1.290 1.263	1.255 1.226	1.149 1.151	1.086 1.099	1.017 1.007	0.914 0.914	0.832 0.825	0.756 0.760	0.699 0.697	0.643 0.643	0.602 0.602	0.568 0.556	0.531 0.516	0.518 0.48
25.7.94 (2)	Obs. Calc.	1.398 1.340	1.286 1.286	1.253 1.240	1.149 1.162	1.086 1.096	1.013 1.008	0.908 0.902	0.813 0.811	0.740 0.748	0.680 0.685	0.623 0.628	0.580 0.580	0.544 0.540	0.505 0.507	...
25.7.94 (3)	Obs. Calc.	1.371 1.300	1.269 1.252	1.217 1.213	1.140 1.141	1.079 1.083	1.004 1.004	0.903 0.900	0.813 0.818	0.740 0.747	0.672 0.689	0.633 0.635	0.580 0.584	0.544 0.544	0.518 0.508	...
27.7.94 (1)	Obs. Calc.	1.386 1.312	1.280 1.266	1.225 1.225	1.149 1.153	1.090 1.092	1.017 1.017	0.919 0.916	0.832 0.832	0.756 0.764	0.699 0.701	0.663 0.650	0.613 0.613	0.568 0.568	0.531 0.531	0.505 0.496
27.7.94 (2)	Obs. Calc.	1.362 1.292	1.267 1.250	1.212 1.210	1.133 1.138	1.000 0.996	0.898 0.894	0.806 0.812	0.740 0.742	0.690 0.683	0.633 0.633	0.591 0.591	0.544 0.550	0.505 0.512	0.477 0.477	...
27.7.94 (3)	Obs. Calc.	1.371 1.294	1.281 1.252	1.215 1.213	1.140 1.138	1.079 1.081	1.004 0.998	0.898 0.898	0.819 0.813	0.748 0.752	0.681 0.687	0.633 0.635	0.591 0.588	0.556 0.553	0.518 0.518	...
30.7.94 (1)	Obs. Calc.	1.364 1.292	1.269 1.252	1.217 1.215	1.140 1.148	1.083 0.089	1.013 1.013	0.919 0.913	0.826 0.833	0.763 0.763	0.708 0.708	0.653 0.653	0.613 0.610	0.568 0.566	0.531 0.525	0.505 0.499
30.7.94 (2)	Obs. Calc.	1.332 1.274	1.255 1.232	1.215 1.196	1.137 1.141	1.079 1.081	1.013 1.013	0.914 0.920	0.832 0.833	0.763 0.769	0.708 0.715	0.663 0.658	0.613 0.611	0.580 0.573	0.544 0.542	0.505 0.507
30.7.94 (3)	Obs. Calc.	1.303 1.262	1.240 1.228	1.199 1.197	1.130 1.128	1.072 1.076	1.009 1.008	0.914 0.914	0.832 0.833	0.763 0.769	0.708 0.710	0.653 0.653	0.613 0.611	0.580 0.568	0.531 0.531	0.505 0.503
31.7.94 (1)	Obs. Calc.	1.238 1.222	1.196 1.196	1.158 1.160	1.100 1.100	1.045 1.050	0.987 0.989	0.898 0.895	0.819 0.820	0.748 0.758	0.708 0.700	0.653 0.643	0.602 0.602	0.568 0.568	0.531 0.525	...
31.7.94 (2)	Obs. Calc.	1.288 1.252	1.230 1.219	1.187 1.191	1.124 1.124	1.072 1.072	1.009 1.002	0.908 0.908	0.832 0.832	0.763 0.763	0.708 0.708	0.653 0.661	0.613 0.611	0.580 0.568	0.544 0.536	0.505 0.497
31.7.94 (3)	Obs. Calc.	1.303 1.290	1.240 1.240	1.196 1.204	1.130 1.150	1.079 1.088	1.009 1.013	0.914 0.917	0.839 0.839	0.763 0.769	0.708 0.710	0.663 0.656	0.613 0.611	0.580 0.570	0.544 0.534	0.505 0.495

TABLE VIII.—Continued.

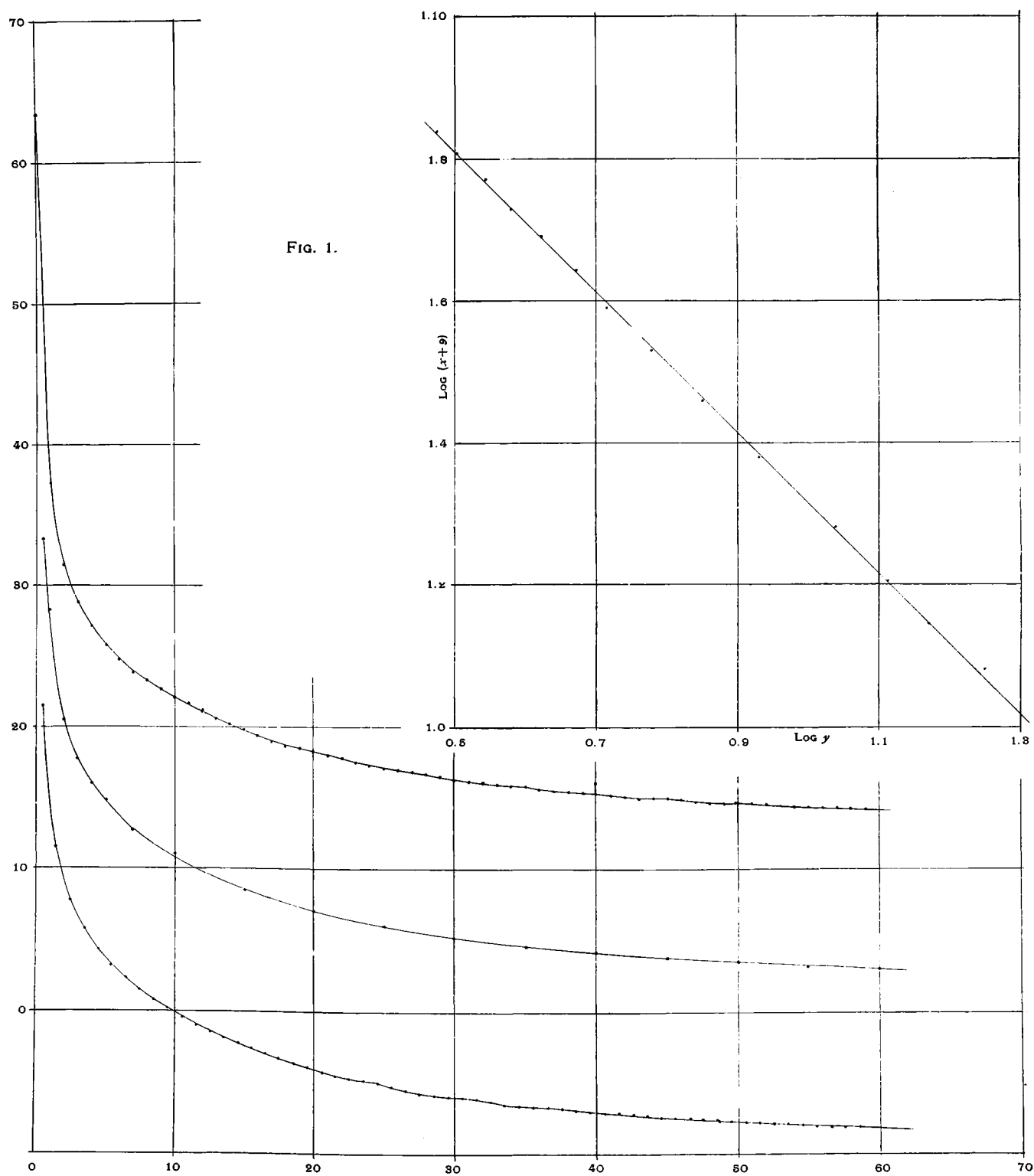
Date.	Log. y	1	2	3	5	7	10	15	20	25	30	35	40	45	50	55
1.8.94 (1)	Obs. Calc.	1.318 1.280	1.250 1.237	1.199 1.199	1.130 1.137	1.079 1.083	1.013 1.012	0.908 0.915	0.839 0.836	0.763 0.766	0.708 0.710	0.663 0.659	0.613 0.615	0.580 0.578	0.544 0.540	0.518 0.500
1.8.94 (2)	Obs. Calc.	1.220 1.219	1.182 1.182	1.152 1.153	1.090 1.098	1.045 1.050	0.982 0.980	0.892 0.895	0.813 0.823	0.748 0.756	0.699 0.699	0.653 0.647	0.613 0.603	0.580 0.567	0.544 0.530	0.505 0.505
2.8.94 (1)	Obs. Calc.	1.310 1.272	1.253 1.235	1.204 1.204	1.133 1.141	1.079 1.088	1.013 1.015	0.914 0.918	0.826 0.824	0.763 0.777	0.708 0.719	0.663 0.663	0.613 0.615	0.580 0.578	0.544 0.538	0.518 0.510
2.8.94 (2)	Obs. Calc.	1.196 1.190	1.161 1.159	1.133 1.133	1.083 1.075	1.025 1.036	0.968 0.973	0.886 0.885	0.806 0.812	0.740 0.754	0.699 0.694	0.643 0.640	0.602 0.597	0.568 0.561	0.531 0.524	......
2.8.94 (3)	Obs. Calc.	1.114 1.116	1.093 1.093	1.068 1.068	1.025 1.023	0.978 0.980	0.919 0.921	0.845 0.845	0.778 0.778	0.708 0.718	0.663 0.663	0.613 0.617	0.580 0.578	0.544 0.539	0.518 0.505	0.491 0.482
3.8.94 (1)	Obs. Calc.	1.017 1.015	1.000 0.998	0.987 0.981	0.954 0.949	0.919 0.920	0.881 0.883	0.819 0.813	0.763 0.768	0.716 0.725	0.681 0.680	0.643 0.637	0.613 0.606	0.580 0.571	0.556 0.532	0.531 0.504
3.8.94 (2)	Obs. Calc.	1.377 1.304	1.276 1.257	1.217 1.217	1.170 1.146	1.079 1.086	1.004 1.004	0.898 0.900	0.813 0.821	0.740 0.748	0.690 0.689	0.633 0.632	0.591 0.588	0.544 0.549	0.518 0.511	......
3.8.94 (3)	Obs. Calc.	0.982 0.976	0.959 0.956	0.939 0.937	0.908 0.904	0.869 0.869	0.826 0.823	0.756 0.756	0.699 0.698	0.643 0.643	0.602 0.602	0.556 0.559	0.518 0.521	0.491 0.489	0.462 0.456	......
3.8.94 (4)	Obs. Calc.	1.176 1.174	1.146 1.146	1.117 1.115	1.061 1.058	1.013 1.005	0.949 0.943	0.851 0.858	0.778 0.784	0.716 0.719	0.653 0.665	0.613 0.613	0.568 0.573	0.544 0.536	0.505 0.509	......
4.8.94 (1)	Obs. Calc.	1.179 1.174	1.152 1.152	1.127 1.127	1.083 1.082	1.041 1.039	0.982 0.980	0.903 0.905	0.826 0.846	0.778 0.786	0.716 0.725	0.681 0.675	0.643 0.635	0.613 0.592	0.580 0.560	0.544 0.523
4.8.94 (2)	Obs. Calc.	1.133 1.127	1.111 1.103	1.090 1.090	1.045 1.043	1.009 1.005	0.954 0.956	0.881 0.883	0.813 0.824	0.748 0.763	0.708 0.706	0.663 0.661	0.623 0.621	0.591 0.586	0.556 0.556	0.518 0.518
4.8.94 (3)	Obs. Calc.	0.799 0.783	0.785 0.774	0.778 0.768	0.756 0.748	0.732 0.731	0.716 0.707	0.663 0.668	0.633 0.628	0.602 0.597	0.568 0.560	0.531 0.527	0.518 0.500	0.491 0.472	0.462 0.447	......
4.8.94 (4)	Obs. Calc.	0.785 0.783	0.771 0.766	0.763 0.763	0.748 0.748	0.732 0.729	0.699 0.706	0.653 0.667	0.623 0.626	0.591 0.596	0.556 0.565	0.531 0.531	0.518 0.503	0.491 0.481	0.462 0.452	......

4.8.94 (5)	Obs. Calc.	1·230 1·207	1·187 1·178	1·152 1·148	1·097 1·092	1·041 1·039	0·982 0·980	0·892 0·891	0·813 0·814	0·748 0·758	0·699 0·701	0·643 0·646	0·602 0·606	0·568 0·568	0·544 0·530	...
16.7.95	Obs. Calc.	1·340 1·302	1·250 1·250	1·197 1·204	1·118 1·126	1·052 1·030	0·977 0·975	0·864 0·862	0·770 0·778	0·700 0·714	0·635 0·646	0·590 0·583	0·557 0·548	0·518 0·508	...	...
17.7.95	Obs. Calc.	1·362 1·342	1·258 1·268	1·200 1·216	1·130 1·120	1·012 1·046	0·954 0·952	0·840 0·820	0·750 0·742	0·674 0·674	0·557 0·613	0·520 0·560	0·500 0·510	0·444 0·475	...	...
18.7.95	Obs. Calc.	1·350 1·303	1·248 1·242	1·184 1·188	1·100 1·098	1·030 1·024	0·945 0·933	0·820 0·822	0·730 0·730	0·683 0·672	0·602 0·590	0·512 0·540	0·462 0·494	0·413 0·450	0·398 0·417	...
19.7.95	Obs. Calc.	1·337 1·285	1·237 1·220	1·178 1·173	1·090 1·084	1·017 1·015	0·930 0·928	0·812 0·821	0·724 0·724	0·664 0·662	0·592 0·602	0·557 0·555	0·518 0·510	0·478 0·470	0·444 0·434	...
20.7.95 (1)	Obs. Calc.	1·324 1·287	1·231 1·229	1·174 1·174	1·090 1·090	1·020 1·020	0·944 0·933	0·824 0·822	0·740 0·737	0·664 0·664	0·617 0·610	0·533 0·533	0·518 0·516	...	...	...
20.7.95 (2)	Obs. Calc.	1·328 1·312	1·224 1·232	1·165 1·174	1·080 1·080	1·000 0·994	0·917 0·902	0·794 0·792	0·701 0·702	0·642 0·633	0·568 0·574	0·523 0·522	0·479 0·481	0·440 0·441	0·20 0·14	...
20.7.95 (3)	Obs. Calc.	1·324 1·315	1·239 1·238	1·164 1·174	1·080 1·080	1·003 1·007	0·920 0·917	0·800 0·800	0·700 0·707	0·624 0·639	0·580 0·578	0·532 0·520	0·479 0·476	...	...	...
22.7.95	Obs. Calc.	1·313 1·268	1·210 1·205	1·150 1·146	1·055 1·048	0·984 0·981	0·892 0·888	0·770 0·776	0·680 0·687	0·612 0·612	0·556 0·558	0·502 0·514	0·461 0·464	0·440 0·426	0·398 0·395	0·362 0·358
23.7.95	Obs. Calc.	1·310 1·328	1·203 1·237	1·144 1·160	1·045 1·045	0·978 0·964	0·877 0·868	0·750 0·754	0·654 0·670	0·590 0·602	0·545 0·540	0·490 0·495	0·450 0·449	0·417 0·415	0·380 0·380	0·343 0·353
26.7.95 (1)	Obs. Calc.	1·302 1·264	1·208 1·199	1·130 1·143	1·043 1·047	0·980 0·978	0·884 0·872	0·968 0·980	0·883 0·887	0·827 0·824	0·766 0·766	0·718 0·719	0·680 0·674	0·650 0·634	0·616 0·600	...
26.7.95 (2)	Obs. Calc.	1·298 1·298	1·192 1·192	1·122 1·118	1·022 1·012	0·938 0·930	0·844 0·840	0·716 0·728	0·643 0·643	0·580 0·574	0·520 0·522	0·478 0·477	0·432 0·430	0·380 0·400	0·344 0·368	0·323 0·339
25.7.95	Obs. Calc.	1·297 1·272	1·192 1·190	1·123 1·128	1·025 1·022	0·950 0·946	0·858 0·852	0·732 0·743	0·645 0·652	0·580 0·569	0·518 0·512	0·478 0·481	0·432 0·431	0·400 0·394	0·461 0·469	...
27.7.95	Obs. Calc.	1·298 1·296	1·190 1·204	1·118 1·127	1·020 1·016	0·944 0·940	0·846 0·840	0·724 0·730	0·646 0·643	0·580 0·578	0·517 0·520	0·478 0·478	0·417 0·430	0·380 0·396	...	...
9.12.95	Obs. Calc.	1·292 1·292	1·190 1·210	1·130 1·146	1·043 1·040	0·968 0·960	0·880 0·866	0·762 0·752	0·668 0·670	0·592 0·602	0·532 0·541	0·506 0·490	0·448 0·446	0·424 0·410	0·380 0·370	...

TABLE VIII.—Continued.

Date.	Log. y	1	2		3	5	7	10	15	20	25	30	35	40	45	50	55
12.12.95	Obs.	1.305	1.190		1.134	1.042	0.968	0.876	0.760	0.672	0.602	0.556	0.505	0.462	0.432	...	...
	Calc.	1.288	1.204		1.146	1.039	0.966	0.874	0.762	0.674	0.599	0.553	0.506	0.462	0.422	...	...
17.12.95	Obs.	1.111	1.072		1.042	0.976	0.930	0.850	0.760	0.690	0.638	0.580	0.544	0.506	0.462	0.440	...
	Calc.	1.110	1.072		1.037	0.981	0.928	0.860	0.768	0.693	0.638	0.578	0.527	0.486	0.450	0.418	...
18.12.95	Obs.	1.121	1.083		1.047	0.992	0.937	0.870	0.786	0.716	0.658	0.612	0.568	...	...	...	...
	Calc.	1.120	1.086		1.046	0.992	0.939	0.873	0.786	0.715	0.658	0.602	0.554	...	...	...	...
19.12.95	Obs.	0.964	0.940		0.924	0.890	0.858	0.812	0.748	0.690	0.648	0.602	0.574	0.544	...	...	...
	Calc.	0.962	0.942		0.924	0.888	0.856	0.810	0.750	0.692	0.641	0.602	0.563	0.528	...	...	...
19.12.95	Obs.	0.842	0.826		0.810	0.778	0.764	0.736	0.682	0.648	0.602	0.562	0.532	0.506	...	...	...
	Calc.	0.838	0.827		0.812	0.782	0.766	0.736	0.684	0.644	0.604	0.564	0.532	0.498	...	...	...
20.12.95 (1)	Obs.	0.716	0.708		0.701	0.688	0.674	0.654	0.622	0.594	0.564	0.536	0.510	0.483	...	...	...
	Calc.	0.713	0.704		0.699	0.687	0.673	0.653	0.622	0.590	0.563	0.537	0.509	0.484	...	...	...
20.12.95 (2)	Obs.	0.474	0.470		0.464	0.454	0.446	0.432	0.408	0.388	0.366	0.344	0.324	...	...	...	...
	Calc.	0.474	0.470		0.464	0.454	0.444	0.429	0.407	0.386	0.364	0.345	0.326	...	...	...	...
24.12.95	Obs.	0.209	0.206		0.202	0.198	0.190	0.184	0.173	0.161	0.146	0.137	0.121	0.111	0.100	...	...
	Calc.	0.207	0.203		0.201	0.197	0.190	0.185	0.176	0.162	0.149	0.136	0.122	0.112	0.099	...	...
24.12.95	Obs.	0.923	0.910		0.900	0.878	0.857	0.826	0.780	0.740	0.704	0.670	0.638	0.606	0.578
	Calc.	0.922	0.910		0.900	0.880	0.857	0.826	0.780	0.740	0.708	0.671	0.638	0.608	0.570

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