

# Computer Analysis of the Historical Values of the Velocity of Light

DR MAURIE G. EVERED

## ABSTRACT

Computer analysis of the full data set of values of the velocity of light presented in *The Atomic Constants, Light and Time* (Norman and Setterfield<sup>1</sup>) indicates that no significant change has occurred in that constant in the last 300 years. This confirms the results of Aardsma,<sup>2</sup> Humphreys<sup>3</sup> and Brown.<sup>4</sup>

## THE COMPUTER ANALYSIS

The entire Norman and Setterfield data set of 163 values of  $c^5$  was subjected to a computer analysis using a program developed by Dr Mark Evered. The reasons why the entire data set must be used in such an analysis have been explained well by Aardsma,<sup>6</sup> Humphreys<sup>7,8</sup> and Brown.<sup>9</sup> There is nothing to be added to their comments

in this respect. In the results that follow  $c$  is the velocity of light in km/s and  $T$  is the corresponding time given by the relationship  $T = (1984 - \text{year AD})$ . This follows the convention of Brown with  $T$  increasing in time past. The significance of each equation was tested using the  $F$  statistic. Significance was considered to be established if the statistic reached the 0.05 level of rejection.

The results of this analysis indicated that —

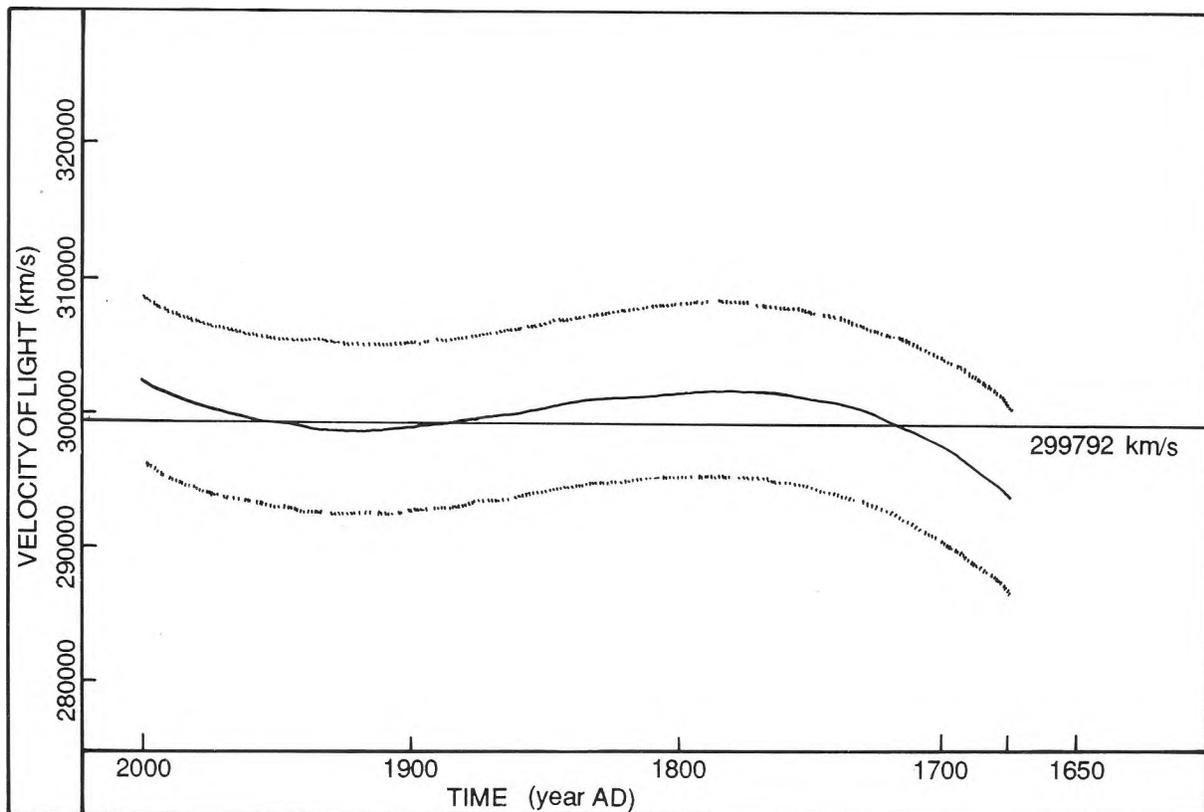


Figure 1. The cubic equation and its 95% confidence limits.

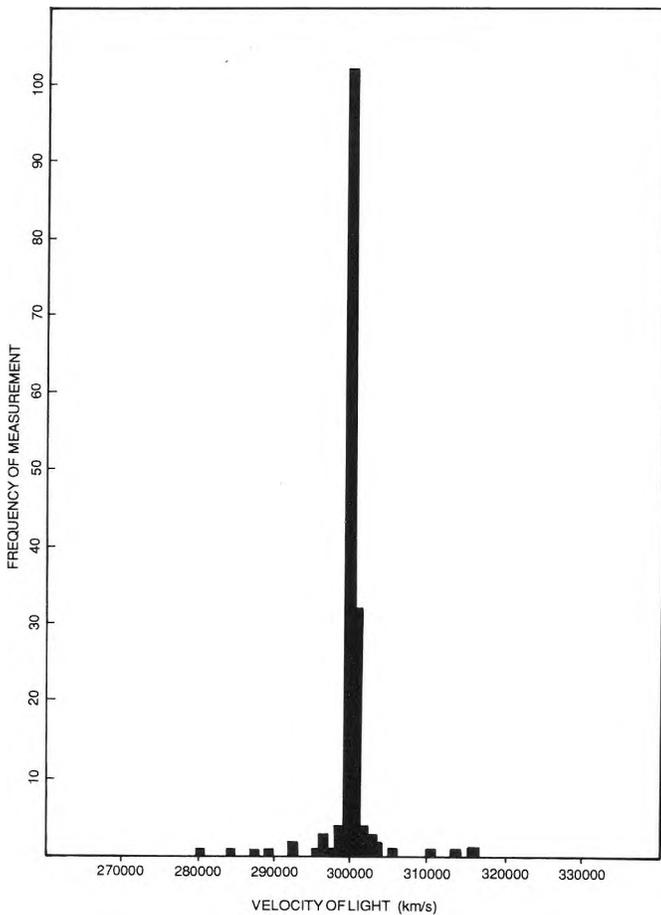


Figure 2. Histogram of  $c$  measurements.

- (1) The 1693 Cassini value should be rejected as an outlier. It is far removed from other estimates of  $c$  made within 20 years and is removed from the arithmetic mean of the rest of the data by sixteen standard deviations.
- (2) With a polynomial equation of degree one  $c = 0.5053017T + 299627$ . With this equation significance is not obtained. To get more information about this equation the standard error of the slope was calculated giving the result  $0.5 \pm 5.6$  km/s/year. The weighted equation was calculated, using the method of Aardsma to be  $0.00001 \pm 0.00005$  km/s/year. Overall there is no case for a linear decrease in  $c$ . This is in line with the results of Aardsma,<sup>10</sup> Humphreys<sup>11</sup> and Hasofer.<sup>12</sup>
- (3) With a polynomial equation of degree two  $c = -0.0207618T^2 + 5.22823159T + 299422$ . This equation is an inverted parabola with  $c$  allegedly rising, peaking then decreasing. Again significance is not obtained.
- (4) With a polynomial equation of degree three  $c = -0.0021896T^3 + 0.85624355T^2 - 80.466791T + 301332$  and here significance is obtained. This is in line with the results of Brown<sup>13</sup> and Hasofer.<sup>14</sup> This equation was tested further using the method of

Brown in applying a regression confidence limits analysis. The result is shown in Figure 1. Throughout the period of 1675–1983 when  $c$  was being measured the 95% confidence bands include the straight line at today's  $c$  value, indicating that there is no evidence for the assertion that  $c$  has varied statistically from that value.

- (5) With an exponential equation  $c = 299640 \exp 4.4611 \times 10^{-7}T$ . This is virtually a horizontal straight line through the data and not surprisingly significance is not obtained.

## DISCUSSION

The results of this analysis are very clear. There is no evidence that the velocity of light has changed in the last 300 years. The only significant equation would predict that  $c$  was lower in the past and will increase in the future. This is a scientific absurdity, but it raises a very important point. No equation claiming to statistically support the behaviour of any physical entity can be considered scientifically valid if its predictions are scientific nonsense. This was shown clearly by Aardsma in his treatment of the carbon-14 dating predictions of the Setterfield degree eight polynomial equation.<sup>15</sup>

The position of the third degree polynomial equation is interesting, occurring as it does as an 'equation of good fit' in three independent analyses, two unweighted and one weighted. The Hasofer weighted analysis also finds the degree two equation as significant but to a lesser extent than the degree three.<sup>16</sup> His quadratic equation does not stand the test of scientific predictability. As an example it predicts that in 1990 the velocity of light should be 299817 km/s, and in 2000 it should be 299838 km/s. This obviously cannot be. If the atomic clock ticks in lockstep with  $c$  as Setterfield theory predicts, then by now the world's time and navigation standards would be in a hopeless mess.

There is another disturbing factor in the Hasofer analysis. He very rightly points out that the result depends heavily on the credibility of five  $c$  measurements made from 1727 to 1771. All the  $c$  values and their error limits were supplied by Norman and Setterfield, but those supplied to Hasofer differ markedly in detail from those published by them in 1987 and from those published in the earlier Setterfield writings, particularly with regard to the associated errors.<sup>17,18</sup> Is it coincidence that these changed values are all in the direction that would favor the theory that  $c$  has decreased?

It is informative to examine some parameters of the distribution of  $c$  measurements, in particular the arithmetic mean 299670 km/s, the geometric mean 299650 km/s, and the median 299790 km/s. These are all **below** 299792.5 km/s, the currently accepted value of the velocity of light. The standard deviation of the  $c$  values is 3257.2 km/s, so the standard error of the mean is 255.9 km/

s. The mean differs from 299792.5 km/s by a value equal to 0.48 standard errors, statistically very insignificant. Look too at the Pearsonian skewness, -0.1105, and the kurtosis, 15.799, of the distribution. These are shown in the histogram of Figure 2. Where is the claimed evidence that this distribution supports the Setterfield theory? Add these facts to the results of three analyses that establish a cubic equation as the line of best fit and you are forced to the conclusion that a decrease in  $c$  exists only in the minds of those advocating the theory.

Like other creationists I have been on both sides of the fence in this argument. I was originally impressed by the Setterfield theory, but became disillusioned and finally disbelieving after the whole situation had been examined. The evidence against a recent decrease in  $c$  is overwhelming, but I fear the argument is far from finished.

### ACKNOWLEDGMENT

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**Dr Maurie Evered** was formerly Officer-in-Charge of the World Health Organisation Influenza Reference Centre at the Commonwealth Serum Laboratories (CSL) in Melbourne, Australia. He retired recently after 41 years service at CSL and resides in Oakleigh (Melbourne).