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Is There Really Evidence of a Recent Decrease in c?

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ABSTRACT

The hypothesis of Trevor Norman and Barry Setterfield that the velocity of light has decreased in the last 300 years has been analysed by examining the implication of the predicted c values in the past and future. On this count the theory is found wanting.

INTRODUCTION

Few theories have caused as much controversy in the world of science as the claim by Barry Setterfield that c, the velocity of light, has decreased since it was first measured by Ole Roemer the Danish astronomer in 1675. Such a decrease, if it can be shown to be scientifically feasible, is of tremendous importance to the cause of recent creation. This was well expressed by Montgomery who asked:

> *'Can one simple scientific assumption radically alter the age of the universe, eradicate the Big Bang, sink the Nebular Hypothesis, undermine geological uniformitarianism and destroy Darwin all at the same time?'*[1]

As you would expect, such a radical notion as a decrease in c was not received without comment, comment that has in the last four years erupted into a full-scale controversy. This has been at its fiercest inside the creationist movement. The aim of this article is to review the short history of the theory, examine some arguments of its proponents and opponents, and finally to see what conclusion can validly be drawn.

AN HISTORICAL REVIEW

Stripped of all but essential details the story reads thus:

1981. Barry Setterfield published **The Velocity of Light and the Age of the Universe**.[2] Introduced is the cosec^2 equation and statistical 'proofs' that c had decreased over the last 300 years or so, having started its journey at creation with a velocity of 2×10^{11} times its velocity in 1961. The reader was also told that in 1961 c ceased to decrease.

1983. The theory was restated claiming to have used all measurements of c and still using the cosec^2 equation, which had now been derived theoretically as well as being established as the 'line of best fit' to the data.[3]

1987. The Norman and Setterfield book, The Atomic Constants, Light and Time was published.[4] Now the 'best 57' values of c are used to derive the equations, and although the cosec^2 equation still rates a mention, it loses favoritism to the damped sinusoid and what is said to be its simpler approximation, the degree eight polynomial. The value of c at creation is now stated as 10^7 times c in 1961, not 2×10^{11} c in 1961 as before.

1988. A paper by Dr G. Aardsma of ICR (California) was published as the first paper in the Creation Research Society's Minisymposium on the speed of light.[5] He claimed that a weighted linear analysis of all 163 measurements of c indicated no significant change and that such a claim is false. An unweighted analysis yields a decrease of 38±8 km/s/year, while the weighted analysis yields a decrease of 0.000014±0.0000596 km/s/year. Aardsma also demonstrated another very important detail. He showed convincingly that 'atomic time' derived from the polynomial equation disagreed completely with carbon-14 estimates of 'age' in the year 2000 (approx.) ^{b}c.

1989. Barry Setterfield replied to the criticisms of Aardsma and others.[6] He claimed that the Aardsma linear-type analysis is unsuitable for a non-linear response and quoted several other statistical values to support the c decrease theory.

1989–1991. Several statistical treatments of the data were published, some defending and some opposing the theory.[7,8,9] The most significant finding was the establishment of a degree three polynomial equation as a line of 'very good fit' in three independent analyses. This equation, while statistically sound, is a scientific absurdity as it predicts that c has sharply decreased in the past and will sharply increase in the future.

Year	F_c value according to — Damped sinusoid	Polynomial	Cosec^2
AD 2000	1.000	1.000	1.000
1500	1.031	1.013	1.013
1000	1.681	1.977	1.060
500	5.849	27.4	1.146
1	22.56	277	1.283
BC 500	85.00	1710	1.497
1000	311.8	7505	1.830
2000	4010	77000	3.303
3000	49730	466000	9.355
4000	6.03×10^5	2.03×10^6	143.5
4334			1.6×10^7
4334.99			1.6×10^{11}
5000	7.2×10^6	7.0×10^6	
6000	8.5×10^7	2.05×10^7	

Table 1. *Past behaviour of c for all three equations.*

WHERE TO FROM HERE?

In the face of this 'where do we stand today situation?', how does one attempt to establish the validity or otherwise of the theory? The work of Aardsma in querying the carbon-14 dating situation 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 will be the prime approach in what is to follow.

Let me introduce the term F_c where F_c is the factor by which the velocity of light in 1961 must be multiplied to equal the velocity at time t.

$$F_c = \frac{c(t)}{c(1961)} = \frac{c(t)}{299792}$$

First, let's examine the past values of F_c as predicted by the damped sinusoid, the degree eight polynomial, and the cosec^2 equations. These are presented in Table 1 and Figure 1. Consider F_c in:–

(1) 1 ad, the time of Christ — F_c would have equalled 22.6 by the damped sinusoid, 277 by the polynomial, and 1.28 by the cosec^2 equation.

(2) 2000 bc — the corresponding values would have been 4010, 77000 and 3.30.

It was the alarming value of 77000 for F_c in the year 2000bc that led Aardsma to the conclusion that atomic time derived from the polynomial equation was so inaccurate if compared with carbon-14 dating information. The value of 4010 given by the damped sinusoid also disagrees with the carbon-14 data. The cosec^2 equation would have taken longer in the past to produce this effect but eventually it too may be subjected to the same criticism. The cosec^2 equation also gives unacceptable prediction of astronomical data. It is also obvious that from this table and figure the authors' claim that the damped

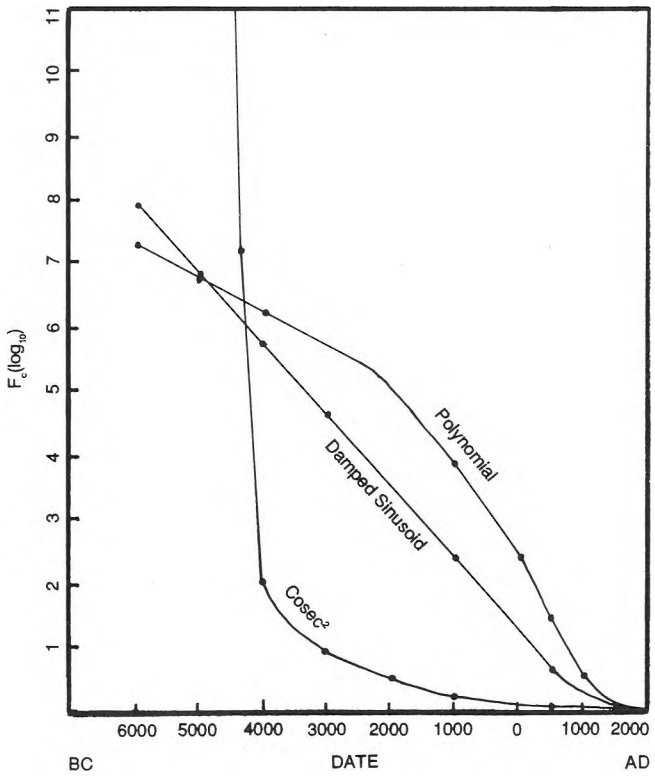

Figure 1. *Comparison of the polynomial, damped sinusoid and cosec^2 curves in the past.*

Year AD	Velocity of light (km/s)	
	Damped sinusoid	Polynomial
1960	299791	299792
1970	299790	299794
1980	299790	299798
1990	299792	299808
2000	299795	299820
2050	299826	299940
2100	299876	300153

Table 2. *Future behaviour of c for two of the equations.*

sinusoid and polynomial equations approximate each other is without foundation. They are like 'chalk and cheese', and many readers must have wondered just which equation describes the alleged decrease in c. It obviously cannot have changed three different ways all at the same time.

I have been accused by one of Barry Setterfield's staunchest supporters of 'stumbling at the unnecessary' in this regard, but I cannot agree. These curves have been extrapolated backward in time to explain all manner of geological, physical and chemical phenomena. It is therefore very important to ensure that they make scientific sense.

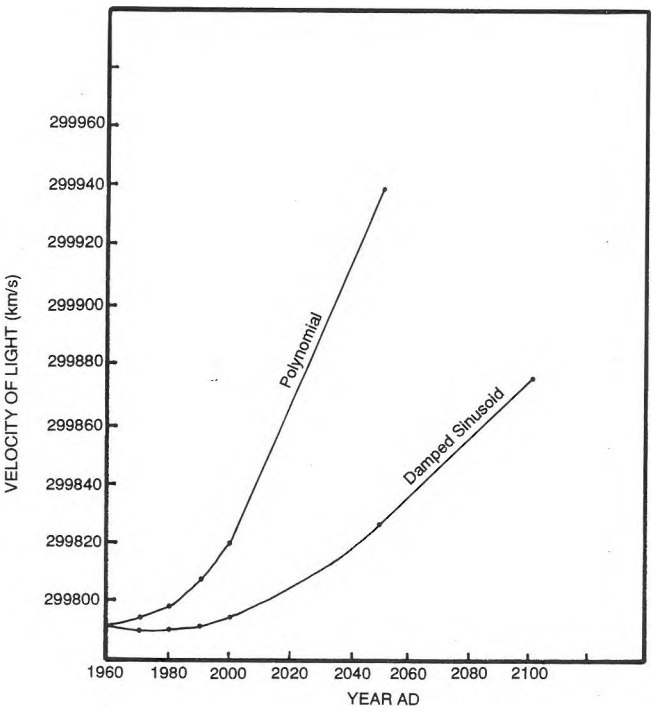

Figure 2. *Comparison of the polynomial and damped sinusoid curves In the future.*

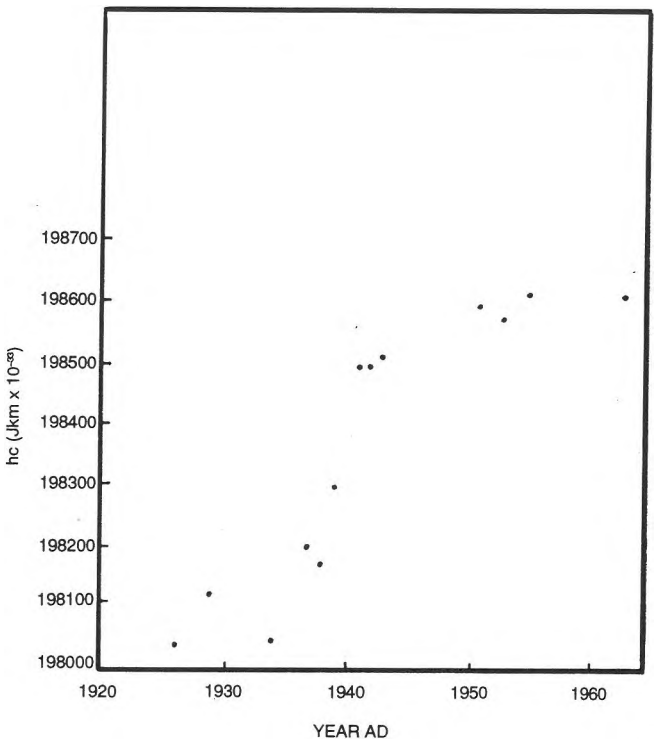

Figure 3. *Graph of hc versus time showing no horizontal straight line relationship.*

Consider now the future behaviour of c as predicted by the damped sinusoid and polynomial equations. These results are presented in Table 2 and Figure 2. Notice the predicted values in the year 2000a d

(1) By the polynomial equation — 299820 km/s.

(2) By the damped sinusoid equation — 299795 km/s.

Consider the implications. If we assume, as does the Setterfield theory, that dynamical time is constant and atomic time varies with c, then there will be in 2000a d four minutes per month difference in the two clock rates if you are to believe the predicted polynomial value. By the damped sinusoid the corresponding difference is about 25 seconds per month. This is highly improbable as such a trend would have already been noticed. Certainly on occasions seconds have to be added to, or subtracted from, standard time to allow for the vagaries of the Earth's rotational period, but variations of this size are by any standards enormous.

It has been claimed that c may be increasing again, as an estimation of Planck's constant h in 1986 was lower than the previous value.[10] By Setterfield theory h $^{1}/_{c}$. An examination of data, however, indicates that the alleged changes in h bear little relation to alleged changes in c. If h $^{1}/_{c}$ then h x c equals a constant, so a graph of hc against time should at least approximate a horizontal straight line. As shown in Figure 3 such a graph drawn from published data does not even resemble this criterion.

By similar reasoning $^{q}/_{mc^2}$ should also graph against time as a horizontal straight line. Here q is the electronic charge

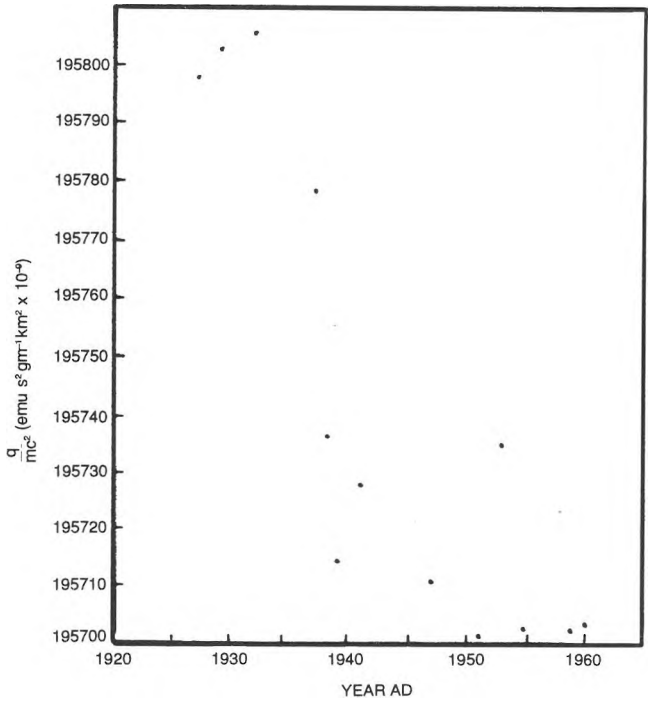

Figure 4. *Graph of q/mc² versus time showing no horizontal straight line relationship.*

and m the electronic mass. This graph is shown as Figure 4. Again this is not a horizontal straight line. Both these lines give regression coefficients statistically differing from zero, the required value if changes in these physical constants correlate with changes in c.

OTHER PROBLEMS

Having shown that all three Setterfield equations may be rejected on scientific grounds, let us pause and examine the nature of the data itself. This is best done by examining Figure 5, reproduced with the kind permission of Dr D. R. Humphreys.[11] It is obvious that the estimates of c over the years are distributed more or less equally above and below the centre line until recently, when virtually all estimates lie along the line itself. Note too the four values indicated by arrows. These values are important because they contribute heavily to any tendency for c to have increased in the past even in a weighted analysis. A consideration of all the facts so far discussed only reinforces the view that a decrease in c exists only in the minds of those advocating the theory.

This view is further reinforced if you examine the weighted means of physical constants alleged to have

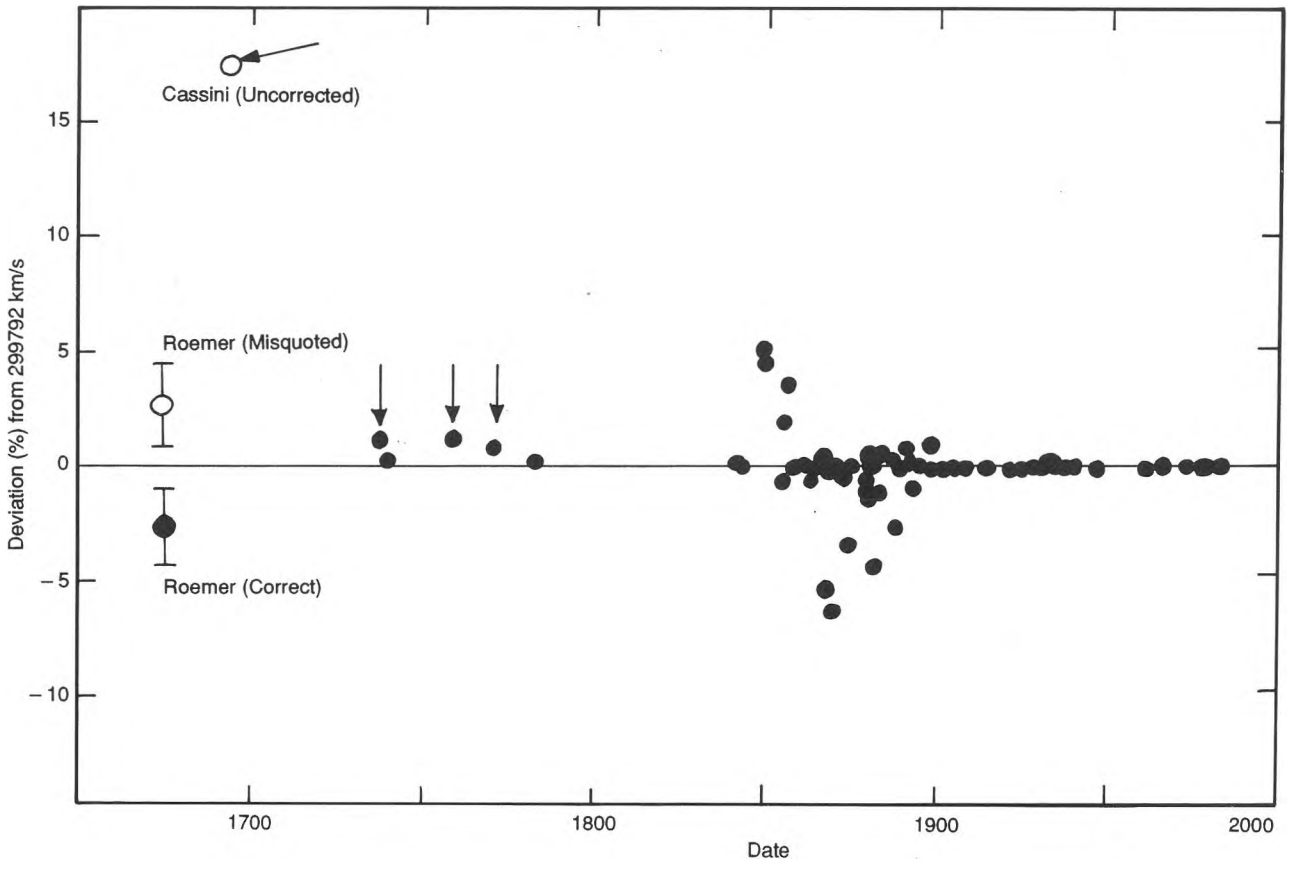

Figure 5. *Percentage deviation of speed of light measurements from 299792 km/s plotted against year of measurement. The 163 date points (estimates of c) include the correct Roemer point. Adapted from D. R. Humphreys.*[11]

Constant	Weighted mean	Most recent value
c	299792.5	299792.5
$\frac{e}{mc^2}$	1.758804	1.758805
$\frac{h}{e}$	1.3795221	1.3795222
Y′	26751.23	26751.23
Rh	25812.847	25812.847

Table 3. *Weighted means of 'variable' constants compared to their most recent values.*

changed as a result of changes in c. Norman and Setterfield often claim that the mean of a set of historical values is above or below the most recent value of a particular physical constant. If however a weighted mean is used, allowance being made for the error limits of each estimate, these claims are seen to be without foundation. Table 3 demonstrates this fact.

The advocates of the theory will of course still ask the usual predictable questions:—

(1) What about the opinion of Troitskii[12] who favors a higher value of c in times past? Two things must be considered. First, nowhere does Troitskii associate his theory with a **recent** decrease in c, and second, many eminent physicists have published arguments that c is constant and invariable. This matter was well reviewed by Brown.[13]

(2) What about Van Flandern's[14] measurements of the orbital period of the moon? The reader should be made aware that these measurements have been highly queried.[15] Van Flandern claimed that the alleged changes in the moon's orbital period resulted from a change in G, the universal gravitational constant. These were interpreted by Setterfield as changes in the atomic clock due to a change in c. However, these results cannot be regarded as supporting either hypothesis. Measurements made by radar ranging of the planets have shown no significant change in G or in any atomic value.[16]

An interesting situation exists with the radioactive isotope iodine-125. This isotope has been used extensively in biological chemistry for 50 years, and during that time its rate of decay has been determined many thousands of times using both dynamic and atomic time standards. Modern counting techniques would certainly have detected any changes in its half-life, approximately 60 days. No such changes have been observed. This is important, because of all the alleged changes in the physical constants associated with 'changes in c', changes in the half-lives of the radioactive elements provide the weakest support.[17] All that Norman and Setterfield say of these results is that they 'do not invalidate the proposal (of a decrease in c).'

CONCLUSION

Without a decrease in c, how do we as creationists explain a young universe? I find satisfaction in the viewpoint that uniformitarianism has prevailed, except for times of Divine intervention when changes, some temporary some permanent, have occurred:

(1) Creation — all matter called into being and order established.

(2) The Fall of Man — biological systems were altered and death started to occur.

(3) The Flood — a time marked by great geological upheaval and the disappearance of some species.

(4) The Dividing of the Earth in the days of Peleg (Genesis 10:25).

It may well be of course that c did change at some time after the creation, or maybe in association with the Flood, but there is no worthwhile evidence that it has changed during its period of measurement over the last 300 years.

Finally, for those interested in a short informative history of the measurements of c, I would recommend an excellent article by Beekman.[18]

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