the expansion option is no longer valid. Now if the c data ties in with the red-shift data, then what is the Universe doing? We have an absolute reference frame, namely the 3°K background radiation. This shows that our Local Group of galaxies is collapsing towards the Virgo Cluster of galaxies at the rate of about 270 km/sec (S. Weinberg, **The First 3 Minutes**, p. 152 and Hart and Davies in **Nature**, vol. 297, 20th May, 1982, p. 195). Again in the May 1984 edition of the **ASSA Journal**, p. 9, there was a report on the highlights of the last year's observations from the Anglo-Australian telescope. One item stated that the AAT had discovered that "A very populous super-cluster of galaxies has been found to be collapsing under its own gravity. . ." In other words this suggests that the Universe is undergoing gravitational collapse rather than expansion.

Well, what about these clusters of galaxies that seem to be disrupting? The figures for the rate of disruption COME FROM THE RED-SHIFT. In other words, the apparent difference in velocity between one part of a cluster of galaxies and another measured by red-shift differences will be mainly due to the change in the speed of light across the cluster. When this is done, knowing the approximate cluster size, then the disruption anomaly disappears and the cluster, instead of disrupting, is in fact collapsing in on itself as indicated by the above quote. There will undoubtedly be some residual movement between individual members, but the change in c will often cause this to be masked out.

Thus the example that was used on the tape has been rendered invalid as an indication of a young universe. Instead it has given supportive evidence for the degree to which c has changed. However, conventional astronomers are taking the collapse of super-clusters as a sign that they are young anyway, since if they were thousands of millions of years old, that process should have stabilised long, long ago. That it is still occurring indicates a youthful cluster, or as the **ASSA** article states "the growth of such clusters is still occurring in the Universe", and the youth is implicit in such a thought.

EXTRAPOLATION OF THE C DECAY CURVE

A question from Rev. W.P. Gadsby, Armidale, N.S.W., Australia.

I refer to the work of Barry Setterfield on the speed of light.

In the recent publication **The Case Against Evolution: The Case for Creation**, the authors state that Setterfield has shown that the speed of light has been decreasing over a 300-year period. During this period, the decay in speed has apparently conformed to the equation:

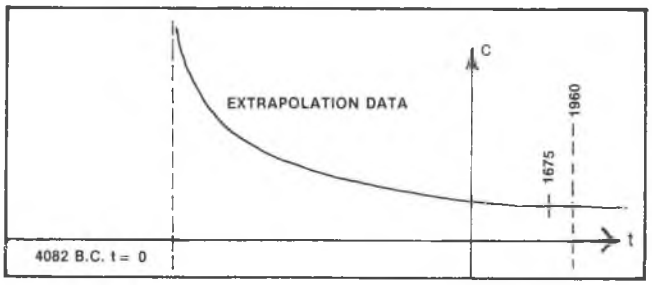
Speed of Light, $c = A \operatorname{cosec}^2(kt)$

where A = 29972.445 km/s (the minimum speed of light, reached in AD 1960);
k = 0.0148957299 degrees/year;
and t = time elapsed in years (since 4082 BC).

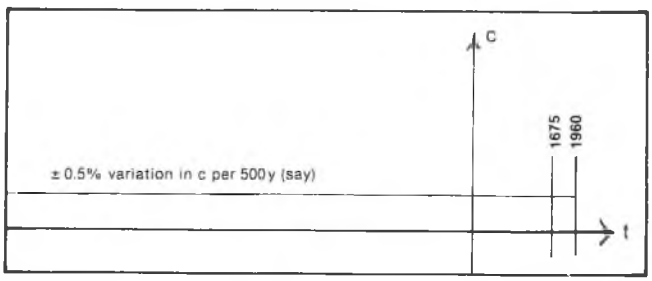
In the publication, **The Velocity of Light and the Age of the Universe**, Setterfield states that in 1960 the value of c ceased to change. In other words, the above equation ceased to apply at that time. Put mathematically, there is a "discontinuity" in the curve at t = 60 + 4082 elapsed time.

Now my question is this: if Setterfield is happy to admit a discontinuity at AD 1960, upon what basis does he assume that there have been no discontinuities prior to AD 1675 (when the first measurement of c was made)? If there is no basis for such an assumption, then how secure is the extrapolation (by a factor of **20** times) backward in time to 4082 BC?

For example: it may have been that in 1674, the speed of light had reached a **maximum** before beginning to decay (again)? So instead of



we may have had



with c oscillating around a fixed value every 500 years (say).

Is there really any evidence in support of Setterfield's **backward** extrapolation of his curve when he admits that we cannot extrapolate it **forward** into the future?

Barry Setterfield responds. . .

You raise several points. First, an error in printing must be corrected. In the Casebook No. 1 **The Case Against Evolution: The Case for Creation**, the equation governing the decay in the speed of light is correctly given as

$c = A \operatorname{cosec}^2 kt$ .....(1)

However the value of A, the minimum speed of light is incorrectly given as

A = 29972.445 km/sec .....(2)

That should read

A = 299,792.445 km/sec .....(3)

The second point that you raise concerns the behaviour of c in the real world compared with a theoretical mathematical function. The real-world observation and behaviour of c is described by the function given in (1) but only in the period 0 — 90°. In other words, once the decay has reached its minimum point in 1960 AD it does not start to climb back up again as the mathematical function does if continued beyond 90°. The situation is similar to a rubber band that has been stretched and then let go. Once it reaches its minimum point it does not re-stretch itself back to its maximum extension and contract again ad infinitum, even though its behaviour can be described by such a periodic mathematical function. There is a difference between pure mathematical abstraction and the real world. Again, the decay curve of light output by a nova or supernova is described by a log sine curve which is a periodic mathematical function. However, the function is only an accurate description of reality in the period 0 — 90°. After the minimum point is reached, the supernova does not start brightening up again. Similarly, the behaviour of a top or gyroscope is similarly described mathematically after it has received a change of axis tilt due to the application of some force. Its restoration to a new position of equilibrium is described by the periodic mathematical function but only in the period 0 — 90°. The top does not start heeling over again to its position of maximum displacement once the new position of balance has been reached at the 90°point in the mathematical function. This smooth tapering into the final position of equilibrium can hardly be described as a discontinuity, though a pure mathematician may desire to.

This bring us to the third point: what evidence is there for the backwards extrapolation of the curve by a factor of 20 times the time base. The point that you fail to grasp is that there IS NO EXTRAPOLATION AT ALL. There are actual data points defining the top end of the curve from geology and astronomy. These data points in fact are the ones that eliminate all other contenders for the type of curve that is governing the decay. From the theory of the situation, a change in c will result in a change in the radioactive decay rates, that is the half-lives of the radioactive elements. Consequently we have in the elemental abundances and the isotope ratios another set of data that must be approximated to at least. In addition, again from the theory of the situation, we have from the Doppler-Michelson equation the fact that a decay in c will inevitably give rise to a red-shifting of light. The red-shifts of the distant galaxies thus give us a direct measure of how much c has decayed and over what sort of time base. The operative equation in this case is that the red-shift Z is related to the total travel time T and the ratio of the speed of light at the time of emission to that now N as follows

$1 - (1/(1 + Z)) = N/T$ .....(4)

For the Virgo Cluster of galaxies with Z = 0.001 we have N/T approximately equal to 0.001. As we know from other measurements that the closest members of this cluster are about 60 million LY away (S. Weinberg **The First 3 Minutes**, p. 174), then it means that the intergral under whatever curve for c decay is chosen must at the time T that approximates to 60 million LY give a value of c in accord with the above which means that

N = c(then)/c(now) = 0.001 T .....(5)

The most distant galaxy has a value of Z = 4 approximately, thus

N = 0.8 T .....(6)

In the limit, the 3°K background gives us the approximation

N = T .....(7)

and in this case the geological data limits the possibility of the range that N approximates to T from an integral value somewhere between 1.8 billion LY to about 5.6 billion LY. Under these conditions the upper value of c is fixed as is the time base for the decay. Consequently there is no extrapolation involved when the three sets of data are considered. This is explained more fully in the article on the red-shift in this volume. However, this should suffice to show that the decay curve is in fact defined both at

its beginning and at its end by real-world observations. I trust that this overcomes your difficulties.

EINSTEIN'S RELATIVITY AND SPEED OF LIGHT DECAY.

Some questions from Mr K. Nolan of East Keilor, Victoria, Australia.

The notion that the speed of light in vacuo, c, has varied strikes me as ludicrous. Apparently the fundamental principle of relativty, in its broadest sense, has been attacked. One must ask the fundamental question: "if the speed of light varies, what could it be **relative** to?" It is universally accepted that the chemical linking forces between atoms and molecules, of which the physicist's measuring instruments, and indeed the physicist himself, are composed, is electromagnetic in nature. Indeed, the most successful physical theory ever devised, Q.E.D., interprets the electromagnetic force as a photon exchange between particles such as electrons and protons. "Light", of whatever wavelength, is also a conglomeration of photons, or quantized electromagnetic field. Once this is grasped, it is immediately apparent that any "speeding up" of light photons, must of necessity mean a "speeding up" of photon exchanges within ordinary matter to a **precisely equal degree**, so that **relative** to the observer and his instruments, nothing could possibly change.

It is only meaningful, and possible, to talk about a possible variation with time of the **ratio** between the fundamental forces of nature, i.e. gravitation: weak force (related to radioactive decay): electromagnetism: strong force (nuclear forces, quarks). Thus it is meaningful to talk of gravity getting "weaker" with time, meaning that the ratio (gravitational force)/(electromagnetic force) is decreasing. There is in fact increasing, though still tentative, evidence to suggest such an effect, and it logically follows if we accept Mach's principle and that the universe is indeed **expanding** (as virtually all astronomers agree).

To claim that the value of c has varied IN EVEN THE MOST MINUTE DEGREE, is to claim that the strength of the electromagnetic field varies relative to itself!! If this were indeed true, the physical universe is a far stranger place than anyone can possibly imagine. We would have to discard the idea of laws of nature and conclude that reality is only an illusion (perhaps Christian Science dogma is right after all!).

Really though, Romans 1:19,20 tells me that the creation of God is very real, and in order to testify to Him, must obey consistent, rational laws.

Consider for example the classic illustration of the relativistic effects of length contraction and time dilation at speeds near that of light. A hypothetical space traveller in a space capsule moving at high velocity **relative** to a stationary observer will appear to be aging much slower, and to contract in the direction of motion. A naive conclusion would be that our space traveller friend would himself notice his "flattened out" wrist-watch on his "flattened out" arm was "going too slow". Of course this is nonsense, and shows a lack of understanding of the principle of relativity; and indeed, **relative** to the "astronaut", the "stationary" observer is the one who is "going too slow" and is "contracted" in length! These same considerations apply to any supposed "tired light" theory.

Let's not fall into the same trap with the evolutionists, who mould and squeeze the "evidence" to support their pre-conceived ideas.

Comments by Barry Setterfield. . .

Mr Nolan seems to have somehow missed one of the key points of Einstein's work in his discussion about relativity. He says "One must ask the fundamental question 'if the speed of light varies, what could it be relative to?'". The whole thrust of Einstein's work is that the SPEED OF LIGHT WILL ALWAYS HAVE THE SAME VALUE AT ANY INSTANT IN ANY AND ALL FRAMES OF REFERENCE no matter how they are moving. This is expressed in another way by saying that the SPEED OF LIGHT IS INDEPENDENT OF THE MOTION OF THE SOURCE OR OBSERVER. If either are moving, then the speed is still measured as having the same value, but there is a Doppler shift in the wavelength. (See 'Principles of Modern Physics', A.P. French, p. 141 ff.).

Mr Nolan, on the other hand, seems to have grasped the main idea behind Part 2 of the printed presentation (see Ex Nihilo, vol. 4, no. 3, 1981, pp 55-81) dealing with the change in c and the atom when he says that any 'speeding up' of light must of necessity mean the 'speeding up' of the exchanges within matter to a precisely equal degree, so that relative to the observer and his instruments nothing could possibly change". This is largely true for atomic processes. When the conservation laws are applied to the atom in a changing c situation it turns out that the electrons move in their orbits at a speed proportional to c. As a consequence, (since the energy of each orbit is constant and the emitted photon wavelength will therfore also be constant), it means that the frequency of light emitted is proportional to c as frequency is proportional to orbital speed. As our reference frequency is also higher, no