article.

11. Ross, H.N., 1995. Progress towards resolution of the creation-date controversy. Facts and Faith 9(1):12–13. Facts and Faith is a quarterly non-peer-reviewed layman's newsletter issued by Ross's organization; it normally does not publish rebuttals. I first saw this issue (first quarter) in March, 1995.

12. Humphreys, D.R., 1995. An open letter to Hugh Ross. Bible-Science News 33(4):21–22. This open letter in the May issue was a copy of a technical reply to Ross's criticisms in Ref. 11; I faxed it to him on March 7, 1995 and mailed him a copy on March 26, 1995. When Ross did not respond, I sent the open letter to BSN. Ross finally replied publicly in the August issue of Bible-Science News 33(6):6, but he did not try to defend his technical points or refute mine, deferring instead to then-future publications he expected from Conner, et al. None of those later publications appeared to use or defend the specific points Ross had made in Ref. 11.

13. Humphreys, D.R., 1995. There you go again, Dr Ross! Bible-Science News 33(6):6–7. On page 7 is a reprint of an August 13, 1994 letter I sent Ross, politely asking him why he had backed out of a radio debate scheduled for the week before — only after he found out I was to be his opponent. He never answered that letter.

14. Humphreys, Ref. 10, p. 210.

15. Humphreys, Ref. 10, p. 201.

16. Humphreys, Ref. 10, p. 212. See that article's Ref. 36, where I did say of Prof. Stephen Weinberg: 'This shows that even Nobel Laureates are not immune from self-contradiction.' Since this appraisal includes the whole human race, nobody needs to feel singled out and particularly offended.

17. Galilei, G., 1632. Dialogo ... Massimi Sistemi del Mondo, G.B. Landini, Florence. English translation in: Drake, S., 1967. Dialogue Concerning the Two Chief World Systems, 2nd Revised Ed., University of California Press, Berkeley. Simplicio, the spokesman for Galileo's academic opponents, often falls back on appeals to Aristotle's authority. Salviati, the spokesman for Galileo's point of view, just as often argues against human authority, calling instead for careful reasoning and evidence to settle scientific issues. Unfortunately, Simplicio's intellectual descendants are still far too numerous today, and Salviati's are far too few.

18. Humphreys, Ref. 10, p. 211. See Ref. 33 of that article.

19. Ellis, G.F.R., Sumeruk, A., Coule, D. and Hellaby, C., 1992. Change of signature in classical relativity. Classical and Quantum Gravity 9:1535–1554.

More on vistas

I congratulate you on publication of the paper 'Starlight and time is the big bang' by Samuel R. Conner and Don N. Page.[1] I am not a cosmologist, but I am a professional theoretical physicist (now in retirement) so I am able to follow the algebra and test the reasoning presented. I applaud the authors for providing such a careful, thorough, perceptive, and exhaustive assessment of the book Starlight and Time by D. Russell Humphreys, and for listing the evidence which excludes the whole class of relativistic young – universe cosmologies. The reply 'New vistas of space-time rebut the critics' by D. Russell Humphreys[2] introduces a completely new argument, but contains a number of incorrect statements. I shall here comment on the central issue.

By his insistence on the use of the Klein metric, Humphreys appears to be expressing a belief in just one true metric for the universe. No! The metric is not a property of the universe, but is a property of the system of co-ordinates used to describe the universe. Since one can readily transform from one set of co-ordinates to another, the metric may change along with the transformation. Conner and Page have explicitly stated the connection between the Schwartzschild co-ordinate system (which implies the Klein metric) and co-moving coordinates (which implies the Robertson–Walker metric). Since the transformation between the two co-ordinate systems exists, the two metrics are exactly equivalent to each other — they stand or fall together. Indeed, Conner and Page have explicitly demonstrated that the two metrics predict exactly the same proper time elements for comoving observers.

Humphreys' apparent belief in just one true metric leads him to a misinterpretation of his own Figure 3 by switching clocks in mid-argument. He first uses clocks reading Schwartzschild time to construct the figure with its 'timeless zone'. Then, instead of regarding such a zone as a pathology induced by the use of Schwartzschild clocks which have been travelling faster than light (clocks which may have some convenience for descriptive purposes, but certainly no physical reality), he mistakenly believes he has uncovered an intrinsic property of the universe thus enabling him to switch to 'expansion fraction' clocks — that is, clocks reading cosmic time — for his exposition of the figure. No! The figure does not indicate some constraint on the behaviour of ordinary physical clocks. If any clocks have been prevented from 'ticking' in the 'timeless zone', they would only be those associated with the Klein metric, i.e. (unphysical) Schwartzschild clocks and not any clocks which, at all stages of the universe expansion, have in their travels obeyed the cosmic speed limit (the speed of light). Actually, even Schwartzschild clocks do something in that zone, they are not completely non-functional, they are not completely stopped as is clearly shown in Conner and Page's Figure 4.

But, does it matter? Suppose a friend telephones you from a very great distance and tells you that sometime in the next two weeks he is going to visit you. Towards the end of that period you locate in your home a favourite watch that you had mislaid some months before. Of course it has stopped, so, joyful at finding it again, you wind it and set it to the correct time. Shortly thereafter your friend arrives and simultaneously you check your watch to see if it is still going — it is, and you note that just ten minutes have elapsed since you wound it. Do you then deduce that your friend's travel time was only ten minutes? No! Why not? Because the very great distance and the maximum possible speed of travel

available to humans forbids it. In like manner, the very great distance from here to the distant galaxies, and the limitation on the speed of light tells us that the light has been traveling for a very long time even if our clocks were stopped (or not even created until the light was about to arrive). So we must allocate a very great age to the universe, not simply an age our clocks have recorded supposing them to have started after changes in the universe when they were not 'ticking'.

The bottom line is this: in our reference frame the distant galaxies are billions of light years away, so in our reference frame the light has taken billions of years to get here, so in our reference frame the age of the universe is in the billions of years range. It is simply quite irrelevant what clocks elsewhere in the universe may be doing, but if D. Russell Humphreys' clocks at the edge of his universe happen to run faster than ours do, then they would indicate an even greater age than those billions of years!

The overwhelming evidence that the universe is very old does not distress me, because I regard the statement '… he made the stars also' (Gen 1:16) to be a parenthetic insertion into a narrative solely about the establishment of the earth's ecosystem. I believe the insertion is there to acknowledge that the Creator of the universe is the same Mighty One who created all living things, and is not there to imply any time relationship between those two creative events.

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References

1. Conner, S.R. and Page, D.N., 1998. Starlight and time is the big bang. CEN Tech. J., 12(2):174–194.

2. Humphreys, D.R., 1998. New vistas of space-time rebut the critics. CEN Tech. J., 12(2):195–212.

Russell Humphreys replies:

I'm glad to have Dr Duff's comments on my cosmology, especially since, being of the old-cosmos point of view, he is motivated to search for errors in my reasoning. Even though his specialty is solid-state physics, not relativity, I welcome scrutiny by more theoreticians. However, Duff seems to have overlooked several things which undermine his main technical points. In that regard, let's examine five of his statements:

1. 'Humphreys appears to be expressing a belief in just one true metric for the universe.' Incorrect. I do not claim uniqueness for the Klein metric, merely that it is more useful here than the metric Conner and Page were using:[1] 'Thus the Robertson-Walker metric is a less complete description of this physical situation than the Klein metric is.'

2. 'Since the transformation between the two coordinate systems exists, the two metrics are exactly equivalent to each other [my emphasis]' Duff put the whole statement in bold font, implying it was his main point. But my paper cites a counter-example to that very point:[2] ' … this is not the first time a change of coordinates has [revealed new physics]. In 1960, Kruskal and Szekeres introduced a new set of coordinates which revealed startling new regions of space-time in the vacuum around and within a black hole, regions which had lain concealed and unsuspected in the Schwarzschild vacuum metric. The new coordinates shed a great deal of light on the nature of the event horizon, opened up the possibility of white holes and worm-holes, and stimulated a great outpouring of research on black holes for the next three decades. Thus it should not be too surprising that a shift of coordinates has again revealed new black-hole physics,

this time within the matter region.'

As experts in general relativity know very well, there exists a transformation between Schwarzschild coordinates and Kruskal coordinates. But no expert would try to claim the Schwarzschild and Kruskal metrics are 'exactly equivalent to each other', because the latter describes more regions of space-time than the former.[3] Thus my example directly contradicts the argument Duff is trying to make.

3. '[The timeless zone is] a pathology induced by the use of Schwartzschild clocks' Duff gives no mathematical proof for this assertion. It is merely an opinion. It is a rather common sentiment, since many textbooks are fond of heaping unmerited verbal abuse upon Schwarzschild coordinates. For example, one text accuses Schwarzschild coordinates of delinquent behaviour:[4]

'spurious … inappropriate … misbehave … go bad'.

But then the same text goes on to say:[5]

'We will of course adopt the view that the coordinates that go bad at [the event horizon] are the Schwarzschild coordinates' [emphasis mine].

The word 'adopt' shows that the textbook writers' preference in coordinates is merely an arbitrary and personal value judgment.

4. 'If any clocks have been prevented from "ticking" in the "timeless zone", they would be only … Schwartzschild clocks.' Here Duff appears to have missed the caution in my paper:[6]

'Schwarzschild coordinates are conceptual. You can think of them as the times and distances which would be read out from clocks and rulers unaffected by gravity, velocity, acceleration, or any other feature of the space-time continuum.'

Conceptual clocks don't

have to stop, not even in Euclidean zones. Duff did not discuss my statement above at all, apparently overlooking it. He also seems to have overlooked that other theoreticians besides myself have concluded there may be Euclidean (timeless) zones in the black-hole/white-hole topology my cosmology uses. The paper in the International Journal of Modern Physics by Hellaby, Sumeruk, and Ellis,[7] which I referred to frequently in my paper, requires that Duff take the concept of timelessness seriously. The use of conceptual Schwarzschild clocks could help him find his way through this new, nearly uncharted wilderness in relativity, the fascinating idea of Euclidean zones.

5. 'But, does [timelessness] matter?' Duff gives an illustration of a watch stopping in your home and uses it to claim that one should measure the friend's travel time only with unstopped watches. He seems to have overlooked the following sentence in my article:[8]

'In particular, their metric gives no hint at all of a large region of space-time in which physical processes, including clocks, are completely stopped.'

I've emphasized 'physical processes' here because Duff's illustration would more accurately fit my theory if all physical processes in your home, including processes in your own brain and body, had stopped. Then the stopped watch would reflect your own experience. From your point of view, the friend would arrive very suddenly. Ignoring this distinction, Duff claims in his second-to-last paragraph that even if my theory were true, the cosmos would still be billions of years old. But he is simply expressing a personal preference in clocks, regarding the distant clocks as more important than the ones on earth. How unrelativistic

of him!

Now let's move on to Dr Duff's final, less technical, point. In his last paragraph he gives us a 'biblical' reason for his scientific worldview, the last part of Genesis 1:16, which he interprets as meaning the stars were made much earlier than the two great lights.

However, if Dr Duff is going to stake so much on just a few words in an English translation (and the vast majority don't support his interpretation), it would be good to examine the original language underlying the translation. In this case, it turns out that the original Hebrew does not support his interpretation (as most Bible translators realise). Just before the word for 'stars', there is a small untranslatable word, the accusative particle 'et. It indicates that 'stars' is the direct object of the verb 'made' at the beginning of the verse. Tacked onto 'et is the Hebrew consonant waw, which is usually translated 'and'. There is an identical construction of waw plus 'et just before 'the earth' at the end of Genesis 1:1. There it is translated 'and the earth', indicating that God created the earth as well as the heavens. Leaving out the middle phrase of Genesis 1:16 (describing the function of the great lights), a very literal translation is: 'And God made the two great lights … and the stars.'

Thus I suggest that the most straightforward meaning of the Hebrew verse is that God made the stars essentially simultaneously with the Sun and Moon, not beforehand.

This illustrates the danger of basing too much on just a few words. We should build our own worldview on an exegesis of all relevant Bible passages. Thus in this matter, we should also take into account such verses as Exodus 20:11,

'For in six days, the LORD made the heavens and the earth ...'

which, combined with the context, clearly and explicitly declares that Jehovah made not only the earth, but also the heavens in six ordinary weekdays. There are many other

Scriptures which support that statement, and there are none which clearly and explicitly say the world is billions of years old. Therefore, in view of Dr Duff's respect for Scripture, I invite him to join me and other believing theorists in searching for young-world cosmologies.
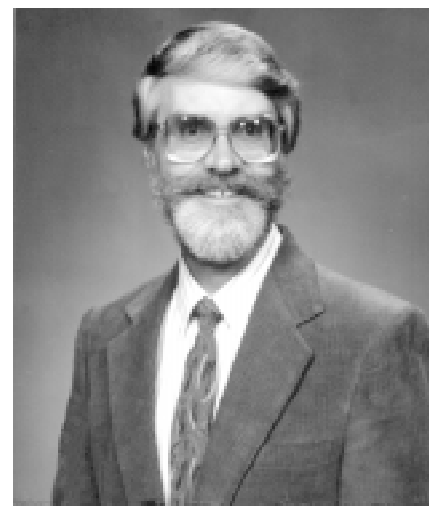
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References

1. Humphreys, D.R., 1998. New vistas of space-time rebut the critics. CEN Tech. J. 12(2):195–212. See p. 202, Section 6, last paragraph.

2. Humphreys, Ref. 1, p. 202, Section 7, first paragraph.

3. Hawking, S.W. and Ellis, G.F.R., 1973. The Large Scale Structure of Space-time, Cambridge University Press, Cambridge, UK, p. 155: 'The Kruskal extension … is the unique and locally inextendable extension of the Schwarzschild metric.'

4. Ohanian, H.C. and Ruffini, R., 1994. Gravitation and Spacetime, 2nd Ed., W.W. Norton & Co., New York, p. 440.

5. Ohanian and Ruffini, Ref. 4, p.441, last paragraph.

6. Humphreys, Ref. 1, p. 197, Section 3, first paragraph.

7. Hellaby, C., Sumeruk, A. and Ellis, G.F.R., 1997. Classical signature change in the black hole topology. International Journal of Modern Physics, D6(2):211–238. See my quote of this paper in my answer to Conner in this issue, p. 59.

8. Humphreys, Ref. 1, p. 196, Section 2, sixth paragraph.

Vistas — one more

As in his original cosmology proposal[1,2] and in subsequent writings in its defence,[3,4] so also in New vistas of space-time rebut the critics,[5] Dr Humphreys makes sweeping physical claims without backing them up with the simple mathematical calculations which would demonstrate their truth or falsity.

It is straightforward, using only undergraduate-level differential calculus, to show that Humphreys' claim of a 'timeless zone' in the Klein metric is false. In order for a 'timeless zone' to exist, there must be a region of spacetime within which there are no spacetime trajectories which have the property $ds^2 > 0$. However, it is easy to verify that every comoving clock in Humphreys' bounded matter sphere cosmology traverses a timelike trajectory ($ds^2 > 0$), even in the region of (α, χ) space which Humphreys alleges is 'timeless.' Consider, for example, the trajectory of the Earth, which Humphreys hypothesizes is at the center of the matter sphere. The Earth's spatial trajectory in Schwarzschild coordinates is given by $d\rho_{Earth} = d\theta_{Earth} = d\varphi_{Earth} = 0$. The Schwarzschild time component of the trajectory, $dt_{Schwarz, Earth}$, must be derived from the definition of the Schwarzschild time coordinate $t_{Schwarz}$.

See equation (1) [below]

Humphreys claims that $dt_{Schwarz}$ is a 'conceptual' time interval which can be assumed to be real, so that $dt^2_{Schwarz}$ is positive[6], but this is manifestly false. The value of $t_{Schwarz}$ for a particular spacetime event is manifestly a function (given in equation 1) of the comoving coordinate location (a, η) of the spacetime event in question, and therefore the Schwarzschild time interval $dt_{Schwarz}$ along a particular spacetime trajectory is determined by that trajectory (i.e., by the succession of spacetime events which constitutes the trajectory).

To obtain the differential Schwarzschild time interval $dt_{Schwarz, comoving clock}$ which elapses along the spacetime trajectory of a comoving clock, one must differentiate equation (1), subject to the constraint imposed by the spacetime trajectory under consideration (namely that η is fixed for a comoving clock). The result is

See equation (2)

(where the leading '-' sign in equation (1) is used, as is appropriate for an expanding bounded matter sphere)[7]. Earth is located at $\eta_{Earth} = 0$, so

See equation (3)

$$t_{Schwarz} = \pm \frac{t_o}{1+b^2}\left[\frac{b^3}{1+b^2}\ln\left(\frac{\zeta+b}{\zeta-b}\right) + \frac{\zeta}{1+\zeta^2} + \frac{1+3b^2}{1+b^2}\left(\frac{\pi}{2} - \arctan\zeta\right)\right] \quad\text{...................................... (1)}$$

where

$$t_0 \equiv \frac{a_{max}}{c\sqrt{1-\eta^2_{edge}}}, \quad \zeta \equiv \sqrt{\frac{a_{max}}{a_{max}-a}\sqrt{\frac{1-\eta^2_{edge}}{1-\eta^2}}-1}, \quad b \equiv \frac{\eta_{edge}}{\sqrt{\eta^2_{edge}}}$$

$$dt_{schwarz, comoving\ clock} = da\frac{\partial t(a,\eta)}{\partial a}\bigg|_{\eta\ fixed} = -t_o \frac{\zeta^3}{\left(1+\zeta^2\right)^2\left(\zeta^2-b^2\right)}\left(\frac{1+\eta^2_{edge}}{1-\eta^2}\right)^{1/2}\frac{a_{max}}{\left(a_{max}-a\right)^2}da \quad\text{.................. (2)}$$

$$dt_{Schwarz,\ Earth} = -t_0 \frac{\zeta^3_{Earth}}{\left(1+\zeta^2_{Earth}\right)^2\left(\zeta^2_{Earth}-b^2\right)}\left(1-\eta^2_{edge}\right)^{1/2}\frac{a_{max}}{\left(a_{max}-a\right)^2}da \quad\text{....................................... (3)}$$

$$\zeta_{Earth} = \zeta(a, \eta_{Earth}) = \sqrt{\frac{a_{max}}{a_{max}-a}\sqrt{1-\eta^2_{edge}}-1} \quad\text{... (4)}$$