I'm glad that Raul raised this issue because it is important to our understanding of biblical geology.

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Time and infinity

In a recent article Andrew Kulikovsky published a critique of the book *Creation out of Nothing*, a defence of the Kalam argument written by William Lane Craig and Paul Copan.[1] While he offers some piercing insights into their work, I believe that some personal preferences have distorted his critique.

Firstly, it is disheartening that Mr Kulikovsky feels compelled to demean the formal approach of Copan and Craig, saying 'They go to great effort … to demonstrate something that is intuitively obvious' (p. 21). Intuitive obviousness is irrelevant—formalism is merely the proper nature of academic work. The creationist intention to popularize scientific topics too often leads to an outright aversion of formalism. Such an attitude is counterproductive to a group of academicians looking to advance professional behaviour.

Tensed and tenseless

Mr Kulikovsky begins his analysis by disagreeing with the authors on the implications of the tenseless view, 'B-theory', stating 'the absence of time does not imply that everything will happen at the same time' (p. 21). He calls this belief 'nonsense', yet suggests no other means of temporal comparison—perhaps because it cannot be done.

In a timeless reference frame there is no alternate point against which to contrast temporally different events in another frame. For example (figure 1), we will place marker events in two temporal reference frames (*P* and *Q*), with clocks running differently to demonstrate the irrelevancy of varying rates of change. We will also have frame *R*, in which time does not progress—thus allowing only a single distinguishable state.

The two states for frame *P* have temporal markers in frame *Q*; the order of events in frame *P* can be tracked by following progressing events in frame *Q* (defining a forward direction).

They may be clocked differently, but a tenseless condition is avoided. Reference frame *R*, however, has no distinguishable temporal markers with which to dissociate events in frame *P*, and is thus tenseless. The ensuing difficulties are demonstrated if we add a third event in frame *P*—we have no idea if it is occurring after, before or between the other two events, because we cannot apply markers in frame *R*. Thus Mr Kulikovsky's statement that a 'B-theorist can simply say that God is ontologically prior to creation' (p. 21) is meaningless with respect to a tenseless frame.

Frame P	Frame Q	Frame R
Event 1.P. - 12:00	Event 1.Q. - 12:00	State 1
Event 2.P. - 12:30	Event 2.Q. - 12:15	State 1

Figure 1. A series of states in different tensed and tenseless reference frames.

Furthermore, if we call the single state in frame *R* 'now', then all of the events occurring in other frames coincide with 'now', just as Copan and Craig said—all events actually 'coexist timelessly with him'. Apparently Mr Kulikovsky still believes it to be possible to speak of an *ex nihilo* event with respect to this system. If we accept B-theory, this would only be possible with respect to the existence or nonexistence of the frame actually coming into existence (the one experiencing tenses)—but it would be meaningless to speak of 'before' the frame came into existence.

The claim that the tensed view, 'A-theory', cannot appeal to God's omniscience is without foundation. The non-existence of future events in no way prevents their certainty from being knowable. Rather than suggest the co-existence of all events (as implied for frame *R* by B-theory), one might simply suggest rigid physical causality; when combined with a full knowledge of starting conditions for the universe, all future physical events are rendered knowable (ignoring human constraints such as quantum resolution limits). Ensuing theological questions regarding free will and determinism are of course inherent with either model, and are beyond the scope of this paper.

It might also be noted that thought, emotion and other personal characteristics are state changes and thus automatically provide a metric for time. A timeless view is thus problematic for the personal deity of the Bible.

Infinity

The critique of Craig's discussion on 'the formation of an actual infinite by successive addition' is critical in the correction of the breakdown in his reasoning. Kulikovsky has done a good job in identifying it, but the matter is deserving of some expansion.

Kulikovsky states that 'an actually infinite collection does not need to be

formed—it simply exists' (p. 23). This statement may cause confusion for those still following Craig's reasoning in treating an infinite set as a set which has some final, fixed number of elements. Any and every specific point in an infinite physical history would have a point at which it did not exist—every specific segment of causal history did require formation through temporal causality. The set, as a whole, however, would always have had the property of an infinite past. The problem is that Craig is implicitly assuming a finite starting point—he is imagining beginning at 'zero' on the number line (with no negatives to the left), then counting 'one, two, three …' until he can finally arrive at infinity. This, of course, cannot be done—because infinity is merely the direction of a limit, not a location on the number line, and this error leads to his numerous claims that an infinite causal progression cannot arrive at the present. Essentially he has defined a finite universe, then set out to prove that it is finite.

The 2nd Law and heat death

Kulikovsky's criticism of Craig on the use of the 2nd law as support for a finite universe seems largely uncalled for. Copan and Craig are correct to contend that a partially decayed system undergoing continual, (relatively) maximizable decay must have a finite history.

The suggestion that observations do not 'necessarily imply the universe had a beginning' and that they 'at best, only suggest that the universe *as we know and observe it* began to exist' begs the question of exactly what Mr Kulikovsky expects from scientific confirmation. As far as actual empirical induction is concerned, the 2nd law of thermodynamics has more statistical support than anyone can reasonably oppose—and this is precisely what it takes to comprise a premise for a scientific deduction.

Kulikovsky's criticism does emphasize a valuable point though: there will always be a theoretical escape hatch preventing natural law from serving a permanent axiomatic position in a pure syllogism. This is why science only works via the delicate blend of statistical induction and empirically based deduction. While Craig's apparently failed attempts to axiomatically defend the impossibility of infinite causal retrogression cannot be substituted equally with empirical data, the empirical data should not be dismissed from serving its appropriate position.

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Andrew Kulikovsky replies:

I wish to thank Mr Dingemans for his letter and the opportunity to clear up any misunderstandings. Dingemans believes that I demean Copan's and Craig's formal approach. I have no problem with the formal approach in general, but I think it is a pointless exercise to apply it in demonstrating something (the meaning of creation *ex nihilo*) that is definitional and intuitively obvious to everyone, and, in any case, is not the subject of any real disagreement. Why waste precious time and energy in applying formalism to something that is not controversial, when that time and effort could be better spent on applying formalism to something that really is contentious. Basically, Copan's and Craig's formal approach to the meaning of creation *ex nihilo* adds nothing to the overall argument.

In reference to timelessness, Dingemans asserts: 'In a timeless reference frame there is no alternate point against which to contrast temporally different events in another reference frame.' I do not think Dingemans really understands the nature of a timeless God creating a time-space continuum external to Himself. In such a scenario, one does not compare different reference frames. Instead, one compares the events within one particular reference frame. Thus, terms such as 'now', 'before' and 'after' simply describe the relative temporal relationship between different events in one particular reference frame. They are not applicable when describing two events in different reference frames, including a timeless reference frame.

Dingemans objects to my statement that a 'B-theorist can simply say that God is ontologically prior to creation.' However, as I pointed out in my review (in the very next sentence!) Craig himself has argued this very point elsewhere and concluded that before God created, He existed timelessly.[1] To say that God is ontologically prior to creation is just another way of saying that God caused the creation to exist.

In addition, Dingemans asserts: 'The point stands that B-theory is by no means strictly necessary by the scriptural account.' However, I never claimed that the B-Theory is strictly necessary, just that it has greater explanatory value.

Dingemans argues that thought, emotion and other personal characteristics imply state changes, and therefore automatically provide a metric for time. He then concludes that the 'timeless view is thus problematic for the personal deity of the Bible.' The problem with this line of argument is that it attributes human finitude to God. The Bible paints the picture of a God whose personal characteristics do not change, and who is all-knowing. I do not know exactly how God thinks and reasons; but His omniscience implies that He does not acquire new knowledge, integrate it with His existing knowledge, and make determinations and inferences from this expanded information base. God already knows everything that was, that is and that will be.

Regarding the 2nd law of thermodynamics and the heat death of the universe, my point is that if one adopts the big bang theory (as Copan and Craig do) then one has to accept the existence of the singularity. It is quite plausible for Copan and Craig to claim that the singularity marks the creation event, but it is just as plausible

for atheists to claim that it only marks the beginning of the universe as we know it. In other words, the empirical evidence does not prove anything.

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Explaining the Pioneer effect?

Dr Russell Humphreys has sought to explain the 'Pioneer effect' in terms of a cosmological model in which the dominant large-scale gravitational influence is due to a massive shell of ice, the present form of the 'waters above' of Gen. 1:7, enclosing the observable universe.[1] He claims success in predicting the observed sign and magnitude of the effect, an anomalous sunward acceleration apparent in spacecraft radar data.

Unfortunately his model and the analysis he presents seem to raise more questions than provide answers. I believe it would be helpful to readers to see his responses to some of the following issues:

1. Humphreys' equation (10) is misleading. The definitions of $d\tau$ and $d\ell$ for proper time and proper distance respectively in equations (11) and (12) are perfectly correct in the right context; $d\tau$ is defined for a *timelike* spacetime interval ($ds^2>0$) and $d\ell$ for a *spacelike* interval ($ds^2<0$),[2] which are mutually exclusive cases. Thus they cannot be placed together in an equation for a spacetime interval. However, equation (10) is correct for the special case of a photon, which will propagate along a null geodesic ($ds^2=0$), provided that $d\tau$ and $d\ell$ refer to proper time and proper distance *for a stationary observer* and not for the photon itself, for which these differentials both vanish. In fact Humphreys' analysis of the Pioneer effect does proceed in terms of $d\tau$ and $d\ell$ as measured by an observer, but this does not correspond to the normal understanding of the terms proper time and proper distance.
2. Humphreys uses arbitrary values for the mass and present-day radius of the postulated shell of ice; his values are merely those required to give an apparent Pioneer acceleration matching the observed value. Thus the only genuine prediction of his model is the *sign* of the apparent acceleration.
3. Humphreys' analysis produces a result depending only on the Hubble constant and on the speed of light; no local parameters (e.g. the observer-spacecraft distance or the speed of the spacecraft) are involved. Thus his analysis should apply to *any* astronomical body, in particular to those for which we may have precise, repeated distance measurements, and whose motion is controlled by well-characterised forces. This certainly applies to the moon,[3] to other spacecraft and possibly also to other planets and asteroids. Has the relevant data ever been checked for a possible 'Pioneer effect'? I have personally never seen such reported except for the spacecraft noted by Humphreys.
4. Humphreys implicitly assumes an infinite propagation speed for gravitational effects. This conflicts with the prevailing view that these propagate at the speed of light,[4] which would imply a lag amounting to billions of years between the motion of the ice shell and its gravitational effect on the solar system. It would seem incumbent on him to at least comment on this point, which is likely to have a considerable impact on his analysis.
5. The critical potential $\Phi = -0.5c^2$ discussed after equation (25) corresponds to Humphreys' ice shell having a radius equal to its Schwarzschild radius. Thus if equation (25) is close to present reality, the universe has expanded relatively little (19%) since it emerged from a white hole. This raises the questions of when, in terms of biblical or Earth history, the universe emerged from its white hole, and what happened on Earth before then, given that it must have been in a timeless zone (cf. Humphreys' reference 39)?
6. According to Humphreys' equation (13), the proper distance traversed by a photon as measured by a stationary observer is related by the speed of light to the proper time taken, i.e. the distance in light years is numerically equal to the time in years. This is simply a basic principle of general relativity. If Creation took place 6,000 years ago in an Earth-based frame of reference, which is Humphreys' stated position (p. 64, second column), we should only be able to see objects within 6,000 light years. Numerous astronomical objects with well-established distances should be beyond view—the Galactic Centre, globular clusters, the Andromeda galaxy M31, and so on[5]. Thus Humphreys' model seems to fail against the old problem of 'distant starlight in a young universe'.

Unless the above issues can be satisfactorily addressed for this model, it is difficult to see its value as an addition to the cosmological models already available to creationists.

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