good first step would be to see another forum in the pages of *TJ* involving Humphreys and Gentry discussing the evidence for and against F–L space-time expansion and how this affects creationist research into cosmology.

References

1. See <www.orionfdn.org>.
2. Humphreys, D.R., *Starlight and Time*, Master Books, Green Forest, p. 36, 1994.
3. Humphreys, Ref. 2, p. 77.
4. Humphreys, Ref. 2, p. 98.
5. Humphreys, D.R., Our galaxy is the centre of the universe, 'quantized' red shifts show, *TJ* **16**(2):95–104, 2002.

D. Russell Humphreys replies and clarifies cosmology

I'm glad Andrew Kulikovsky is thinking carefully about creationist cosmologies, and I encourage him and other creationists to continue doing so. Since he touches on several areas people frequently ask me questions about, I welcome the chance to amplify upon them here. Here are my replies to Kulikovsky's specific points, numbered to correspond to his 'first … second … third', etc.:

1. *Continued stretching of the heavens*. He might be right that 'and it was so' applies to the stretching of the heavens on the second day, and thus would imply the stretching ceased on that day. However, the phrase might quite reasonably apply to the verb 'separated' (KJV 'divided', Hebrew *yâv^{e}ddāl*) immediately preceding it (Gen. 1:7). In that case the separation might be what God completed, while the stretching might continue beyond that day, for the reasons I mentioned in my book.[1] There are a number of possibilities for the stretching: (1) it stopped on Day 2 and restarted later in Creation week, or (2) it went on continuously during the week, or (3) it was continuous until now, or (4) there were episodes of rapid stretching during Creation Week and the Genesis Flood, or (5) various combinations of those scenarios. It doesn't make much difference to me, because it appears we can successfully build various creationist cosmologies on most, and possibly all, of the various options.
2. (A) *Value of 2nd day stretching*. In the option I favour, events (including stretching) during the fourth day would cause a timeless (Euclidean) zone to appear and disappear, as Figure 1 (which I have published previously[2]) illustrates. That would enable light from stars and galaxies created on the fourth day to reach the Earth at the end of the same day, which would be of ordinary length as measured by clocks on Earth. However, contrary to Kulikovsky's assertion, there would be some value to expansion on the previous days, the second and possibly the third. One benefit would be to stretch out the wavelengths of first-day light (Gen. 1:5), and the infrared thermal radiation of the waters above the heavens (Gen. 1:7). Either one of those could be the source of today's cosmic microwave background radiation, as I remarked in my book.[3]
   (B) *Lack of time dilation equations*. Figure 1 provides enough information to generate the time-mapping equations (at least one sample of the possibilities) for which Kulikovsky asks. I leave it as an exercise for the student, pointing out the time relations: billions of years on the right, one day on the left.
3. *How a white hole works*. Kulikovsky shares the general misunderstanding about how a white hole would work, which in turn is due to lack of clear explanations in the popular literature. According to the basic equations,[4] a white hole would not repel matter. Instead, the matter in it gravitates normally, but has enough *outward momentum* to overcome its own self-attraction. The next three figures illustrate the essentials of black and white holes.
   Figure 2 shows a cross-section of the 'fabric' of space-

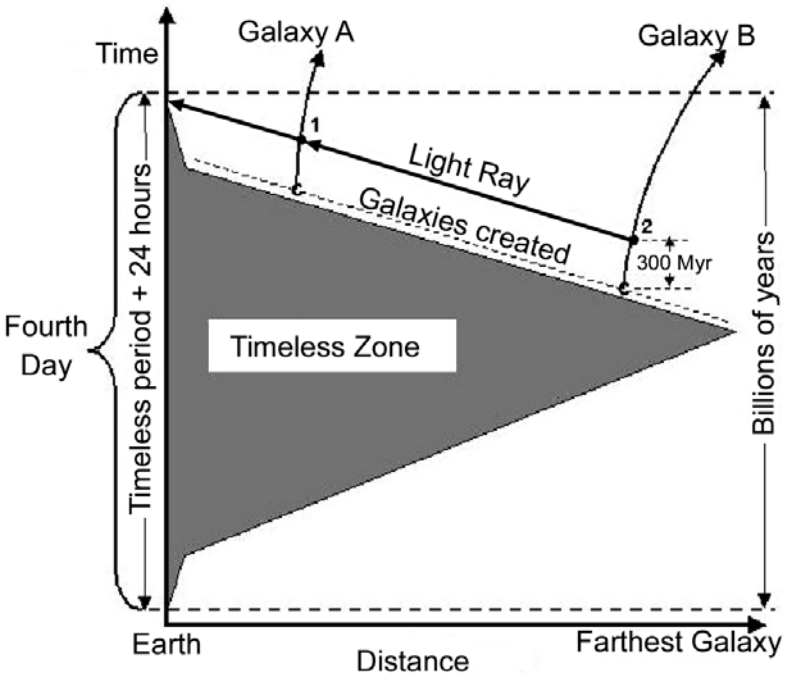

Figure 1. *Trajectories of light and galaxies on the fourth day.*

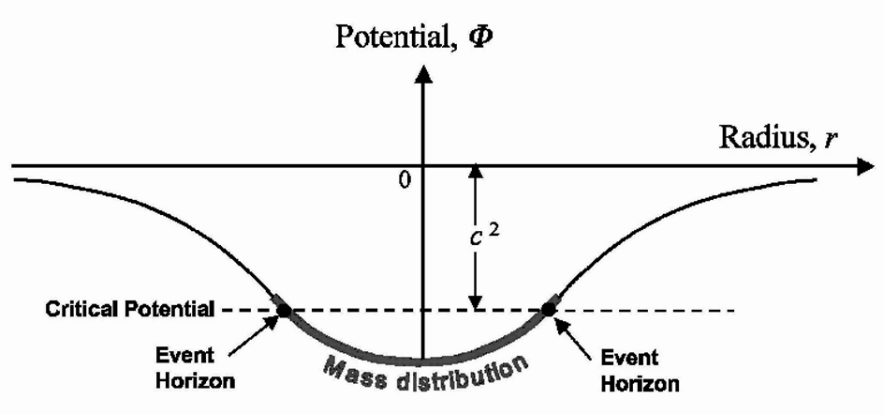

Figure 2. *Mass makes a dent in the membrane of spacetime.*

time, dented by the presence of matter. (Physicists: the depth of the dent corresponds to gravitational potential energy.) You can imagine the 'fabric' (the thin black curves) as a thin stretchable rubber membrane, and the matter (the thick gray curve) as heavy grains of sand glued onto the membrane, deforming it downward. There is a critical depth (physicists: potential energy equal to c^2) whose intersection with the membrane defines the event horizon. (There is a deeper critical depth that determines the outer boundary of the timeless Euclidean zone, but since it behaves in a similar way as the event horizon, I won't show it here to keep the diagrams simple.)

Figure 3 shows matter in a black hole in the process of collapsing. Start with stage (a) at the top of the figure and proceed downward to stage (d) at the bottom of the figure. As the sand deepens the dent, both the sand and the membrane compress themselves into a smaller area. Thus both matter and space are being compressed. Notice that as the sand moves into the event horizon, the horizon moves outward. The horizon stops moving outward when the last sand has entered the horizon.

Finally we reach a very compressed state (d), which many physicists would consider as approaching a 'singularity'. The Stephen Hawking school of thought claims the singularity would persist virtually forever. But I think Hawking's former colleague George Ellis and others[5] are correct in saying that a Euclidean zone would form and cause the matter to 'bounce', starting a white hole. I made note of that in this journal several times.[6,7]

Figure 4 shows the matter in the white hole spreading outward. Start with stage (a) at the *bottom* of the figure and move *upward* to stage (d) at the top of the picture. In stage (c), sand starts moving out of the event horizon, so the horizon begins shrinking. Stage (d) shows the event horizon yet smaller. As the sand expands, so does the membrane. So in a white hole, both matter and the 'fabric' of space expand. This answers Kulikovsky's question as to how a white hole relates to spacetime expansion. Inside the matter region, the expansion is similar to that in the big bang theory. The key difference is that the presence of a centre of mass causes gravitational time dilation effects, both at the event horizon, and in the timeless Euclidean zone.

4. *Cosmic microwave background*. As I mentioned in item 2(A) above, the expansion of space would stretch out the wavelengths of light or thermal radiation generated on the first or second days. If the source of the cosmic microwave background was first-day light with a colour temperature similar to sunlight, then the cosmic expansion factor from Day 1 to now would be about 5770 K divided by 2.7 K, about 2100. If the source was Day-2 thermal radiation, then the expansion factor from the second day to now would be about 300 K / 2.7 K, about 100. These are simple constraints, easily attainable by many different expansion scenarios.
5. (A) *Validity of General Relativity*. The concept of spacetime expansion goes deeper than work by Friedmann and Lemaître. It is enmeshed in General Relativity theory itself, which pictures spacetime as a material that can be bent and stretched. The claims, which do not originate with Gentry, that General Relativity and the GPS system don't agree, are only non-peer-reviewed allegations on the Internet. Moreover, as I've tried to chase them down to their roots, they seem to be without documentation. I would like to see these claims made more open to public scientific review in a journal like

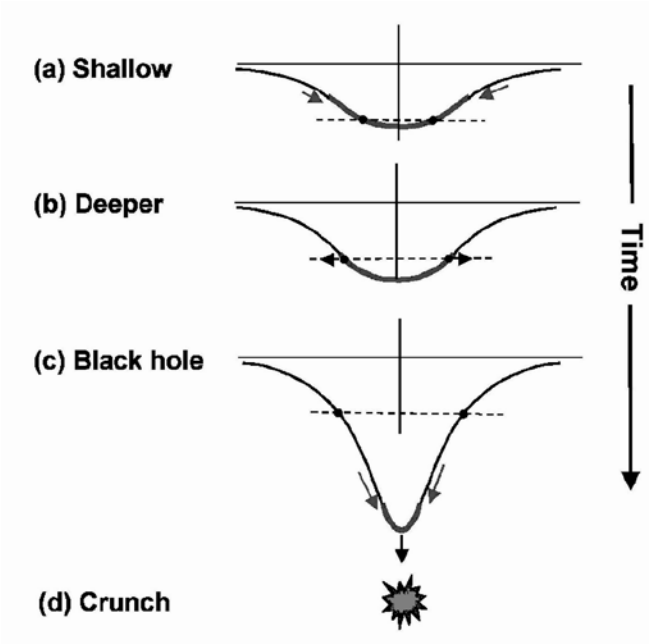

Figure 3. *How a black hole develops.*

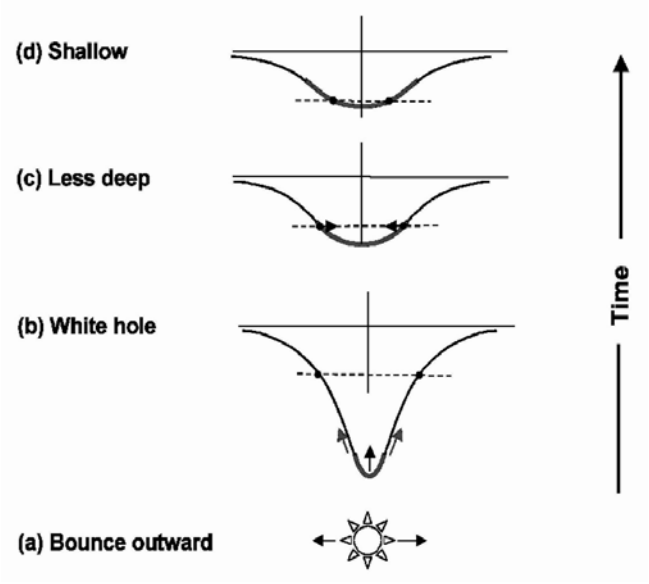

Figure 4. *How a white hole develops.*

TJ before I spend much time and energy on them. I think everybody, especially creationists, should put less faith in what they see on the Internet. There, *anybody* can claim *anything*!

(B) *Expansion faster than light.* That particular criticism of space expansion is based on a misunderstanding of the theory. As I explained in my book,[8] the speed limit *c* only applies to things moving through the 'fabric' of space. The fabric itself would be moving through 'hyperspace'.[9] Because we don't know what the speed limit in hyperspace might be, we cannot exclude movement of the fabric faster than *c*, either of one part of the fabric from another, or in the extra direction.

6. *Formation of galaxy shells*. The concentric spherical shells of galaxies my recent *TJ* article[10] describes are evidence for a cosmology with a centre of mass, such as Gentry's or mine. The spherical shock waves I suggested as causing the shells are a familiar phenomenon to specialists in that field. They would be a natural consequence of a rapid spherical expansion and would be strongest in the early stages of the expansion. The rate of expansion of the matter (with respect to the 'fabric' of space local to it) would be less than *c*. The 'fabric' itself could move away from us faster than that. But even so, nobody claims that happened for galaxies within sight of the Hubble Space Telescope.

In the parts corresponding to items 2(B), 4 and 6, Kulikovsky seems disappointed that I have not produced all the details he wants. But I feel no particular obligation to produce them, because (a) I have staked no claim on creationist cosmology as my exclusive domain, and (b) I have many other research areas to explore besides cosmology. So I encourage Kulikovsky and others to fill in the details for themselves, or to depart from my sketchy map entirely and discover for themselves new hills and valleys in spacetime.

Suppose that, after Davy Crockett returned from his first trip over the Cumberland Gap, his easterner friends had upbraided him for lack of details in his map of Kentucky. I imagine him drawling, 'Wal, it ain't *my* territory. Git over thar and make yore own maps!'

References

1. Humphreys, D.R., *Starlight and Time*, Master Books, Green Forest, Arkansas, p. 68, 1994.
2. Humphreys, D.R., Appendix, *TJ* **15**(2):48, 2001, giving a detailed explanation of this diagram. Or see <www.answersingenesis.org/home/area/faq/docs/starlight_snr.asp>.
3. Humphreys, Ref. 1, pp. 122, 125.
4. Landau, L.D. and Lifshitz, E.M., *The Classical Theory of Fields*, Pergamon Press, Oxford, pp. 316–320, 1971.
5. Hellaby, C., Sumeruk, A. and Ellis, G.F.R., Classical signature change in the black hole topology, *Int. J. Modern Physics* **D6**(2):211–238.
6. Humphreys, D.R., New vistas of space-time rebut the critics, *CEN Tech. J.* **12**(2):195–212, 1998; see Fig. 12, p. 210.
7. Humphreys, D.R., Russell Humphreys replies, *CEN Tech. J.* **13**(1):59–60, 1999; see p. 59, quote of Hellaby, Sumeruk, and Ellis near top of third column
8. Humphreys, Ref. 1, p. 98.
9. Humphreys, D.R., Our galaxy is the centre of the universe, 'quantized' red shifts show, *TJ* **16**(2):95–104, 2002; Sect. 8, Fig. 9, pp. 100–101. Or see <www.answersingenesis.org/home/area/magazines/tj/docs/TJv16n2_CENTRE.pdf> for a downloadable PDf file.
10. Humphreys, Ref. 9, pp. 98, 102.

Uncertain fundamentals

'Croswell makes no attempt to disguise the fact that our present knowledge is very limited, and that we are still uncertain about fundamentals such as the Hubble constant, ... Neither can we be really confident about the age of the Universe. The best current estimate is of the order of 15 billion years, but it is conceivable that this figure may be drastically modified in the foreseeable future.'

Patrick Moore
in reviewing *The Universe at Midnight*
by Ken Croswell (publ. The Free Press)
New Scientist **171**(2310):48, 2001.