



The Proceedings of the International Conference on Creationism

Volume 3
Print Reference: Pages 255-266

Article 25

1994

A Biblical Basis for a Creationist Cosmology

D. Russell Humphreys
Creation Science Fellowship of New Mexico

Follow this and additional works at: https://digitalcommons.cedarville.edu/icc_proceedings

[DigitalCommons@Cedarville](#) provides a publication platform for fully open access journals, which means that all articles are available on the Internet to all users immediately upon publication. However, the opinions and sentiments expressed by the authors of articles published in our journals do not necessarily indicate the endorsement or reflect the views of DigitalCommons@Cedarville, the Centennial Library, or Cedarville University and its employees. The authors are solely responsible for the content of their work. Please address questions to dc@cedarville.edu.

Browse the contents of [this volume](#) of *The Proceedings of the International Conference on Creationism*.

Recommended Citation

Humphreys, D. Russell (1994) "A Biblical Basis for a Creationist Cosmology," *The Proceedings of the International Conference on Creationism*: Vol. 3 , Article 25.

Available at: https://digitalcommons.cedarville.edu/icc_proceedings/vol3/iss1/25

A BIBLICAL BASIS FOR CREATIONIST COSMOLOGY

D. RUSSELL HUMPHREYS, Ph.D.*
Creation Science Fellowship of New Mexico
P.O. Box 10550, Albuquerque, NM 87184

ABSTRACT

Taking Genesis 1 and other scriptures in the most straightforward possible sense leads to several conclusions of great importance for cosmology: (1) The "expanse" of Genesis chapter 1 is not the earth's atmosphere but interstellar space, (2) The "waters above the expanse" are cosmic in scale and represent a boundary for interstellar space, (3) the earth is near the center of the universe. These conclusions form the basis for a young-earth relativistic cosmology which I describe in another paper presented at this conference.

KEYWORDS

Biblical cosmology, young-earth creationism, age of universe, hermeneutics.

1. INTRODUCTION

To him that rideth upon the heavens of heavens, which were of old — Psalm 69:33, KJV.

The Bible lays a good foundation for a young-earth relativistic cosmology. That is the main point I want to make in this paper. Contrary to impressions made by the news media, no one today can start from observed data and build up a cosmology by rigorous scientific deduction. Instead, some ideological initial assumptions are necessary, as cosmologists Stephen Hawking and George Ellis [5, p. 134] acknowledge:

... we are not able to make cosmological models without some admixture of ideology.

All the major cosmologies of this century, including the "big-bang" cosmologies, start with an arbitrary assumption which Hawking and Ellis call the *Copernican principle* [5, p.134]. Reduced to its essence, the Copernican principle requires matter in the universe to be *unbounded*, that is, the distribution of stars and galaxies in the cosmos can have no edges and no center. When cosmologists plug this assumption into the equations of Einstein's general theory of relativity and turn the mathematical crank, the big-bang and other famous cosmologies follow logically as a result.

In this paper I list evidence that the most straightforward understanding of the relevant scriptures gives us a cosmos which contradicts the Copernican principle. That is, the distribution of stars and galaxies in the biblical cosmos has a clearly-defined edge and a center. Moreover the earth would be, on a cosmological scale of distances, near the center. In another paper at this conference [8], I show that putting this condition of boundedness into the equations of general relativity results in a cosmos which is radically different than the conventional cosmologies. In this new picture of the cosmos, gravity and black hole physics play a central role.

In particular, an experimentally-measured general relativistic effect, called *gravitational time dilation* by some authors [10, p. 21], causes clocks (and all physical processes) to tick at different rates in different parts of the universe. (This is not the more familiar "velocity" time dilation of special relativity.) By this effect on time itself, God could have made the universe in six ordinary days as measured on earth, while still allowing time for light to travel billions of light-years to reach us by natural means. The theory also appears to explain the two other major cosmological phenomena we see: the red shifts of light from distant galaxies and the cosmic microwave background radiation. Thus, this biblical foundation appears to lead to a young-earth cosmology which is consistent with Einstein's general theory of relativity and astronomical observations. As measured by clocks on earth, the age of the universe today could be as small as the face-value biblical age of about 6000 years.

Before we examine the relevant scriptures, I want to clarify my approach to them in the next section.

2. UNDERSTANDING SCRIPTURE STRAIGHTFORWARDLY

A basic premise of modern creationism is that the Bible is an accurate message from God to man, including matters of science, and intended to be understood and used, as set forth in 2 Timothy 3:17:

All scripture is inspired by God and profitable for teaching, for reproof, for correction, for training in righteousness; that the man of God may be adequate, equipped for every good work.

(All quotes in English are from the *New American Standard Bible*, unless otherwise indicated.) To be useful in this way, the message must be understandable, and that raises the question of how to "interpret" scripture. Scripture itself provides some guidance on that point. For example, consider Proverbs 8:8,9, where wisdom, personified as a woman, says:

All the utterances of my mouth are in righteousness;
There is nothing crooked or perverted in them.
They are all *straightforward* to him who understands,
And right to those who find knowledge.

The word "straightforward" (KJV "plain") here is from the Hebrew word נִכּוֹחַ (*nakoach*), which one lexicon [6, p. 238] translates as "lying straight ahead ... straight, right." So the words of a wise person are characteristically straightforward. They are not "crooked or perverted," that is, they are not intended to deceive the hearer. According to Proverbs 8:22, Jehovah possesses this wisdom, and so we would expect His words to be straightforward. There may be great depth to His words, but *any deeper understandings should be encompassed within the plain, face-value meaning* of the words as they would be understood by a speaker of Hebrew or Greek in the time and place where they were first given to men. Anything else would lead to deception, which the passage says is not characteristic of wisdom.

A caution is necessary at this point. While recognizing that God is the ultimate author of the Bible, some theologians nonetheless insist that we should not look for any more meaning in scripture than its *human* intermediaries intended:

In other words, in answer to the question, "How much scientific truth can one extract from Genesis 1?" the answer must be: "One can extract only that which the writer himself, Moses, intended to teach." [3, p. 13]

The motive of this theologian was good; he wanted to guard against the natural tendency of people to read into scripture meanings not included within the bounds of the normal meanings of the words. But good motives do not always produce good principles, and here I think the principle is clearly wrong. First of all, it is not scriptural. For example, the same Peter who wrote about the inspiration of scripture, "... men moved by the Holy Spirit spoke from God" (2 Peter 1:21), also wrote that inspired prophets did not immediately understand fully what the Holy Spirit was moving them to say:

As to this salvation, the prophets who prophesied of the grace that would come to you made careful search and inquiry, seeking to know what person or time the Spirit of Christ within them was indicating as He predicted the sufferings of Christ and the glories to follow — *1 Peter 1:10,11*.

If these prophets had fully understood what they were saying as they were saying it, they would not after that have had to make "careful search and inquiry, seeking to know ..." If we were to limit ourselves to the intent of the speaker or writer as he spoke or wrote, this passage says we would miss a lot of rich truth. Secondly, the principle essentially shuts us away from God and what He intended to say to us. We don't study Genesis in order to know the mind of Moses; we study to know the mind of *God*.

A straightforward approach to scripture is the only one I can think of which can yield surprising new knowledge. Without such an approach, I would tend to re-interpret any passage of scripture which did not fit into what I thought was true at the time, and scripture would lose its power to astonish me. If God intended scripture to inform us of things we would not otherwise know, then He must also have intended it to be understood straightforwardly. "Straightforward" does not mean "literal." Someone who reads straightforwardly recognizes the metaphors in scripture, while someone who reads literally will try to squeeze a metaphor into a concrete straitjacket. But when we come to a possible metaphor, we ought to try on some literal meanings for size. If we find one that seems to fit, we ought to go with that meaning as a working hypothesis until we find good reason in scripture to think otherwise.

To make these points a little clearer, imagine a young Jewish Christian of the first century who understands Greek, Hebrew, and the scriptures well. Let's call him "Timothy," since Paul's protege was like that. But let's also imagine that this Timothy knows nothing of the advanced scientific knowledge of his day, such as Aristotle's works. All that Timothy knows is from either everyday experience or careful study of scripture, which Paul says is sufficient to give us wisdom (2 Tim. 3:5). Now if scripture really is straightforward and sufficient, then the meaning Timothy derives from the words is probably the meaning that God intended everybody to get. For example, when Timothy reads in Exodus 20:11,

For in six days the LORD made the heavens and the earth, the sea and all that is in them, and rested on the seventh day; therefore the Lord blessed the sabbath day and made it holy,

he notices that the context is that of ordinary days of the week. Not having *Scientific American* to tell him that the earth is billions of years old, Timothy is not looking for loopholes in this statement. Instead he simply concludes that scripture is saying Jehovah made the whole universe in six ordinary weekdays. My point is that if scripture is what it claims to be, then we ought to take Timothy's view of the passage and not try to twist the words into new meanings compatible with *Scientific American's* worldview, or for that matter into anyone else's worldview.

Of all people, young-earth creationists probably take scripture the most straightforwardly. For example, see Robert Walsh's article on hermeneutics [14]. But I find that even we are prone to abandon that principle when it runs counter to some teaching or model we cherish. In this paper I intend, when presented with two or more interpretations of a passage, to apply the "Timothy test" and choose the most straightforward.

3. THE EXPANSE IS INTERSTELLAR SPACE

And God made the expanse, and separated the waters which were below the expanse from the waters which were above the expanse; and it was so. And God called the expanse heavens — Genesis 1:7,8, my translation.

One question that leaps to mind when we first encounter the verses above is: What is the "expanse" (KJV "firmament")? The King James version's word appears to come from the Vulgate's word *firmamentum*, which in turn appears to stem from the Septuagint's translation, *στερέωμα* (*stereōma*). These three translations emphasize 3-dimensional solidity (*stereo-*) and firmness, about which I will say more in section 7. The Hebrew word is *רקיע* (*raqia*), meaning "extended surface" [1, p. 956]. Lexicons [2, p. 591] say it comes from the verb *רקע* (*raqa*), whose primary meaning is "to stamp ... stamp down ... spread out" [6, p. 347]. One 19th-century lexicon [2, p. 692], uncontaminated by 20th-century cosmology, adds to the list of the verb's meanings the interesting phrase "to expand." I will say more about that meaning in section 7. But aside from what learned commentators think, Genesis 1:14-17 gives some direct information about the expanse, which God also called "heavens":

Then God said, let there be lights *in* the expanse of the heavens ... and let them be for lights *in* the expanse of the heavens ... and God made the two great lights ... He made the stars also. And God placed them *in* the expanse of the heavens to give light on the earth.

In this passage I have italicized the little word "in" to emphasize an important point: the sun, moon, and stars are *in* the expanse. The Hebrew for "in" here is the prefix *ב* (*b*), which has essentially the same range of meanings as the English word "in" [6, p. 32].

Now imagine what the Timothy of Section 2 would think about the expanse from this passage. I think everyone would agree that he would simply say the expanse is the place where the sun, moon, and stars are. Therefore, the "Timothy test" leads me to conclude the most straightforward understanding of this passage is that *the expanse is interstellar space*. Using our knowledge of the distances of heavenly bodies, that means that the waters above the expanse must now be at cosmic distances from us, billions of light-years away!

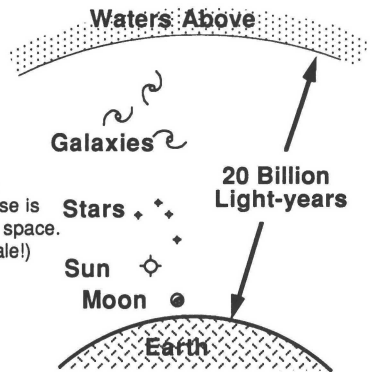


Figure 1. The expanse is interstellar space. (Not to scale!)

4. THE EXPANSE IS NOT MERELY THE ATMOSPHERE

As most creationists will recognize, the above reading of scripture conflicts with the venerable "vapor canopy" model, which holds that the expanse is merely the earth's atmosphere and that the "waters above" were a canopy of water vapor immediately above the atmosphere [3]. (Canopy theorists correctly argue that the "waters above" had to have been a large amount of water distinctly above the expanse and could not have been mere clouds in the atmosphere [3, pp. 48-58].) The canopy is supposed to have been related to the "windows of the heavens" of Genesis 7:11, and the canopy, by collapsing during the Genesis flood, is supposed to have provided some of the waters of the flood.

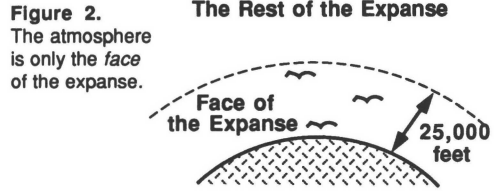
Advocates of the canopy model seem to have assumed without much consideration that the expanse is only the earth's atmosphere [3, p. 47]. However, two of them [15, p. 229] use an English translation of Genesis 1:20 as support for that idea:

... and let birds fly above the earth in the open expanse of the heavens.

The phrase "in the open expanse," used in most English translations, implies that the expanse is what birds fly in. In my early years as a creationist, I thought that was a sufficient justification for the canopy model. However, one day I discovered that the actual Hebrew phraseology is quite different. On the next page I have reproduced the last part of Genesis 1:20 from an interlinear Hebrew Bible [4, p. 1]. Read it from right to left:

הַשָּׁמַיִם	רְקִיעַ	עַל-פְּנֵי	עַל-הָאָרֶץ	יְעוֹפֶה	וְעוֹף
the	the	the on	the over	fly let	and
heavens	expanse	face	earth	around	birds
	of	of			

So the literal Hebrew doesn't have "in the open expanse." It doesn't even have the preposition "in." Instead it uses another preposition, על ('al), which means "on, over, above," but not "in" [6, p. 272]. Moreover, the word here translated "open" comes from the word פָּנֵה (paneh), whose primary meaning is "face" [6, p. 293]. I can't find "open" listed as a secondary meaning for paneh in any of my lexicons [6, p. 293] [1, p. 815] [2, p. 627]. The passage literally says "on the face of the expanse of the heavens." It is the same phraseology as in Genesis 1:2, which is correctly translated, "on the face of" the deep. In biblical usage, the "face" can be oriented in any direction, and what is "on" it need not be gravitationally above it (e.g., Exodus 34:33 and Genesis 11:28, Hebrew). Looking up into the sky, we see birds flying across it, and the passage says what they are flying in is merely at the surface of the expanse. Birds can fly up to altitudes of 25,000 feet [9, p. 785], at which point they are above two-thirds of the atoms of the atmosphere. So most of the atmosphere is merely at the surface of the expanse. Therefore the expanse itself must be something much bigger — such as interstellar space.



Thus, the only verse allegedly justifying the identification of the atmosphere with the whole expanse really supports the idea of the expanse being interstellar space!

I also have a "prepositional" problem with the canopy model: If the expanse were really only the atmosphere, then a better preposition to use in verses 14, 15, and 17 would have been 'al, which as I mentioned means "on" or "above." Then the verses would tell us that sun, moon, and stars were "above the expanse of the heavens." But the verses don't use that preposition.

Some people say that God let the stars "appear" as if they were in the atmosphere, even though they were really above it. One problem with that view is that God did not use the word "appear" in connection with the expanse, even though in Genesis 1:9 He did use it in connection with the appearing of the dry land. However, the main problem is with the straightforwardness principle. If even you or I can think of simple ways to say the stars are above the expanse or only appeared to be in it, then why wouldn't God do so in the interest of accuracy? Perhaps He refrained from saying so because it would be inaccurate for Him to imply the expanse is merely the atmosphere.

Another biblical problem with the canopy model is Psalm 148:1-4, which mentions the "waters above":

Praise the LORD!	Praise Him, all His hosts!
Praise the LORD from the heavens;	Praise Him, sun and moon;
Praise Him in the heights!	Praise Him, all stars of light!
Praise Him, all His angels;	Praise Him, highest heavens,
	And the <i>waters that are above the heavens!</i>

First notice the context in which these waters appear: "heavens ... heights ... sun and moon ... stars ... highest heavens." This suggests that the waters belong "way out there with all those other heavenly objects, not close to the earth. Next, notice the timing. The canopy model says the waters above the expanse of the heavens collapsed at the Genesis flood, but this Psalm, written after the flood, implies the waters above the heavens still exist in the present. In fact, verses 5 and 6 of the same Psalm say that the waters and the heavens are to last at least as long as the time of this physical universe endures:

Let them praise the name of the LORD,
 For he commanded and they were created.
 He has also established them forever and ever;
 He has made a decree which will not pass away.

But if the waters are to endure "forever and ever" above the heavens, then they can't have collapsed.

A last biblical problem is with how the waters of the Genesis flood ceased:

Also the fountains of the deep and the floodgates of the sky were closed, and the rain from the sky was restrained — *Genesis 8:2*.

Notice the account doesn't say the waters from above stopped themselves because there were none left to collapse. Instead it implies there were still some waters available, and that they had to be stopped by closing the floodgates of the sky (literally "the windows of the heavens"). In line with this, Malachi 3:10 implies that the

"windows of the heavens," whatever they are, still exist. These verses do not fit very well with the concept of a collapsing vapor canopy. Thus the canopy model has considerable biblical problems. To me the most serious one is simply that the most straightforward interpretation excludes it.

5. A CANOPY IS NOT SCIENTIFICALLY NECESSARY

As a younger creationist, one of the great attractions of the canopy model for me was that its logical consequences would provide an explanation of several scientific problems for creationists. The most important of these consequences were: (1) a "greenhouse" effect to make the warm, uniform pre-flood climate indicated by the fossils; and (2) a shielding of cosmic rays to reduce carbon 14 in the pre-flood world, thus explaining "old" radiocarbon dates.

However, we now have very good scientific reasons [16] to think that the amount of carbon dioxide in the pre-flood atmosphere was many times greater than today. That would produce a strong greenhouse effect, a warm climate, and as a bonus, stimulate plant growth to produce the large amount of plant life we find in the fossils. The additional ordinary carbon in the biosphere would dilute carbon 14, so that the pre-flood $^{14}\text{C}/^{12}\text{C}$ ratio would be considerably lower due to that effect alone, thus explaining the "old" post-flood radiocarbon dates. In addition, we have evidence suggesting that the earth's magnetic field was at least ten times greater before the flood than now [6]. That would enable the geomagnetic field to be a very effective shield for cosmic rays, thus greatly reducing the production of carbon 14, making the pre-flood world a healthier place, and further explaining post-flood radiocarbon dates. Thus we have alternative scientific explanations for the main things the canopy model was supposed to explain.

For decades, creationist atmospheric scientists have put a lot of diligent work, some of it presented at these conferences, into scientifically modeling vapor canopies. I greatly respect their work, but it looks to me as if they still haven't got the problem solved. I also greatly respect the pioneers of modern scientific creationism, who in the first decades of their work developed the canopy model as part of the alternative worldview they were presenting.

However, the idea of a canopy atop the atmosphere did not come down from Sinai with Moses, engraved by the finger of God on the back side of the stone tablets. Instead, it was a human interpretation of scripture which was, for a time, the best understanding we could come up with. I think that time has passed. In spite of the large emotional investment some of us may have put into the canopy model, I suggest that now is a good time to re-evaluate the model, to see if it is worth any further effort. One thing to consider is whether other scriptures besides Genesis 1 can support the idea. If so, there need be no conflict between the cosmic-size expanse I am proposing and a vapor canopy over the pre-flood atmosphere. Lastly, if it is any comfort, my suggestion doesn't do away with a canopy of water; it simply raises it a bit higher — a cosmic canopy!

6. A BOUNDED UNIVERSE

The importance of the waters above the expanse is that they represent a boundary for the matter of the created universe. What is beyond that boundary? Take a look once more at the first two verses of Genesis:

In the beginning God created the heavens and the earth. And the earth was formless and void, and darkness was over the surface of the deep; and the Spirit of God was moving over the surface of the waters.

The "deep" was the body of water within which God later, on day two, made the expanse, which He called "heavens" (Genesis 1:7,8). But notice that the deep has a *surface*. What is above that surface? I suggest that it is the "heavens" of Genesis 1:1. That is, on day one God made a space, called the heavens, which contained a large body of water, the deep. On day two He made the expanse, which He also called "heavens", within the waters. Thus there would be two heavens, the day-two heavens being a subset of the day-one heavens. This dual naming has a parallel in the case of the earth. Having created "the earth" as a formless body on day one (Genesis 1:1,2), God then on day three calls the dry land "earth" (Genesis 1:10). But the dry land (i.e., the continent or continents) is only a subset of the whole earth, which for example includes the seas also (Genesis 1:10). So there seem to be two meanings to the word "earth," one including the whole planet, the other limited to the dry land only. In the same way there would be two meanings to the word "heavens," the day-two heavens being the expanse, and the day-one heavens being the larger space in which the other created things exist.

Some theologians would object that Genesis 1:1 is a summary statement of all the work God would do later on in creation week, and so there would not be two heavens and two earths, but only one of each. Other theologians [11] argue strongly against that view, saying that the Hebrew phrasing favors consecutiveness from verse one to verse two. Another point is that if verse 1 is a summary of later work, then the account really begins with verse 2, leaving no statement at all about who created the matter of the earth and the deep. Thus we would no longer know for certain that God created the original matter; we would simply have an account of how He modified it. The theological consequences of that view would be major, and there would be severe inconsistencies with the rest of scripture.

Thus the most straightforward view is that there are (at least) two spaces called "heavens." By this view, another scriptural name for the heavens of day one would be the "heavens of the heavens," *שמי השמים* (*sh^omai ha-shamaim*), which is often translated "highest heavens," as in Psalm 148:4, NAS. Although this created heavens is larger, it also is of limited extent, since Solomon said it was not big enough to contain God:

But will God indeed dwell on earth? Behold, the heaven and heaven of heavens cannot contain thee; how much less this house that I have builded? — *1 Kings 8:27, KJV.*

This verse alone should be enough to convince most creationists that the created universe is of finite extent. A finite cosmos could still be closed and unbounded; see my other paper for the distinctions. Above I said "at least" two heavens because Paul mentions a third heavens in 2 Corinthians 12:2 :

I know a man in Christ who fourteen years ago — whether in the body I do not know, or out of the body I do not know, God knows — such a man was caught up to the third heaven.

Let's count up heavens. Numbering outward from earth, there is the *first* heavens, interstellar space, also known as the expanse, created on day two. The earth's atmosphere, by my view, is simply the face of the expanse. Above the first heavens, out beyond the most distant galaxy, is a wall of ordinary water, of unknown thickness. Beyond the outside surface of the waters is a space which I here call the *second* heavens, also called the heavens of heavens, the heavens of day one. We know very little about the second heavens, except that it is a created thing and is of finite extent. This space could be closed and unbounded, but the matter within it is bounded. Somewhere beyond the second heavens is the *third* heavens, about which we know little. Maybe that is where God lives. Anyhow, the simple answer to the question of what is beyond the waters above is: the second heavens.

7. THE EXPANSE HAS EXPANDED

A large number of Bible verses refer to God "stretching out" or "spreading out" the heavens. Here are some:

Who alone stretches out the heavens — *Job 9:8.*

Stretching out heaven like a tent curtain — *Psalms 104:2.*

Who stretches out the heavens like a curtain,
And spreads them out like a tent to dwell in — *Isaiah 40:22.*

He has stretched out the heavens — *Jeremiah 10:12.*

The LORD who stretches out the heavens — *Zechariah 12:1.*

There are at least 12 other similar verses in the Old Testament. Here is a list:

2 Sam. 22:10	Job 26:7	Job 37:18	Psalms 18:9
Psalms 144:5	Isaiah 42:5	Isaiah 44:24	Isaiah 45:12
Isaiah 48:13	Isaiah 51:13	Jer. 51:15	Ezekiel 1:22

In these verses the Hebrew words translated "stretch out" come from the verb *נָטָה* (*natah*), whose primary meaning is "extend, stretch out ... spread out" [6, p. 235]. In three of the verses (2 Samuel 22:10, Psalm 18:9, and Psalm 144:5) the verb is translated by a secondary meaning, "to bow." The Hebrew words translated "spread out" come from the verbs *מָטַח* (*matach*) "spread out", *פָּתַח* (*taphach*) "spread out, extend", or *רָקַע* (*raqa*) "stamp, spread out." The last verb (from Job 37:18) is related to the noun "expanse" (*raqia*) mentioned in sect. 3.

So these 17 verses use four different verbs to communicate the idea of stretching and spreading. The verses occur in a wide variety of contexts throughout the Old Testament, generally as an illustration of God's great power. The frequency, diversity, and widespread locations of these verses led me to suspect in 1985 that they were more than mere metaphor.

If there is a more literal meaning, what is it? To answer that, we must consider more precisely what the heavens are, since they are the object of the stretching. First of all, the heavens cannot be the stars, because God made the heavens on days one and two, before He made the stars on day four. Moreover, many verses, such as Nehemiah 9:6, make a distinction between the heavens and "host" of the heavens, namely the things occupying the heavens. So the word "heavens" must be roughly equivalent to our word "space."

Generally we think of space as a vacuum, an empty volume. But how can a nothingness be stretched out as if it were a *something*, like a tent curtain? To get a clue, notice how scripture speaks of other things happening to the heavens. The heavens can be *torn* (Isaiah 64:1), *worn out* like a garment (Psalm 102:25), *shaken* (Hebrews 12:26, Haggai 2:6, Isaiah 13:13), *burnt up* (2 Peter 3:12), *split apart* like a scroll when it is rolled up (Revelation 6:14), and *rolled up* like a mantle (Hebrews 1:12) or a scroll (Isaiah 34:4). It certainly sounds like space itself is a material of some sort!

Interestingly enough, there are many phenomena in modern physics which point to such a concept (such as Maxwell's displacement current and vacuum polarization), and physics even offers an explanation of why we cannot perceive this medium through which we would be moving (Dirac's electron "sea" and Pauli's exclusion principle). The physics clues suggest that such a medium would be like an elastic solid. This might explain why the words *raqia*, *stereoma*, and *firmamentum* (see section 3) all seem to have some connection with solidity and firmness:

When He made firm the skies above — *Proverbs 8:28*.

Can you, with Him, spread out the skies,
Strong as a molten [cast] mirror? — *Job 37:18*.

Notice also the references to "rolling up" the heavens like a mantle or a scroll (Hebrews 1:12 and Isaiah 34:4). This suggests that (1) there is some dimension in which space is thin, (2) space can be bent, and (3) there exists a direction it can be bent toward. Thus these verses could be hinting that a fourth spatial dimension exists, even though we can't perceive it. (Time would be a fifth dimension, dealt with separately.) Again, this idea is not foreign to modern physics. See my other paper for the ramifications in general relativity.

So if space is a material, some kind of "stuff" and not a nothingness, then it can be stretched out like a tent curtain, etc. This corresponds exactly to the picture behind the general relativistic expansion of the cosmos, where it is space itself which is being stretched out. Again, see my other paper for the physics of this phenomenon.

In summary, the verses of this section imply that God stretched out space itself at some time in the past. Now let's consider when He did this. Certainly the second day of creation is a good candidate for the starting point, because that is when He made the "expanse." But was the stretching complete at the end of the second day? There is a clue which suggests the answer is "no." The second day is the only day in which God did not comment "good" about the things He had made that day. Yet on the sixth day, God saw that *all* things He had made were very good (Genesis 1:31). The "all" would include the expanse. I suggest that He didn't call it good on the second day because the expansion wasn't complete by that time. This reasoning would correspondingly imply that the expansion stopped on or before the sixth day. (The Hebrew of 2 Samuel 22:10 and Psalm 18:9 refers to stretching the heavens (the translations usually use a secondary meaning, namely "bow"). If those passages refer to the Genesis flood, then it is possible that there was another episode of stretching during the flood. It is also possible than the expansion has been continuous from day two until now, although I consider that unlikely in the light of these verses and the above rationale.) Thus the heavens would have been complete by the time that Adam and Eve first saw them.

8. THE WATERS OF THE DEEP

And the earth was without form, and void; and darkness was on the face of the deep. And the Spirit of God was moving on the face of the waters — Genesis 1:2, KJV.

Ever since I first encountered this verse as a seven-year-old, I wondered what the "deep" in this verse was. The Hebrew word is הַדְּרוֹם (*ḥom*), which lexicons translate as "deep, sea, abyss ... primaevial ocean ... depth" [1, p. 1062], "primeval ocean, deep ... depths of sea ... subterranean water" [6, p. 386]. The Septuagint translates it as the ἀβύσσος, the abyss, "the immeasurable depth" [13, p. 2]. In this section let's consider the composition of the deep.

The first clue is the last word of the verse, "waters." That word caused the seven-year-old me to think that the deep was ordinary liquid water. As grownups, however, we might wonder if the Hebrew word used here for "waters" (מַיִם, *mayim*) could include more sophisticated uses, such as "snow," "ice," "steam," "fluid," or even "plasma."

According to three Hebrew lexicons [6, p. 193] [1, p. 565] [2, p. 694], most occurrences of this word in the Old Testament refer literally to liquid water. A few other occurrences are as part of metaphors, such as "the hearts of the people melted and became as water" (Joshua 7:5), but even in those cases the metaphors would be meaningless if the word *mayim* did not refer to ordinary water. In the few remaining cases, there are other substances in the water, such as salt or poison, but they are still essentially water. If frozen or gaseous forms of water are meant, the Bible always uses other words, as far as I have been able to find. As for the physics concept of "plasma," the words for "fire" or "flame" would be more accurate, since fire is the most common thing in everyday human experience which contains some hot plasma. In summary, *all* of the approximately 580 other uses of the word in the Old Testament refer to ordinary liquid water. Thus, according to the Timothy test, the most straightforward interpretation of Genesis 1:2 is that the deep, or at least its surface, initially consisted of ordinary water at normal densities and temperatures.

9. THE DEPTH OF THE DEEP

Then God said, "Let there be an expanse in the midst of the waters, and let it separate the waters from the waters." And God made the expanse, and separated the waters which were below the expanse from the waters which were above the expanse; and it was so — Genesis 1:6,7.

Now let's consider how big the deep was initially. Sections 3 and 4 show that the expanse is now of cosmic size, and Section 7 shows that it has expanded, so it must have started at a smaller size. In my other paper I surmise that God formed the stars from waters of the deep left behind by the expansion, so the mass of the visible universe would have been contained in the deep. A simple calculation in the other paper shows the mass is roughly 3×10^{51} kilograms. Lastly, I show evidence in the other paper that the universe is approximately spherical. So if the deep were similarly spherical (as it would be normally under the force of gravity), and if its waters were initially of ordinary density as Section 8 affirms, then a simple calculation shows that its radius had

to be at least *one light-year*. I say "at least" because we also need to account for the waters above the expanse, which are of undetermined thickness.

This is surprisingly small compared to the cosmos. However, it is still huge, about 10 trillion kilometers, more than a thousand times larger than the radius of our solar system. And yet it took years for the Voyager spaceprobes, travelling at very high speeds, to reach the edge of the solar system. Imagine floating on the face of the deep and gazing down into its immense depths! "The deep" is certainly an appropriate name. Furthermore, a sphere of nothing but water is bottomless; if you plunged down to its center and kept going, you would start rising upward without ever having hit a solid bottom. So the Septuagint's word "the abyss" ("without bottom") is also a very appropriate name for the deep.

Notice that I said "how big the deep was *initially*." Strong gravitation was very likely in operation at the time of Genesis 1:2, in order to have a clearly-defined surface over a large body of liquid water in the presence of a vacuum (surface tension can't do it). The word "above" in Genesis 1:2 also hints at the existence of gravity by that time. If gravity was working normally, the gravitational force at the surface for the above mass and radius would be about 3×10^{17} (nearly a million trillion) times greater than at the earth's surface today. My other paper shows that if God let things proceed normally, these enormous gravitational forces would cause the deep to begin collapsing down toward the center.

Also, the huge gravitational forces would mean that the deep was far within a *black hole*. See my other paper for an outline of the physics of black holes. As I point out in that paper, one of the ramifications of being deep inside a black hole is that the collapse would take place very rapidly. As measured by either of the two types of clocks mentioned in my other paper, the collapse would take much less than a year, possibly a few days, to become an infinitely-small "singularity" at the center. However, the verses in the next section imply that God did not let the collapse proceed that far; you can't have a center in something infinitely small.

10. THE CENTER OF THE UNIVERSE

Since I've brought up the center of the deep several times, let's consider it more carefully. Notice the words "in the midst" in Genesis 1:6 :

... Let there be an expanse in the midst of the waters ...

The corresponding Hebrew word is בתוך (*b^etok*), which is the preposition ב (*b^e*), "in," combined with the noun תוך (*tawek*) whose primary meaning is "midst, middle" [6, p. 387], "midst ... of a space or place," and with the preposition, "in the very heart and midst of" [1, p. 1063]. The middle of a sphere is its center, so the expanse must have started in the vicinity of the center. I say "in the vicinity" in order to leave some room for the approximate nature of the phrase.

Another clue is the word "below" in Genesis 1:7 :

... and separated the waters below the expanse from the waters which were above the expanse ...

The Hebrew translated word "below" is מתחת (*mittachath*), which consists of the preposition מן (*min*), "from," combined with the adjective תחת (*tachath*), meaning "under, beneath" [6, p. 389]. This word, along with "above," confirms that gravity was operating. It also suggests that the center of gravity was within the waters below, providing supporting evidence for the idea that the waters below were at or near the center.

Now let's consider what the "waters below the expanse" of the heavens became:

Then God said, "Let the waters below the heavens be gathered into one place, and let the dry land appear"; and it was so. And God called the dry land earth, and the gathering of the waters he called seas; and God saw that it was good — *Genesis 1:10*.

At this point, the waters below have become the continent(s) and seas of our own planet. Therefore during creation week, *the earth was at or near the center of the universe*. (I find nothing in the context to say that the earth was motionless with respect to the center, so it may have moved away from the center a bit since that time.)

11. TRANSFORMING THE WATERS

Section 8 has the original material of the creation being nothing but water. Yet Genesis 1:10 says that by day three dry land appeared, and dry land is obviously not water, but rather a collection of minerals containing silicon, iron, magnesium, calcium, carbon, oxygen, and many other elements. How did that happen? The apostle Peter gives us some additional insight on this point:

... by the word of God the heavens existed long ago and the earth was formed out of water and by water — *2 Peter 3:5*.

The word translated "formed" is the Greek participle συνεστῶσα (*sunestosa*), from the verb συνίστημι (*sunistemi*), whose primary meaning is "to place together, to set in the same place, to bring or band together" [13, p. 605]. (The KJV translation "standing" is a subsidiary meaning of the last part of the verb, ἵστημι (*histemi*); the translation does nothing with the prefix σύν (*syn*), which adds the important qualifier "together.") The American Standard 1901 translates it as "compactd." In the late 1970's this verse suggested to me that the original

material God created, the deep, was pure water, which He then transformed into other materials. In my astrophysical paper I show how God could produce such transformations by simply letting the gravitational collapse take its normal course. The tremendous compression ("compaction") would raise the temperature, pressure, and density to enormous values. This would first rip the hydrogen and oxygen atoms apart into their constituent elementary particles. Then thermonuclear fusion reactions would occur, producing an intense light in the interior during the first day of creation, and generating many different atomic nuclei. The word *sunistemi* seems to me like an excellent choice of words to describe thermonuclear fusion, because it involves "putting together" or "banding together" the various elementary particles and nuclei (fusion) to make different atomic nuclei.

Here is another line of evidence for the possibility that God transformed water into the other elements of the cosmos: In the early 1980's I based a theory about the origin of planetary magnetic fields on the possibility that the earth and other bodies in the solar system were originally created as pure water. The theory has been remarkably successful, even to the point of correctly predicting the Voyager spaceprobe's measurements of the magnetic fields of the planets Uranus and Neptune [7]. The theory could not work with the present elements composing the solar system bodies, but only with water as the original material. Thus it seems that transformation — the modern word is "nucleosynthesis" — of water on day one is a distinct biblical and scientific possibility.

In the beginning God created the heavens and the earth. And the earth was formless and void ...
— *Genesis 1:1,2.*

If the "nucleosynthesis" scenario above is correct, then it means that at the instant of creation, the earth was merely a small region of water at the center of a much larger ball of water, the deep. That region had no distinguishing marks and was empty of any other kind of matter. This, I suggest, is the meaning of the much-discussed phrase "formless and void," or in Hebrew, *tohu wa-bohu*. In light of Sections 3 through 11, the heavens and earth God created in verse 1 consisted of: (1) a large, mostly empty space (the heavens of heavens), and (2) a ball of ordinary water more than two light-years in diameter. Item (2) contained within itself what would become (a) the waters above the expanse, (b) another heavens called the expanse and the stars within it, and (c) the earth. Thus the first verse would describe the creation of the raw materials of the whole universe, space and water.

12. EARTH STANDARD TIME

In the astrophysics paper I show that if the universe is bounded, then *gravitational time dilation* causes clocks (and all physical processes) to tick at different rates in different places. This means we must consider which set of clocks the Bible is referring to when it makes statements about time. For example, referring back to Section 2, the most straightforward understanding of Exodus 20:11 is that Jehovah made the universe in six ordinary days. But "six days" as measured by which clocks? To answer this, first notice that in Genesis 1:5 God Himself provided a definition of the word "day":

And God called the light day, and the darkness He called night. And there was evening and there was morning, one day — *Genesis 1:5.*

It sounds like a "day" is a period of light and darkness marked off by the rotation of the earth, or in the case of day one, by the rotation of the deep. I will say more about this in the following section. Also notice God's purpose in making the heavenly bodies:

Then God said, "Let there be lights in the expanse of the heavens to separate the day from the night, and let them be for signs, and for seasons, and for days and years; and let them be for lights in the expanse of the heavens to give light on the earth"; and it was so — *Genesis 1:14,15.*

His intention, among other things, was to give markers in the sky which would allow us to clearly measure periods of time in terms of the *earth's* rotation and the *earth's* movement around the sun, and thus he further defines "days" and "years." In other words, God quite reasonably tells us periods of time in terms of our own frame of reference, not in terms of some otherworldly frame of reference, as some authors would have it [12]. So Genesis 1, Exodus 20:11, and other passages are telling us that God made the universe in 6 days E.S.T. — Earth Standard Time.

13. DAY ONE

Now that I have laid a biblical foundation in this paper and developed a scientific blueprint in the other, let's try to re-construct the events of creation week. Many details of my reconstruction at this point are speculative and could be wrong, but it is important to spell out exactly how I am picturing these events. Keep in mind that though I write positively, this picture is always subject to revision. Also, please remember that I am not trying to deny the miraculous elements of creation; I am merely considering how God may have used some of the physical laws He Himself invented. The translations in italics from Genesis chapter 1 are my own.

In the beginning God created the heavens ... These include both the heavens of heavens (the second heavens), and also the expanse (the first heavens), as yet not defined within the deep. ... *and the earth. And the earth was without form and void ...* The earth, as I said, is a formless, undefined region within the deep, empty of inhabitant or feature.

... and darkness was on the face of the deep, and the Spirit of God was moving on the face of the waters. At the instant of creation, the deep is a sphere of liquid water more than two light-years in diameter. Electromagnetic and nuclear forces (and thus relativistic effects) are fully operational, allowing fully functioning water molecules with their constituent atoms, electrons and nuclei. The deep is rotating with respect to the Spirit of God, and probably with respect to the space within which it exists, the second heavens. There is no visible light at the surface of the deep.

The deep contains all the mass of the visible universe. Gravity is also functioning, and its great strength allows a clearly-defined interface to exist between the waters and the vacuum of the second heavens. The deep is within a black hole, whose outer boundary, called the "event horizon," is 450 million light-years further out, according to an equation in the other paper. As the other paper shows, strange and significant things happen to time near the event horizon. The intense gravity makes the deep collapse toward the center very rapidly. The rate of collapse is not limited by the speed of light (see other paper). As the deep is compressed, it becomes very hot and dense. Descending into the deep, we find that molecules, atoms, nuclei, and even elementary particles are being ripped apart.

And God said, "Let there be light," and there was light. At a certain range of depths, thermonuclear fusion reactions begin, forming heavier nuclei from lighter ones (nucleosynthesis) and liberating huge amounts of energy. An intense light illuminates the interior. As the compression continues, the fusion reactions reach a shallow enough depth to allow light to reach the surface, thus ending the darkness there. The strong gravity causes light leaving the surface to return to it, so light at the surface would be coming from all sides. The deep would have no dark side.

And God saw that the light was good, and God separated the light from the darkness. (This paragraph is the most tentative part of my reconstruction of events.) As the collapse continues, gravity becomes so strong that light can no longer reach the surface, re-darkening it. Psalm 104:2, "Covering Thyself with light as a cloak," appears to refer to day one. That suggests to me that at this point the Spirit of God, "moving [or 'hovering'] over the surface of the waters" (Genesis 1:2), becomes a light source for the surface, in the same way as He will again become a light source at a future time (Revelation 19:23, 20:5). This would give the deep a bright side and a dark side, thus dividing light from darkness and inscribing "a circle on the face of the waters, at the boundary of light and darkness" (Job 26:10, c.f. Proverbs 8:27).

And there was evening and there was morning, one day. Conservation of angular momentum causes the deep to speed up its rotation as the collapse proceeds, like a twirling ice skater speeding up as she brings in her arms. We can imagine a reference point on the surface rotating around to the dark side and continuing further around to the bright side again, marking off evening and morning. Rough calculations (see other paper) show that all of the events from the beginning instant to this point had to take place in a very short time, much less than a year. To calculate the time exactly would go beyond the frontiers of modern relativity, but I suspect that a modern clock (if it could survive) on the surface of the deep would register about 24 hours from the instant of creation to the end of day one.

14. DAYS TWO AND THREE

And God said, "Let there be an expanse in the midst of the waters, and let it separate the waters from the waters." And God made the expanse, and separated the waters which were above the expanse from the waters which were below the expanse. Possibly by direct intervention God increases the cosmological "constant" Λ (the tension of space, see other paper) to a large positive value, changing the black hole to a white hole (a black hole running in reverse, see other paper) and begins rapidly stretching out space. As I showed in the other paper, the expansion is not limited by the speed of light, even in conventional theory. God marks off a large volume, the "expanse," within the deep wherein material would be allowed to pull apart into fragments and clusters as it expanded, but He requires the "waters below" and the "waters above" to stay coherently together:

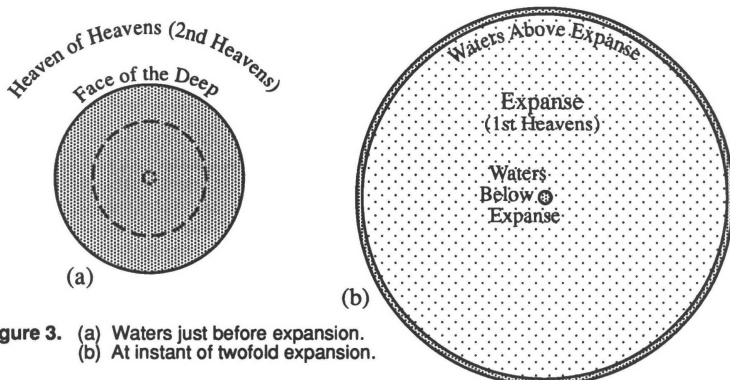


Figure 3. (a) Waters just before expansion. (b) At instant of twofold expansion.

Normal physical processes cause cooling to proceed as rapidly as the expansion. The stretching of space causes thermal ("heat wave") electromagnetic radiation in the expanse to drop from its initial very high temperature to much lower values in direct proportion to the increase in size of the expanse. These red-shifted heat waves eventually become the cosmic microwave background radiation (see other paper). Matter beneath the expanse expands until the surface reaches ordinary temperatures, becoming liquid water underneath an atmosphere. God collects various heavier atoms beneath the surface and constructs minerals of them, laying "the foundations of the earth" (Job 38:4), i.e., its core and mantle. Gravity at the surface drops to normal values. Matter in the expanse is drawn apart into clusters of hydrogen, helium, and other atoms formed by the nucleosynthesis of the first day. The waters above the expanse stay together, becoming thinner as their surface area increases to keep the volume roughly constant. Figure 3(b) illustrates this phase of the expansion.

And God called the expanse "heavens." And there was evening and there was morning, a second day. These heavens are interstellar space, the first heavens as we count outward. The expansion continues at least until the end of the fourth day. Since God has not yet created the sun by this point, the Spirit of God continues to be the light source for the waters below the expanse.

And God said, "Let the waters under the heavens be gathered into one place, and let the dry land appear," and it was so. Rapid radioactive decay and rapid volume cooling occur as secondary effects of the rapid stretching of space (see other paper). God uses the radioactivity to heat the continental cratons and to provide power for other geologic work. Thermal expansion makes the cratons buoyant relative to the rocks below them and lifts them above the remaining waters, thus gathering the waters into ocean basins. Volume cooling (a result of the expansion, see other paper) solidifies batholiths and much of the athenosphere.

At some time during the expansion, probably on the third day, the waters above the heavens reach the event horizon and pass beyond it. The event horizon begins rapidly shrinking toward the earth (see other paper). At the same time, gravity draws together the atoms of hydrogen, helium, and other elements in each cluster left behind by the expansion. As my other paper shows, there has been plenty of time — billions of years — for that process to occur farther out, even though only days have elapsed on earth.

15. THE DAY THE UNIVERSE OPENED (DAY FOUR)

And God said, "Let there be lights in the expanse of the heavens ... to give light on the earth," and it was so. The event horizon reaches earth early in the morning of the fourth day. During that ordinary day as measured on earth, billions of years worth of physical processes take place in the distant cosmos.

And God made the two great lights ... the stars also. And God gave them in the expanse of the heavens to give light on the earth ... Early in the fourth morning, God finishes coalescing the clusters of material left behind in the expansion, and thermonuclear fusion begins in the newly-formed stars. During the fourth day the distant stars age billions of years, while their light also has billions of years to travel here. While the light from the more distant galaxies is traveling to earth, space continues to expand, stretching the wavelengths of the light and thus shifting them to the red side of the spectrum (see other paper).

And God saw all that He had made, and behold, it was very good. And there was evening and there was morning, the sixth day. God stops the expansion, reducing the cosmological constant Λ to a small positive value or zero, before the evening of the sixth day. Thus Adam and Eve, gazing up for the first time into the new night sky, can now see the Milky Way, the Andromeda galaxy, and all the other splendors in the heavens that declare the glory of God.

16. CONCLUSION

This Bible study has led us to several ideas of profound importance to cosmology:

1. Matter in the universe is bounded.
2. The universe has expanded.

My astrophysical paper shows that, according to the best physics and cosmological knowledge we have today, these ideas lead directly to the conclusion that our cosmos expanded out of a white hole (a black hole running in reverse). As a consequence, gravitational time dilation caused clocks (and all physical processes) both inside and outside the event horizon (the border of the white hole) to tick at vastly different rates from one another in different places. Our Bible study has brought us to several conclusions related to this matter of time:

3. The earth is near the center of the universe.
4. The universe is young as measured by clocks on earth.

My other paper shows that, given item 3, known physical processes explain item 4, in particular getting light from distant galaxies to us in a short time. Furthermore, the expansion would cause the proper amounts of red shift in light from those galaxies. This Bible study also leads to several other conclusions related to how God formed matter:

5. The original matter God created was ordinary liquid water.
6. God transformed the water into various elements by compaction.

I have suggested, but not proven, here that God did this by the simple means of creating the original waters within a black hole, allowing the resulting rapid gravitational collapse to heat the waters to the point where nucleosynthesis would occur, and finally on the second day converting the black hole to a white hole by beginning the rapid expansion of space. The high temperatures, followed by the expansion, would produce the cosmic microwave background radiation.

I have listed the above conclusions in decreasing order of their cosmological importance and biblical support. These items of vital information from the Bible, as I remarked at the beginning of this paper, lay a good foundation for a young-earth creationist cosmology. The apostle Paul has expressed my feelings about the marvelous subtlety God has shown in making all these things work together in His construction of the universe:

O the depth of the riches both of the wisdom and knowledge of God! How unsearchable are his judgements, and his ways past finding out! — Romans 11:33 KJV.

ACKNOWLEDGEMENTS

My hearty thanks to all who have prayed for this project, to the creationist groups and individuals who gave me good biblical feedback and encouragement, to David Rodabaugh, who pointed out several supporting scriptures to me, and to my wife and children for putting up with me all these years of abstraction.

BIBLIOGRAPHY

- [1] F. Brown, The New Brown-Driver-Briggs-Gesenius Hebrew and English Lexicon, 1979, Hendrickson Publishers, Peabody, Massachusetts.
- [2] B. Davidson, The Analytical Hebrew and Chaldee Lexicon, 1970, Zondervan Publishing House, Grand Rapids. Second edition originally published in 1850 by Samuel Bagster & Sons, Ltd., London
- [3] J. C. Dillow, The Waters Above: Earth's Pre-Flood Vapor Canopy, 1981, Moody Press, Chicago.
- [4] J. Green, editor, The interlinear Hebrew/Greek English Bible, Volume I: **Genesis to Ruth**, 1979, Associated Publishers and Authors, Lafayette, Indiana.
- [5] S. W. Hawking and G. F. R. Ellis, The Large Scale Structure of Space-Time, 1973, Cambridge University Press, Cambridge.
- [6] W. L. Holladay, editor, A Concise Hebrew and Aramaic Lexicon of the Old Testament, 1971, Eerdmans Publishing Company, Grand Rapids. Based on the First, Second, and Third editions of the Koehler-Baumgartner Lexicon in Veteris Testamenti Libros.
- [7] D. R. Humphreys, **Good news from Neptune: the Voyager 2 magnetic measurements**, Creation Research Society Quarterly, 27:1 1990, 15-17. Predictions of the Voyager 2 results are in **The creation of planetary magnetic fields**, Creation Research Society Quarterly, 21:4 1984, 140-149.
- [8] D. R. Humphreys, **Progress toward a young-earth relativistic cosmology**, Proceedings of the Third International Conference on Creationism, 1994, Creation Science Fellowship, Inc., Pittsburgh.
- [9] K. D. Morrison, **Birds**, Encyclopedia Americana 3 (1969) 781-797.
- [10] W. Rindler, Essential Relativity, 1977, Revised Second Edition, Springer-Verlag, New York.
- [11] C. C. Ryrie, The Ryrie Study Bible, 1978, Moody Press, Chicago.
- [12] G. Schroeder, **The universe — 6 days and 13 billion years old**, Jerusalem Post, September 7, 1991. Schroeder has God's clocks ticking off only 6 days of time at the edge of the universe, while earth is 13 billion years old — the reverse of what the equations in my astrophysical paper say!
- [13] J. H. Thayer, Thayer's Greek-English Lexicon of the New Testament, 1889, Associated Publishers and Authors, Grand Rapids.
- [14] R. E. Walsh, **Biblical hermeneutics and creation**, in Proceedings of the International Conference on Creationism, 1987, R.E. Walsh, et al, Editors, Creation Science Fellowship, Pittsburgh, Vol. 1, pp.121-27.
- [15] J. C. Whitcomb, Jr., and H. M. Morris, The Genesis Flood, 1961, Baker Book House, Grand Rapids.
- [16] C. J. Yapp and H. Poths, **Ancient atmospheric CO₂ pressures inferred from natural goethites**, Nature 355 (23 January 1992) 342-344. The authors' result is that the partial pressure of CO₂ when the Ordovician strata were being laid down was at least 16 times greater than today.

* Dr. Humphreys is a physicist at Sandia National Laboratories, Dept. 1271, M. S. 1187, Albuquerque, NM 87185-1187. The Laboratories have not supported this work. He is also an Adjunct Professor of Geophysics and Astrophysics at the Institute for Creation Research, 10946 Woodside Ave. N., Santee, CA 92071.