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NEW MECHANISM FOR ACCELERATED REMOVAL OF EXCESS RADIOGENIC HEAT

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ABSTRACT

In a technical paper (Humphreys, 2014), I presented Biblical and scientific evidence that (a) space is a physical material that we do not perceive, (b) this *fabric of space*, and objects within it, are thin in a 4th spatial direction we do not ordinarily perceive, and (c) the fabric is surrounded by a *hyperspace* of four spatial dimensions. End note 27 of the paper explained that light emitted by objects within the fabric ordinarily would be constrained to travel entirely within the fabric. The end note also proposed that under certain extraordinary conditions the Bible calls the *opening of the heavens*, some of the emitted light could leak directly into hyperspace. Here I point out that such leakage would include other types of electromagnetic radiation, particularly black-body (thermal) radiation. This would allow the interiors of hot objects to cool rapidly, proportionally to the 4th power of their absolute temperature, according to the Stefan-Boltzmann law. Cooler objects would lose their heat much less rapidly. This mechanism appears to be a good way to get rid of the excess heat generated by accelerated nuclear decay during several episodes in the Earth's history, and it explains the evidence that this *accelerated cooling* did occur (Humphreys, 2005). It also would be a good way to get rid of other heat generated in creationist geologic models, such as heat in batholiths and new ocean floors. Last, I will briefly discuss the possibility that the opening of the heavens also caused accelerated nuclear decay.

KEY WORDS

Radiogenic heat, accelerated cooling, hyperspace, black-body radiation

INTRODUCTION

From the beginning of the Radioisotopes and the Age of the Earth (RATE) research initiative in 1997, we knew that the large amount of heat that would be generated by our hypothesized accelerated nuclear decay would be a problem (Humphreys, 2000, pp. 369-373). So we further hypothesized the existence of an *accelerated cooling* mechanism that could remove large amounts of heat quickly from the entire volume of an object, not just its surface.

By 2000, we knew of one geophysical mystery, the distribution of heat flow from the Earth's surface, which would be solved by the existence in the past of both (and only both) accelerated nuclear decay and accelerated cooling (Baumgardner, 2000, pp. 80-86). By 2005, we knew of two other geological mysteries that would be solved by having both acceleration mechanisms in operation simultaneously. One was the rapid formation of polonium radiohalos near uranium radiohalos (Snelling, 2005). The other was the apparent lack of heating of zircons that had experienced accelerated nuclear decay (Humphreys, 2005, pp. 68-70).

In Volume I of the RATE book, I outlined a possible theoretical mechanism for accelerated cooling (Humphreys, 2000, pp. 370-373). I clarified it in Volume II (Humphreys, 2005, pp. 70-74). This model had several disadvantages. First, it required a two-fold expansion of the cosmos during the year of the flood, whereas the Biblical support for any expansion at all during that period was slim. Second, the cooling was equally efficient for bodies of any temperature. That gave me a problem: how to keep the creatures aboard Noah's ark from freezing to death. All I could offer at the time was a hope for a future modification of my 2005 theory for low-temperature objects. It has been clear to me for many years that we need a better theory for accelerated cooling. That is the motivation for this paper.

My new theory depends on the nature of space. In the next two sections I review several important ideas about space which I introduced in a physical model that helps us to visualize the meaning of Einstein's gravitational field equations (Humphreys, 2014).

EVIDENCE THAT SPACE IS A PHYSICAL MATERIAL

The first step toward a new theory of accelerated cooling is the idea that space itself is a *physical material* which we do not perceive. There is scientific evidence for this idea, which I will discuss below, but I would not have as great a confidence in it were it not that a number of Scriptures, straightforwardly (not figuratively or allegorically) understood (Humphreys, 1994, pp. 55-57), strongly imply it. The Old Testament word for "space" appears to be the Hebrew word (always plural) translated "heavens." Gen. 1:1 says that God made the heavens, a seemingly-empty space, before He made the Sun, Moon, and stars (often called the "host of the heavens," Gen. 2:1, Neh. 9:6) four days later (Gen. 1:14-19)

Generally we think of space as a true vacuum, an empty volume which contains some material here and there, such as air or stars. But Scripture speaks of space as a *real material*. The heavens can be *torn* (Isa. 64:1), *worn out* like a garment (Psa. 102:26), *shaken* (Heb. 12:26, Hag. 2:6, Isa. 13:13), *burnt up* (2 Pet. 3:12), *split apart* (Rev. 6:14), and *stretched out* and *spread out* like a tent curtain (Isa. 40:22 and sixteen other verses, Humphreys, 1994, p. 66). These verses make sense if space is indeed a real material. Many of these verses compare the material to a fabric, hence the

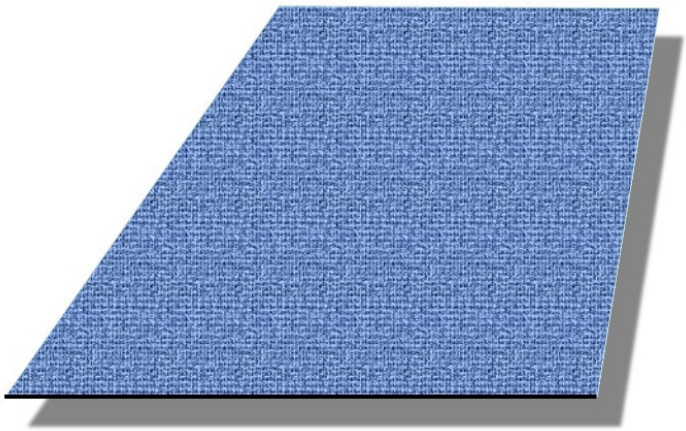

Figure 1. If space has the structure of a fabric, it must be woven exceedingly fine, with the threads very much closer together than the size of a proton, about 10^{-15} meter.

Figure 2. James Clerk Maxwell (1831-1879) predicted radio waves on the basis of electromagnetic experiments suggesting that space is a physical material, which he called the æther.

Figure 3. In 1905, Albert Einstein (1879-1955) tried to dispense with the idea of an æther. But in 1920, he came back around again to the æther.

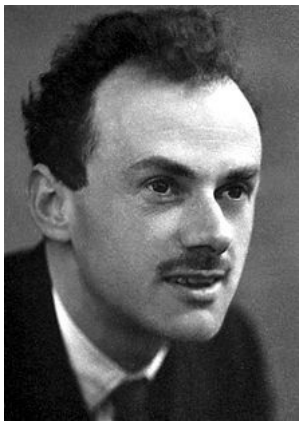

Figure 4. In 1931 Paul Dirac (1902-1984), one of the founders of modern quantum theory, predicted the existence of antimatter on the basis of his theory requiring the existence of a "sea" of electrons permeating all space — an æther.

phrase which I borrow from popular science writers, "the fabric of space" (Fig. 1).

Nineteenth-century physicists, such as the creationist James Clerk Maxwell (1891a) regarded space as pervaded with, or equal to, an intangible material called the æther (or "ether," but not the anesthetic gas). Maxwell (Fig. 2) had noticed that electromagnetic experiments would make sense if the vacuum could be electrically polarized (indicating bound electric charges hidden in it) when one applies an electric field to it (Maxwell, 1891b, p. 253). This involved the idea of "displacement" electric current in a vacuum, which in turn led him to the discovery that light is an electromagnetic wave propagating through the æther. The properties of this "luminiferous medium," as he called it, determine the speed of light, just as the properties of water in a pond determine the speed of waves moving over it (Maxwell, 1891b, pp. 431-450, 402-493.)

When Albert Einstein (1905), Fig. 3, introduced his special theory of relativity, he sought to dispense with the æther (or "light-aether" from the original German) as anything useful to physicists, declaring it "superfluous" (unnecessary). However, in a little-known address in 1920 (Einstein, 1922), he came back to the concept of an æther: "According to the general theory of relativity, space without ether is unthinkable." He had found that his 1916 theory, general relativity, insists on space having physical properties, in particular being bendable in the same way that a solid material is bendable. He hastened to explain that we cannot measure our speed with respect to the æther, but he did not back down from saying it is real.

Academics ignored the 1920 address, and while not recanting it, Einstein did not publicize it or repeat its ideas. Hence the idea of an æther remained in the state of disrepute into which Einstein had put it in 1905. However, modern physicists began to find it was essential. Quantum field theory is built on the assumption that all space is filled with "fields" which have mass and oscillate like particles (Henley and Thirring, 1962). This "quantum vacuum," a modern code name for the æther, makes forces between metal plates in a vacuum (Casimir effect), affects the orbits of electrons in atoms (Lamb shift, vacuum polarization), explains the appearance of electron-positron pairs from a vacuum (Dirac electron "sea," Fig. 4), (Milloni, 1994), and determines the speed of light (Urban *et al*., 2013). Other modern code names for the æther are "spacetime," "continuum," "manifold," "substratum," and "plenum," often in various combinations. Though most modern physicists are reluctant to admit it even to themselves, the bottom line is that they believe that space is a real material, an æther (Dirac, 1951).

This modern æther is pervasive. It moves through us as we move through it. The quantum physics of solids offers an explanation of how this could be, based on the Pauli Exclusion Principle. This principle could allow us to move through a material space as freely as an unbound electron moves through a perfect crystal (Feynman, Leighton, and Sands, 1965). This medium, space, also offers a reason why there should be a relativistic speed limit, namely the speed of light, on particles moving through it. If space were a truly empty nothingness, why should there be a speed limit at all? Instead, motion through this medium affects clocks (actually slowing them down) and rulers (actually shortening them) in such a

way that, regardless of their speed through the medium, they always give the same number for the speed of light (Lorentz, 1904). The existence of a real æther thus eliminates a number of paradoxes that boggle the minds, not only of students, but also experienced practitioners of physics (Humphreys, 1994, p. 84).

EVIDENCE THAT THE FABRIC OF SPACE IS FOUR-DIMENSIONAL

Think about the shape of this fabric, the space we live in. It appears to have only three dimensions (directions): length, width, and height. Lay a sheet of paper flat on a table. It is 8.5 inches wide by 11 inches long, but it is only 0.003 inches thick. It does not occupy much of the height direction at all. Now roll up the paper like a scroll. You used the third dimension, height, in the air above the table, to roll it up, and the thinness of the paper in that dimension allowed you to do so. So if an object is thin in one of its dimensions, you can roll it up. But here is an amazing thing … Scripture says the same thing about the heavens:

> *And the heavens shall be rolled up like a scroll* — Isaiah 34:4 (NKJ)
>
> *And like a mantle You will roll them* [the heavens] *up* — Hebrews 1:12 (NAS)

Here again God depicts the heavens as a real material that He can manipulate. In the three directions we can see, the heavens are very thick. Yet God says He will roll them up like a scroll (Fig. 5). That implies that the heavens are thin *in a fourth direction that we cannot see*. The verses in the second section comparing the heavens to a curtain of fabric support that idea, since a fabric is thin in one of its dimensions. Moreover, there must be more room in that fourth direction, which allows the rolling-up to occur. The future tense of these verses implies the heavens are not in a rolled-up condition at present. In the fourth dimension we cannot perceive, space is nearly flat, like an unrolled scroll or cloak.

The three dimensions we can see would exist as a thin sheet within a larger four-dimensional space, for which I would like to borrow the theoretical term "hyperspace" (Kaku, 1994). As I pointed out in *Starlight and Time* (Humphreys, 2004, pp. 93-96), the extra dimension makes sense of the equations of Einstein's general theory of relativity by giving room and a direction in which the "spacetime continuum" can be bent. Einstein's first cosmology using general relativity *made explicit use of four spatial dimensions*, with time being a fifth dimension (Einstein, 1917). Later cosmologies, such as the Big Bang theories, use four spatial dimensions implicitly, without spelling out the fourth one. Most theorists avoid thinking of the extra dimension as anything more than a mathematical convenience (Misner, Thorne, and Wheeler, 1973).

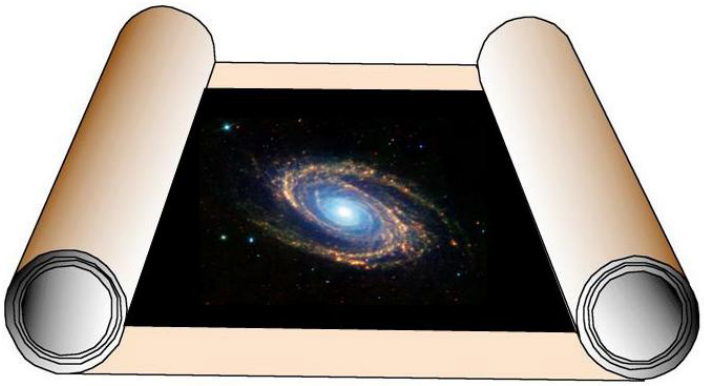

Figure 5. Rolling up the heavens like a scroll. Galaxy image: M81, Spitzer Space Telescope.

Some commentators, not knowing how the heavens could be rolled up literally, propose that the Scriptural *similies* (Humphreys, 2014, last paragraph of the introduction) I cite above are instead *metaphors*, figurative ways of saying "the heavens will be ended." However, the "Timothy" principle of straightforward interpretation I have proposed (Humphreys, 1994, pp. 55-57) makes me prefer to try to take these verses as meaning the heavens will be rolled up physically — not figuratively. If, for example, "rolled up" were figurative, these verses would be almost meaningless. They would be saying, "the heavens will have something figurative done to them like a scroll or a mantle." But what the figurative "something" might actually mean would be left entirely to the commentators to guess about. It makes much more sense to think that the words mean what they say, that the physical heavens will be rolled up physically like we roll up a scroll or mantle (Bullinger, 1898, p. 727). Such a rolling-up apparently requires an extra dimension, an extra direction.

This fourth direction is not time. Relativity theory treats time as a real dimension, in our case, a fifth dimension. That is, the fabric is really space*time*. Its time dimension, or direction, differs from the space directions in several ways. First, we only observe a narrow slice of time, the present. Second, the slice seems to be moving through time, from the past into the future. Third, physical phenomena can only develop in one direction of time, toward the future. For example, if we toss a stone into a pond, we only see waves coming *from* the impact, forward in time, even though all the equations we know would allow waves to travel backward in time also. If that were the case, we would first see waves in the pond converging on the future point of impact, then the stone hitting the water, and finally waves radiating outward from the impact. In real life, something seems to compel the waves to travel only futureward. But in spite of the special nature of time, the equations of relativity seem to say that the past and the future physically exist, and that the timeward direction is just as real physically as the space directions. This, of course, is an *interpretation* of time that is open to question, discussion, and further research.

Why can we not see the 4th spatial direction? We are creatures confined within a fabric which is very thin in the fourth direction (so we also are very thin in the 4th direction). It appears that we usually see light coming at us only from within the fabric, not from outside it.

But why can we not *imagine* it, visualizing it as a direction perpendicular to the three directions we can see? I do not know. Speaking for myself, my imagination is limited to the kinds of things I can see in three dimensions. I have a similar problem with time as a dimension. I cannot see either my past or my future, or point to a direction for them. But I do perceive myself moving through time, out of the past and toward the future. Perhaps we can

imagine the 4th space direction similarly.

In practice, the way to imagine the 4th dimension is by an *analogy*: eliminate one of the three space directions you can see, and replace it with the 4th direction. For example, call the east-west direction *x*, the north-south direction *y*, and the up-down direction *z*. Now, imagine everything as being compressed in the *z*-direction down to a flat sheet, the *x*-*y* plane. Now tack a vertical axis onto the *x*-*y* plane and call it *w*. That's the extra direction, the 4th dimension. The plane is very thin in the *w*-direction. You and I are embedded in that plane, so we also are very thin in the *w*-direction. The total number of space coordinates describing the real world would be four (*w*, *x*, *y*, *z*), but to visualize things we only show three (*w*, *x*, *y*), making the world into a "flatland" as a model. If you noticed, that is what I depicted in Fig. 5. Edwin A. Abbot's entertaining nineteenth-century novel, *Flatland*, shows the usefulness of this method for imagining the 4th dimension (Abbot, 1884).

SUCCESS OF THE 4-D FABRIC MODEL

It may be helpful to see that the 4-dimensional fabric-of-space model explained above leads to a simple physical picture of how gravity works. In my gravity paper (Humphreys, 2014, plus answers to reader questions below the web version), I presented Biblical evidence for two additional ideas about the fabric of space, that (a) it is under *tension*, and (b) it is being greatly *accelerated* in the 4th direction. I showed how these ideas, along with the two ideas in the previous sections, lead directly to Newton's gravity equations. Furthermore, they yield an additional term that depends on time, resulting in a moderate-field approximation of the most important of Einstein's sixteen gravitational field equations. That suggests that this model can lead to the exact Einstein equations (Landau and Lifshitz, 1975), a derivation I hope to publish soon. This model solves four long-standing mysteries about gravity, explaining:

(1) Einstein's *equivalence principle*, the initial assumption on which he based general relativity.
(2) Why mass should deform spacetime.
(3) Why deformed spacetime should affect particles with mass.
(4) The *cosmological constant* problem, the huge discrepancy between general relativity and quantum field theory.

See the paper for more details (Humphreys, 2014, p. 111). In addition, the model leads directly to an alternative explanation (to the one offered by the Big Bang theory) for the *cosmic microwave background radiation* (CMB). This explanation accounts more easily for the remarkable uniformity of the CMB (Humphreys, 2014, p. 112.)

OPTICS OF THE FABRIC OF SPACE

As I remarked in the gravity paper (Humphreys, 2014, p. 112), the fabric of space has to be very transparent in the *x*, *y*, and *z* directions, because we can see through it for billions of light-years, over a wide range of wavelengths. The invisible particles bound in this medium must have very low cross-sections for absorption and scattering, meaning that the forces binding those particles together must be very strong. That is what we would expect from the very high tension in the fabric, 5.386×10^{39} megabars (1 Bar is about 14.7 pounds per square inch) as calculated from the model (Humphreys, 2014, p. 112, Sect. 5, eq. 16 and text below it, as corrected in the web version).

In section 3 of the gravity paper (Humphreys, p. 110), I suggested that we do not perceive the 4th direction from our position within the fabric because (a) the fabric is very thin in that direction, and (b) "we usually see light coming at us only from within the fabric, not from outside it." That is, something must constrain light emitted by objects in the fabric to travel only within it, and also prevent us from seeing light from hyperspace. I referred to end note 27 in the paper (Humphreys, 2014, p. 114), which said:

> One reason for the confinement of light to within the fabric of our space could be that the speed of light in hyperspace is very much greater than in the fabric of our space. Thus, almost all light emitted from within our space would suffer total internal reflection, as in an optical fiber. Or, the two boundaries of the fabric in the *w* direction could reflect photons for some other reason. The same kind of constraint might be what prevents matter in the membrane from leaving it. In either case, light would effectively propagate only in the *x*, *y*, and *z* directions, not in the *w* direction. The blocking of light would also apply to light coming from hyperspace toward us …

That light can traverse hyperspace is suggested by several Scriptures, such as "… light from heaven …" (Acts 9:3). If hyperspace is filled with a light-bearing medium, then the higher speed of light in it might be due to that medium having considerably less mass density than the fabric of our own space (Humphreys, 2014, eqs. 9 and 15).

Fig. 6 shows our space under normal conditions, with total internal reflection constraining light from objects within it to travel purely in the *x*, *y*, and *z* directions. An example of total internal reflection occurs when we are underwater looking up at the surface. Light from above the surface can come to us only within a cone of acceptance determined by a critical angle θ_c (see Fig. 7). The speed of light *c* in air (about the same as in vacuum) and the slower speed of light *u* in water determine the critical angle (Jenkins and White, 1950):

$$\theta_c = \text{Arcsin}\ \frac{u}{c} \qquad (1)$$

For water, *u* is about ¾ of *c*, and the critical angle is about 48.6°. Outside the acceptance cone the surface looks like a mirror, and light beams hitting the surface from below at greater angles will be

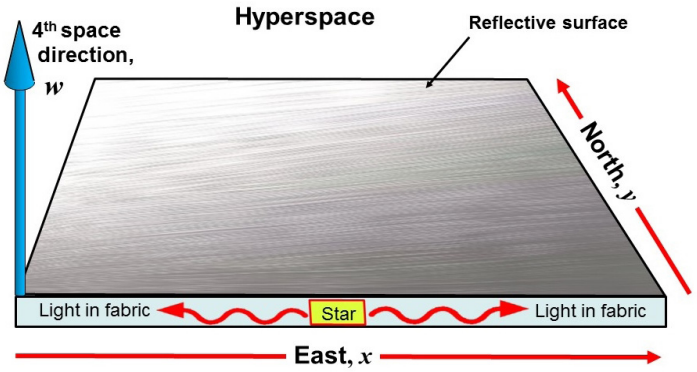

Figure 6. Reflection ordinarily constrains light to travel entirely within the fabric of space. The fabric is very thin in the *w*-direction, probably thinner than the 3-D size of a proton, about 10^{-15} meter.

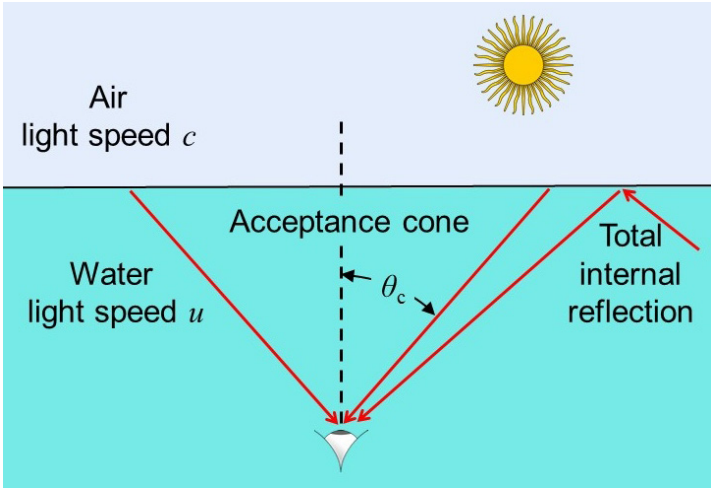

Figure 7. Critical angle of acceptance θ_c and total internal reflection under water.

reflected back downward. This total internal reflection can be quite efficient, which is the reason "single-mode" (only propagating light along their long axis) optical fibers using it can transmit light for great distances (Saleh and Teich, 1991). To adapt eq. (1) to the situation at hand, call the speed of light in the fabric of space c and the postulated much higher speed of light in hyperspace v. Then the equation for the critical angle becomes:

$$\theta_c = \text{Arcsin}\ \frac{c}{v} \qquad (2)$$

So if v in hyperspace is very much higher than c in our space, the critical angle will be very small. Light will be able to enter or leave our space only if it is very close to being parallel with the w-direction. In our analogy to four dimensions the circular base of the cone of acceptance represents a sphere. That means the electromagnetic power lost from an emitting object in our space will be proportional to the cube of the small critical angle. See eq. (7) in the section after the next. Under these ordinary circumstances, the fraction of power lost would be very small.

OPENING THE HEAVENS

End note 27 of my 2014 paper went on to suggest,

> … It may be that occasionally God enables light and matter from hyperspace to enter the fabric of our space, which could explain the instances of the heavens being "opened" in Scripture.

He could do this by modifying the reflecting surfaces in a number of ways to increase the critical angle, or alternatively, make the surfaces more transparent. That would permit more electromagnetic radiation not only to enter our space (at an angle we can detect), but also permit more to leave it. Since according to quantum theory, matter is also a wave phenomenon, conceivably matter also would be able to enter or leave our space in these special circumstances. The degree of opening could well vary, and it could be different for different wavelengths (as in anti-reflective coatings for lenses), and also different for matter.

Many scriptures apparently refer to such an *opening of the heavens*, or similar phrases and ideas: 2 Ki. 7:2,19; Psa. 78:23; Ezek. 1:1; Mal. 3:10; Matt. 3:16; Mark 1:10; Lk. 3:21; Jn. 1:51; Acts 7:56, 9:3, and Rev. 19:11. Two more verses refer to the beginning and middle of the year of the Genesis Flood:

> *In the six hundredth year of Noah's life, in the second month, on the seventeenth day of the month, on the same day all the fountains of the great deep burst open, and* ***the windows of the heavens were opened****.* — Gen. 7:11
>
> *Also the fountains of the deep and* ***the windows of the heavens were closed****, and the rain from the sky was restrained* — Gen 8:2

I have translated the phrases in bold font literally from the Hebrew text. Many creationists, including myself, have long thought that "the windows of the heavens" are just a picturesque way to say "rain", but the end of Gen. 8:2 adds, "and the rain from the sky was restrained." That would be redundant if the previous phrase, "the windows of the heavens were closed," meant simply that the rain stopped. Taking the two verses literally implies that sections of the heavens can be opened or closed, and through those sections matter (in this case water), as well as light (indicated by some of the other verses above), can come or go.

It is especially significant that the above two verses apply to the Genesis flood, because RATE found evidence that there was a great acceleration in both nuclear decay and cooling during that year. Below I suggest that the opening of the heavens during that and other periods would cause the accelerated cooling.

BLACK-BODY RADIATION INTO HYPERSPACE

When I wrote end note 27 for my 2014 paper, it did not occur to me that other types of electromagnetic radiation besides visible light might come or go through the windows of heaven. But a very important type of electromagnetic radiation is the *thermal radiation* (often called black-body radiation) emitted by all bodies warmer than absolute zero. See Fig. 8. For incandescent objects, most of the thermal radiation is visible light. For objects at room temperature, most of the radiation is infrared, showing up in sniperscopes. For objects just a few degrees above absolute zero, most of the radiation has centimeter wavelengths, such as in the Cosmic Microwave Background radiation. For a body of surface area A and emissivity ε (for a perfect black body $\varepsilon = 1$; for other "grey" bodies, $\varepsilon < 1$), the Stefan-Boltzmann law says the total power P emitted in thermal radiation from the surface is proportional to the fourth power of the absolute temperature T (in Kelvin, K):

$$P = A\,\varepsilon\,\sigma\,T^4 \qquad (3)$$

The Stefan-Boltzmann constant, σ, is determined by the Boltzmann constant k, Planck's constant h, and the speed of light c:

$$\sigma = \frac{2\,\pi^5\,k^4}{15\,c^2\,h^3} = 5.670373 \times 10^{-8}\ \frac{\text{Watts}}{\text{m}^2\,\text{K}^4} \qquad (4)$$

(Jenkins and White, 1950, p. 431; Reif, 1965). Ordinarily, atoms at and very near the surface of the body are the only ones contributing to the emitted power. However, if the windows of the heavens are open, then *all* the atoms throughout the interior of the body can emit radiation in the 4th direction. In that case, the emitting area A becomes the surface area of all the atoms in the volume V of the body

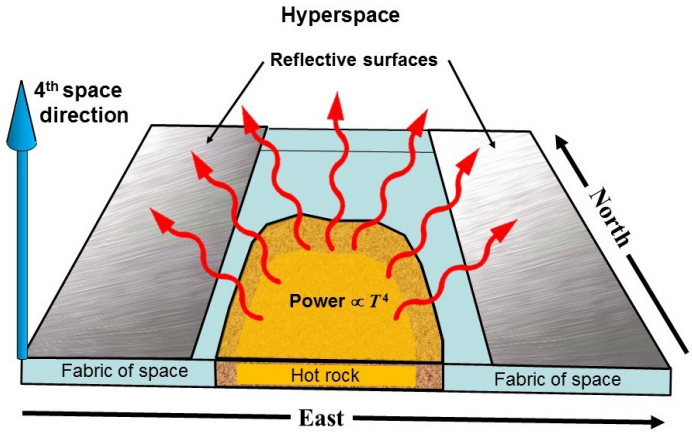

Figure 8. Removing reflective surface (or making it more transparent) over part of the fabric of space allows hot rock to radiate heat into hyperspace.

$$A = 4\,\pi\,a^2\,n\,V \tag{5}$$

where a is the average radius of an atom, and n is the number of atoms per unit volume. If the atoms in the volume are closely packed, then n is roughly

$$n \cong \frac{1}{(2a)^3} \tag{6}$$

Last, let us replace the emissivity ε, which is on the order of one, by a factor giving the efficiency of the opening into hyperspace, as determined by the four-dimensional solid angle subtended by the critical angle θ_c (in radians) of eq. (2):

$$\varepsilon \rightarrow {\theta_c}^3 \tag{7}$$

Then putting eqs. (5) through (7) into eq. (3), and dropping several geometric factors of order one, gives us the approximate power lost from a body of three-dimensional volume V when the windows of the heavens are open:

$$P \cong V\,{\theta_c}^3\,\frac{\sigma}{a}\,T^4 \tag{8}$$

For atoms of average radius $a = 10^{-10}$ meter, the factor σ/a in this equation is approximately:

$$\frac{\sigma}{a} \cong 600\ \frac{\text{Watts}}{\text{m}^3\ \text{K}^4} \tag{9}$$

The heat loss depends on the value of the critical angle of opening into hyperspace, θ_c, for the wavelengths of importance. For this theory to work, we want the heat loss Noah would experience aboard the ark to be significantly less than the 2000 dietary calories (1 dietary calorie = 4186 Joules) minimum he would consume in a day, about 100 Watts worth (ignoring inefficiency in converting food to heat). Estimating his weight as about 70 kg (154 pounds) and approximating his density to be that of water, his volume V would be about 0.07 cubic meter. His 37°C (98.6°F) body temperature would be an absolute temperature of T = 310 kelvin. If we want his heat loss P to be only 10 watts, then these data in eq. (8) require θ_c = 0.295 milliradian (61 arc-seconds). This would be at infrared wavelengths. Noah could make up for the 10-watt heat loss to hyperspace simply by consuming a few hundred more calories daily.

Let us now reckon the heat loss from molten basalt at the Earth's surface if we assume that θ_c had the same value for visible light as the above value for infrared light. Taking the temperature of this red-hot lava as 1500 kelvin (about 1200°C), then eq. (8) gives its heat loss per unit volume (P/V) as 78 kilowatts per cubic meter. Figure 9 plots the rapid increase (due to the fourth power of T) of the power loss with increasing temperature. For a density of 2900 kg/m^3 and a specific heat of 700 joules/kilogram-kelvin, (Stacey, 1969, p. 280) and with no other heat input or output, the lava would start cooling at about 170°C per hour down from its initial 1200°C. Of course, the cooling rate would decrease as the lava got cooler.

Let us consider how such heat losses would compare to the heat gained from accelerated nuclear decay. To get about 500 megayears' worth of nuclear decay during the one actual year of the Genesis flood, the decay rate would have to be accelerated by a factor of 500 million. Multiplying present-day nuclear heating rates in typical rocks (Stacey, 1969) by that acceleration factor gives 1500 watts/m^3 for granite and 80 watts/m^3 for basalt. Fig. 9 shows that with the value of θ_c assumed above, even granite would rise to a temperature of only about 600 Kelvin (about 300°C), far less than its melting point. That means this mechanism of cooling would be very effective at controlling the temperature of rocks heated by nuclear decay, while at the same time not cooling creatures at room temperature very much.

It is very likely that God adjusted the heat leakage to hyperspace by making the critical angle of opening θ_c depend on *both wavelength and location*, in order to get the temperatures He wanted from place to place in the Earth. For example, over ("over" in the *w*-direction) places like the Earth's core and mantle, which may not have many radioactive nuclei, He may have left the windows entirely closed (with θ_c = 0), in order to keep the temperatures of the core and

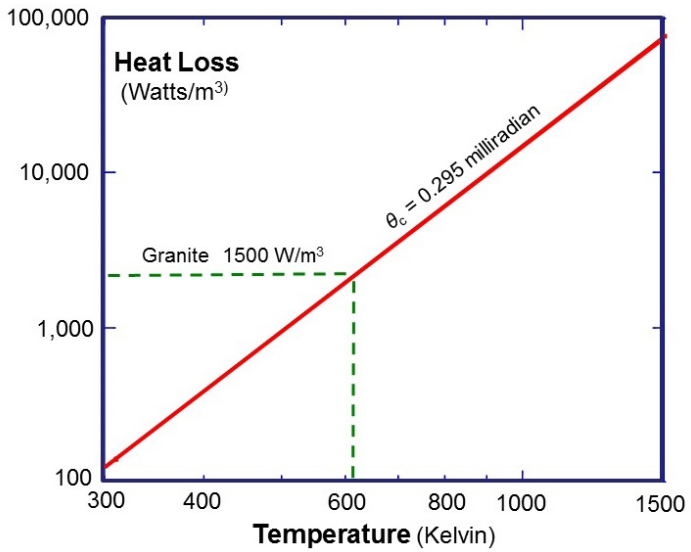

Figure 9. Heat loss into hyperspace increases as the fourth power of absolute temperature. Line shown is for a critical angle of opening θ_c into hyperspace of 0.295 milliradian. Granite with accelerated decay generating 1500 W/m^3 in it would rise to a temperature of only about 600 Kelvin (about 300°C).

mantle as high as they are today.

OPENING THE HEAVENS MIGHT ALSO ACCELERATE NUCLEAR DECAY

RATE found evidence that *both* nuclear decay and volume cooling were greatly accelerated during the year of the Genesis flood. It is possible that the same opening of the windows of heaven (Gen. 7:11) I suggest caused the accelerated cooling also caused the acceleration of nuclear decay. Here I will briefly outline a possible way that could have happened.

Nuclear theorists today think the main part of the attractive *strong force* between nucleons (protons and neutrons) when they are at the distances apart they are in the atomic nucleus, on the order of several femtometers (1 fm = 10^{-15} meter), comes from the exchange of lighter particles called *pi mesons*, or pions (Roy and Nigam, 1967). If the opening of the heavens makes the reflective boundaries of the fabric more transparent to pions, then some of the pions leaving a nucleon can move out into hyperspace before coming back to the other nucleon, as Fig. 10 illustrates. I have deliberately made the pion paths similar to lines of force in classical electromagnetics, but I do not know if that is justified. Notice that the curved pion paths are sloped at the points where they touch the nucleons, with a component in the *w*-direction. That suggests that the component of the force in the *x*, *y*, or *z* directions at those points is reduced compared to the force along the straight pion paths. That would reduce the total force between the nucleons.

Weaker attractive forces between the nucleons would increase the radius of the nucleus they are in. That would greatly accelerate the decay of alpha particles (Chaffin, 2005, pp. 527-533). Also, energy levels of nucleons in the nucleus would change, and that would strongly affect the rates of beta decays with half-lives that are normally long (Chaffin, 2005, pp. 563-567). Beta-decaying isotopes with relatively short half-lives, such as carbon 14, would not be affected as much. In summary, the weaker forces between nucleons (caused by the opening of the heavens) would greatly accelerate both alpha- and beta-decay in most cases. It may be that God controlled the transparency of the windows of the heavens to pi mesons independently of the windows' transparency to heat radiation, so as to better control the temperatures He wanted in various parts of the Earth.

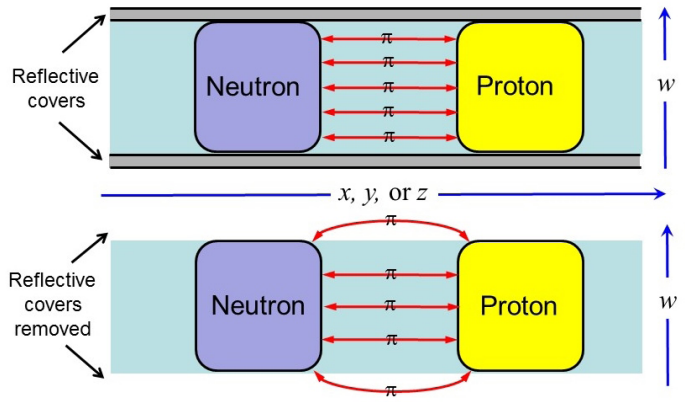

Figure 10. Nuclear forces may have been affected by the opening of the heavens. With the reflective covers removed (or made more transparent), π mesons could leak into hyperspace, reducing the (attractive) force in the *x*, *y*, and z directions. That would increase nuclear decay rates greatly. Sizes of the neutrons and protons are on the order of 10^{-15} meter.

CONCLUSION

I have cited Biblical and scientific evidence that space itself is a physical material, the fabric of space, existing in a hyperspace of four spatial dimensions. This, plus many Scriptures describing an opening of the heavens at certain times in the past, leads straightforwardly to the idea that under those conditions hot objects in the fabric of space could radiate their heat efficiently into hyperspace. This model works out well numerically, effectively limiting the temperatures of rocks heated by accelerated nuclear decay, while at the same time not significantly cooling creatures at ordinary temperatures. Last, the same opening of the heavens may well have also accelerated nuclear decay. In that case, the two major objections to the results of the RATE research initiative can now be set aside.

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In 1963 Russell Humphreys received a B.S. in physics from Duke University, and in 1972 he received a Ph.D. in physics from Louisiana State University. He worked as a physicist for General Electric Company and then for Sandia National Laboratories in Albuquerque, New Mexico, retiring from there in 2001. After that he worked for the Institute for Creation Research in San Diego and then Creation Ministries International in Atlanta. In 2010 he fully retired but still researches, speaks, and writes about creation science from his home office in Chattanooga, Tennessee.

APPENDIX (helpful notes on the references)

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