Analysis of Walt Brown's Model of a Pre-Flood 360-Day Year

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Abstract

Walt Brown (Brown, 2008) has proposed that the year originally was 360 days long and had twelve 30-day months. He further proposed that within his hydroplate model significant changes in the earth and moon at the time of the Flood altered the lengths of the day and month to the current configuration. Here I evaluate this claim. From the standpoint of basic physics, his mechanism of shortening the day by 1.46% is plausible, though I don't address the question of the geophysics involved. However, the mechanism for decreasing the size of the moon's orbit to shorten the month has problems. Brown's proposal of selective impacts on the leading edge of the moon as it orbited the earth is based upon a misunderstanding of orbital mechanics. There is no suitable site on the moon for the required number of impacts. Furthermore, the energy released by the many required impacts would have produced far too much heat on the moon.

Introduction

A previous paper (Faulkner, 2012) analyzed the often-heard claim among recent creationists that prior to the Flood the year consisted of twelve months, each with 30 days, for a total year length of 360 days. That paper showed that ancient documents do not support the contention that the actual length of the year ever was 360 days long. It further argued that the biblical passages that supposedly indicate a 360-day year in the past are easily understood in other ways. It also stated that no one has proposed a clear model of how such a change could have taken place to alter the supposed creation calendar to the one we have today. In a letter to the editor, Enyart (2013) showed that that statement about a lack of models was untrue, for Brown (2008) had published such a model in conjunction with his hydroplate model. In a response to this letter, I apologized for that oversight and suggested that Brown's proposal be examined (Faulkner, 2013). I endeavor here to evaluate Brown's model of how the lengths of the day and month might have readjusted because of the Flood.

Brown's Model of How the Day Changed

As stated before, in order to change the calendar as alleged, one must alter at least two of the three natural measures of time: the day, the month, and the year (Faulkner, 2012). Brown suggested changing the lengths of the day and the month, while leaving the year the same. He proposed that the length of the day was shortened by the settling of denser material toward the earth's center at

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the time of the Flood (Brown, 2008, p. 149). Like any other spinning object, the earth possesses angular momentum. For a spinning object, angular momentum, L, is given by

$$L = I\omega,$$

Where I is the moment of inertia and ω is the angular velocity. Alternately, we may express the spin angular momentum in terms of the period of rotation T, as

$$L = 2\pi I/T.$$

Absent a net torque, angular momentum is conserved. That is, the initial angular momentum, L_1, and the final angular momentum, L_2, are equal:

$$L_1 = L_2.$$

If we concern ourselves with the moments of inertia and periods at two epochs, then we can express this as

$$2\pi\, I_1/T_1 = 2\pi\, I_2/T_2,$$

which reduces to,

$$I_1/T_1 = I_2/T_2,$$

or

$$I_1/I_2 = T_1/T_2 = \text{constant},$$

where the subscripts refer to the two epochs. That is, a change in rotation period must be accompanied by a proportional change in the moment of inertia. Thus, if at the time of the Flood the earth's moment of inertia decreased, the length of the day would have decreased, and now there would be more days in the year than prior to the Flood.

The moment of inertia of a *uniform*-density sphere spinning on an axis passing through the sphere's center of mass is

$$I = 2/5\, mr^2,$$

where m is the mass and r is the radius. The earth is not a uniform sphere, but we can compute its moment of inertia by summing a series of nested uniform shells, each with mass m and having inner radius r_1 and outer radius r_2. This assumption requires that the earth be reasonably spherically symmetric, which appears to be correct. A shell has moment of inertia,

$$I = 2/5\, m\,(r_2^2 - r_1^2).$$

A change in the earth's rotation so that it spins 365.246 times in a year rather than an original 360 times per year requires that the rotation period decrease by 1.46%. By conservation of angular momentum, this must be accompanied by a 1.46% decrease in the earth's moment of inertia. Brown tabulated the computation of his proposal for the pre-Flood and post-Flood earth (Brown, 2008, pp. 430–432). This shows a 1.46% decrease in the earth's moment of inertia at the time of the Flood; so from the physics of rotational motion, this is possible. I am not qualified to assess the geophysical plausibility of Brown's proposal, so I will leave that to others.

Technically, because the earth orbits the sun, one ought to include the angular momentum due to the earth's orbital motion as well. Because the situation under review involves merely the rearrangement of material in the earth, there is no transfer of angular momentum between the rotational and orbital terms. However, when one alters the momentum of inertia of an orbiting body, in the general case the orbital motion changes too. One is tempted to treat the earth as a point mass orbiting the sun. In that case, there is no change in the earth's orbital motion, as material within the earth rearranges. But is this approach warranted? I shall show that this approximation is warranted, and that the earth's orbital motion is not appreciably affected by a 1.46% change in its moment of inertia. The total angular momentum of the earth is the sum of the spin angular momentum and orbital angular momentum:

$$\mathbf{L}_{total} = \mathbf{L}_{spin} + \mathbf{L}_{orbital}.$$

Note that here I have written L in boldface, indicating that it is a vector. Letting M represent the earth's mass, **R** the radius vector, and **V** (both vectors) the orbital velocity, we can write the total angular momentum as,

$$\mathbf{L}_{total} = \mathbf{L}_{spin} + \mathbf{R} \times M\mathbf{V}.$$

I already considered the spin angular momentum case. What is the value of the orbital angular momentum? Because the earth's orbit is nearly circular, we can approximate it as a circle, in which case the orbital angular momentum becomes

$$\mathbf{L} = I\, \omega_{orbital},$$

where $\omega_{orbital}$ is the orbital angular velocity (also expressed as a vector). By the parallel axis theorem,

$$I = I_{spin} + MR^2.$$

The assumption that the earth is a uniform sphere would overestimate the value of I_{spin}, but making that assumption and using the appropriate values of the earth's mass, radius, and orbital radius, I find that the second term is 1.4×10^9 times larger than the first term. That is, treating the earth as a point mass as it orbits the sun introduces an error of about one part per billion. However, since we are merely concerned with any change that results from altering the I_{spin} term by 1.46%, the second term is 9.5×10^{10} larger than the first term. The more exact treatment of a nonuniform earth and noncircular orbit will not change this situation. At best, a 1.46% change in the earth's moment of inertia will not alter the earth's orbit by about eleven orders of magnitude. Since there are 3.15 x 10^7 seconds in a year, this would change the length of the year by at most 1/3000 second.

Brown's Model of How the Month Changed

Brown suggested that the moon's orbital period decreased at the time of the Flood by collisions with material ejected from the earth. In discussing this, Brown wrote:

> While these particles would have a wide range of orbits, the greatest concentration of debris would initially travel near to and roughly parallel with Earth's orbit. Half the time, the Moon would have traveled generally in the same direction as this dense debris, so collisions would have been few and of low velocity. During the other half of the Moon's orbit, orbiting debris would have opposed the Moon's motion; many high-velocity collisions would have removed energy from the Moon's orbit.
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> The Moon would have been analogous to a massive truck that every 15 days traveled in the proper lane (with the flow of traffic). On alternate 15-day periods this "truck" traveled in the wrong lane (facing oncoming traffic), experienced many collisions, and lost some of its energy. (Brown, 2008, p. 421)

There are at least three problems with this. First, this scenario reveals a fundamental misunderstanding of the orbital mechanics of the moon, earth, and sun. Brown suggested that a large amount of debris was travelling "near to and roughly parallel with the earth's orbit." This required that the debris orbit the sun in orbits very similar to the earth's orbit. Otherwise, the debris would not have remained in close proximity of the earth very long. The moon travels near to and roughly parallel with the earth's orbit as well. This is easy to see by comparing the gravitational force of the sun on the moon to the earth's gravitational force on the moon. The sun's gravitational force is twice that of the earth's gravity. Consequently, the moon's orbit is at every point concave toward the sun, even as it orbits the earth. This is a subtle point that most people miss, for we tend to think in terms of the moon solely orbiting the earth. But the primary gravitational force on the moon is that of the sun, and in a very real sense the moon orbits the sun. Within the local frame of reference, the earth and moon are in free fall around the sun. Therefore, the earth, being the largest mass in the vicinity, produces the dominant local gravitational force, causing the moon to orbit it. Since Brown's proposed concentration of debris is moving along with the earth in its orbit around the sun, the debris is in free fall too, is subject to similar gravitational attraction from the earth that the moon is, and hence must orbit the earth as the moon does. Ironically, elsewhere Brown discussed this concept in the context of his "sphere of influence" (Brown, 2008, pp. 265–266). The only way that debris in Brown's proposal could avoid orbiting the earth would be if they had very different orbits than the earth did around the sun. But under this circumstance, they would rapidly depart the vicinity of the earth and moon, leaving at most one opportunity for those particles to collide with the moon. The departure time would be on the order of days, far less than the many months of collisions that Brown seems to imply. Thus, Brown's comparison to the moon moving along like a truck alternately flowing with and then opposing "traffic" is not physically possible. This is a serious flaw, because without the preferential higher-speed impacts on the moon's leading side, Brown's proposal would not work. The key to Brown's mechanism is the relative efficiency of high-speed impacts on the leading side of the moon. Since this is not possible, Brown could greatly increase the amount of debris that would collide with the moon in hopes that a somewhat less efficient mechanism of removing orbital energy from the moon could balance out the lack of efficiency. However, a much greater number of impacts would exacerbate the remaining two problems.

A second problem is that there is no evidence that the moon received a greater number of impacts on its leading side as it orbits the earth. Elsewhere Brown identified the likely impact sites as what is now the nearside of the moon (Brown, 2008, p. 280). He suggested that originally the moon did not follow synchronous rotation as it does today but before the Flood rotated slightly more rapidly than it revolved. He further suggested that the Flood-related impacts produced an oscillation and that tidal interaction eventually produced synchronous rotation. Brown identified the mascons found mostly (but not exclusively) on the nearside of the moon as the sites of early major impacts in his scenario. Synchronous rotation (rotating and revolving at the same rate) is a common feature of planetary satellites, including the moon. While this might explain the moon's synchronous rotation, it does not explain why nearly all planetary satellites in the solar system experience synchronous rotation. Furthermore, tidal locking such as this takes a long time, much longer than a biblical timeframe would allow.

The third problem is the amount of energy required to decrease the length of the month. To reduce the moon's orbital period from its supposed original state to what exists today, Brown showed that the amount of orbital energy that the moon must lose is 2% (Brown, 2008, p. 421). Orbital energy is given by,

$$E = -GmM/2a,$$

where G is the universal gravitational constant, m is the mass of the orbiting body, M is the mass of the orbited body, and a is the semimajor axis. The negative sign is the result of our choosing the reference point of the potential energy at infinity (it makes the math work out better). Putting in the appropriate numbers, the moon's orbital energy is -3.81×10^{28} J, and so a decrease of 2% orbital energy results in a loss of energy of 7.62×10^{26} J. Collisions of the type that Brown proposes are very inelastic, and we can accurately model them as totally inelastic collisions. Modeling this as totally inelastic collisions, all of the orbital energy robbed from the moon is physically absorbed by the moon. While some of this energy would go into deformation, most of it eventually would end up as heat.

Just how much heat is this? It would be helpful to determine how much rock this much heat could melt. The lunar surface consists of rocks very similar to granite and basalt. Much of the moon's interior probably is basalt. The specific heats of granite and basalt are very similar, about 800 J/Kg C. Their latent heats of fusion are similar too, about 4.2×10^{5} J/Kg. The melting points vary, but a good approximation (particularly since we do not know the initial temperature) is 1200 C. Let us assume a temperature change of 1200 C, followed by melting. The equation for determining the heat involved is

$$E = cm\Delta T + mL,$$

where c is the specific heat, m is the amount of rock heated and then melted, ΔT is the temperature change, and L is the latent heat of fusion. The result is that 5.5×10^{20} Kg of rock would be melted. The density of basalt is about 2.9×10^{3} kg/m^3, with granite slightly less. Assuming basaltic density, the rock heated and melted would have occupied 1.9×10^{17} m^3. Uniformly distributed over the moon, this would be a layer 5.0 km thick. However, this is a minimal figure, because this result came by considering only impacts that rob orbital energy from the moon. As Brown admits, some impact would be from behind, imparting orbital energy, though he seriously underestimated the efficiency of his mechanism (see objection one above). Other impacts would have affected the moon's orbital energy by varying degrees, both positively and negatively. All impacts, whatever the change, if any, in orbital energy, will impart heat to the moon. Even granting the unrealistic scenario of preferential impacts on the leading face of the moon, the lower velocity impacts that add orbital energy to the moon add additional heat, and these impacts must be counterbalanced by additional collisions that rob orbital energy, resulting in the net release of more heat. Thus, at best, we must multiply the thermal energy input on the moon by some factor. I will assume a very conservative number of two, increasing the depth of melted rock to 10 km. I emphasize that this is a very conservative number; if the orbits of debris that Brown proposed are properly assessed, the multiplicative factor would be far higher.

Brown likely would respond to this criticism by pointing out that the lunar maria, some of which coincide with lunar mascons, are the locations of the melted rock. The maria account for 16–17% of the lunar surface. Correcting for this, the maria would need to average about 60 km in depth to account for the amount of heat generated by the questionable scenario Brown suggests. Of course, this assumes that the maria resulted entirely from melted rock and not from any magma released upon the surface from the lunar interior. Maria depth is difficult to measure at this time, and it probably varies from one impact basin to another. However, Thomson et al. (2009) recently determined that the Imbrium Basin mare basalt is about 2 km thick. Much earlier, Baldwin (1970) found a similar maximum depth of the Oceanus Procellarum mare. If this depth is typical of the maria, then even the conservative estimate of melted material required by Brown's model is an order of magnitude greater than is found on the moon. Head and Wilson (1992) estimated the total volume of lunar maria basalts at 1×10^{7} km^3 (10^{16} m^3). This, too, is an order of magnitude less than computed volume of required melted rock in Brown's model computed here (1.9×10^{17} m^3).

The above melted rock computation is very conservative, because it assumes the unrealistic model of the moon sweeping up far greater debris during one half its orbit than during the other half. However, as previously argued, this assumption ignores the fact that any debris sharing the earth and moon's orbit around the sun must orbit the earth as the moon does, so there is no preferential sweeping up of material. That is, the "truck analogy" is false. With a far more random distribution of impacts, the number of impacts required to reduce the moon's orbital energy by 2% rises to unacceptable heights, probably by another order of magnitude at least.

Conclusion

I have evaluated Brown's model for how the lengths of the day and month could have changed at the time of the Flood. While his proposal for how the day might have changed length is consistent with basic physics and hence may be possible, his suggestion of how the Flood altered the month is fraught with difficulties. There is a problem with his presentation of the orbits of debris ejected from the earth. This suggests a fundamental misunderstanding of orbital mechanics on his part, for any particles appreciably smaller than the earth co-orbiting the sun with the earth must orbit the earth, as the moon does. His identification of the lunar nearside as the site of the impact of debris that robbed the moon of orbital energy is questionable. Even if one grants Brown's unrealistic claim of preferential impacts on the moon, there is a considerable heat problem. When the orbital problem with the debris is corrected, the heat problem is far greater.

The results presented here agree with my earlier assessment (Faulkner, 2012), that models of altering the day, month, and/or year at the time of the Flood have serious physical problems. As shown in that previous paper (Faulkner, 2012), there are neither biblical nor historical reasons for believing that the original year consisted of twelve 30-day months. Hence, proposals to change the relationship between the day, month, and year at the time of the Flood are unnecessary.

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